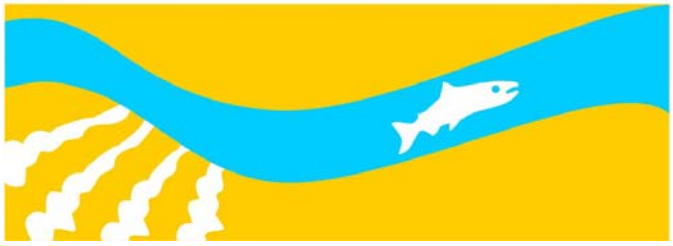
Mendota Pool Bypass and Reach 2B Improvements Project

Selection and Use of Analytical Tools

SAN JOAQUIN RIVER
RESTORATION PROGRAM



October 2010

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List of Abbreviations and Acronyms

° F	degrees Fahrenheit
ADT	Average Daily Traffic
APE	area of potential effects
ASFMRA	American Society of Farm Managers and Rural Appraisers
ASPIS	Abandoned Site Program Information System
AWP	DTSC's Annual Workplan
BLM	U.S. Bureau of Land Management
CAAQS	California Ambient Air Quality Standards
CalEPA	California Environmental Protection Agency
CalSim	DWR water resources simulation model
CARB	California Air Resources Board
CCAR	California Climate Action Registry
CDF	California Department of Finance
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH4	methane
CHP	California Highway Patrol
CIWMB	California Integrated Waste Management Board
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO2	carbon dioxide
CO2e	carbon dioxide equivalents
CORRACTS	Corrective Action Facilities
CRHR	California Register of Historical Resources
CVHM	Central Valley Hydrologic Model
CVP	Central Valley Project
DFG	California Department of Fish and Game
DO	dissolved oxygen
DTSC	Department of Toxic Substances Control
DWR	California Department of Water Resources
EC	electrical conductivity

EDT	Ecosystem Diagnosis and Treatment
EIS/R	Environmental Impact Statement/Environmental Impact Report
ERNS	Emergency Response Notification System
ESA	Endangered Species Act
ESRP	Endangered Species Recovery Program
FAA	Federal Aviation Administration
FAF	frequently activated floodplain
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FMWG	SJRRP Fisheries Management Work Group
fps	feet per second
ft	foot, feet
GHG	greenhouse gas(es)
GIS	Geographic Information System
HARP	Hot Spot Analysis Reporting Program
HAZNET	Hazardous Waste Information System
HEC-RAS	Hydraulic Engineering Center – River Analysis System
HEC-5Q	Hydraulic Engineering Center – Water Quality Model
HFC	hydrofluorocarbons
ISO	International Organization for Standardization
ITA	Indian Trust Asset
LiDAR	Light Detection and Ranging remote sensing system
LOS	level of service
LUST	leaking underground storage tank
MEI	Mussetter Engineering, Inc.
MIG	Minnesota IMPLAN Group, Inc.
n/a	not applicable
N2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOA	naturally occurring asbestos
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRDC	Natural Resources Defense Council
NRHP	National Register of Historic Places

NSA	Noise Sensitive Area
NWI	National Wetlands Inventory
OEHHA	Office of Environmental Health Hazard Assessment
OHP	Office for Historic Preservation
OHWM	ordinary high water marks
PEIS/R	Program Environmental Impact Statement/ Environmental Impact Report
PFC	perfluorocarbons
Pool	Mendota Pool
POTW	Publicly Owned Treatment Works
Project	Mendota Pool Bypass and Reach 2B Improvements Project
RCRA	Resource Conservation and Recovery Act
RCRIS	Resource Conservation and Recovery Act Information System
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Restoration Area	the San Joaquin River Restoration Area from Friant Dam to the Merced River confluence
RWQCB	Regional Water Quality Control Board
Settlement	Stipulation of Settlement
SF6	sulfur hexafluoride
SJRRP	San Joaquin River Restoration Program
SJVAPCD	San Joaquin Valley Air Pollution Control District
SLIC	Spills, Leaks, Investigations, and Cleanup
sq. yd.	square yard(s)
SRAC	Sacramento River Advisory Council
SRH-1D	Sediment and River Hydraulics – One Dimension Model
SRH-1DV	Sediment and River Hydraulics – One Dimension Model with Vegetation Component
SSJVIC	South San Joaquin Valley Information Center
SSPA	S. S. Papadopulos & Associates
State	State of California
SVP	Society of Vertebrate Paleontology
SWF/LF	Solid Waste Active and Inactive Landfills
SWIS	Solid Waste Information System
SWP	State Water Project
SWRCB	State Water Resources Control Board
TM	Technical Memorandum

TSD	Treatment, Storage, and Disposal Facilities
UCCE	University of California Cooperative Extension Service
UCMP	University of California Museum of Paleontology
U.S.	United States
USA	Underground Service Alert
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCDC	U.S. Centers for Disease Control and Prevention
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
V/C	volume-to-capacity ratio
VMC	Visual Modification Class Approach
WNV	West Nile virus
WQO	water quality objective(s)

Definitions

The Project – The Project refers to the portion of Reach 2B that will convey Restoration Flows, the Mendota Pool Bypass, and all facilities related to implementation.

Reach 2B – Reach 2B refers either to the existing San Joaquin River between the Chowchilla Bifurcation Structure and the Mendota Dam or to the future portion of that reach which will contain Restoration Flows. Reach 2B does not include the Mendota Pool Bypass or other potential facilities.

This Draft Technical Memorandum (TM) was prepared by the San Joaquin River Restoration Program (SJRRP) Team as a draft document in support of preparing an Environmental Impact Statement/Environmental Impact Report (EIS/R) for the Mendota Pool Bypass and Reach 2B Improvements Project (Project). The purpose for circulating this document at this time is to facilitate early coordination regarding initial approaches currently under consideration by the SJRRP Team with the Settling Parties, Third Parties, other stakeholders, and interested members of the public. Therefore, the content of this document may not necessarily be included in the Project EIS/R. While the SJRRP Team is not requesting formal comments on this document, all comments received will be considered in refining the concepts and approaches described herein to the extent possible.

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1.0 Introduction

This Selection and Use of Analytical Tools Technical Memorandum (TM) documents the approach for analyzing the initial alternatives and assessing the resource areas for the Mendota Pool Bypass and Reach 2B Improvements Project (Project), a component of Phase 1 of the overall San Joaquin River Restoration Program (SJRRP). The SJRRP was established in late 2006 to implement the Stipulation of Settlement (Settlement) in *Natural Resources Defense Council (NRDC), et al. v. Kirk Rodgers, et al*.

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), as the Federal lead agency under the National Environmental Policy Act (NEPA), and the California Department of Water Resources (DWR), as the State of California (State) lead agency under the California Environmental Quality Act (CEQA), prepared this TM as an initial step in preparation of an Environmental Impact Statement/Environmental Impact Report (EIS/R) for the Project. Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Public Law 111-11).

1.1 Purpose of this Technical Memorandum

This TM is intended to:

- Document the approach and methods for analyzing the Project initial alternatives
- Document the approach and methods for assessing the environmental consequences to the various resource areas for selected alternatives
- Document data to be utilized, data gaps to be filled, timelines for filling data gaps, modifications to existing analytical tools, and results format for the analyses and assessments
- Obtain input and feedback from the Implementing Agencies, Technical Work Groups, landowners, and other stakeholders involved in the Project on the approach to analytical tools
- Establish a process for analyzing the alternatives as part of the NEPA and CEQA documentation for the Project

1.2 Overview of the Mendota Pool Bypass and Reach 2B Improvements

The Project includes the construction, operation, and maintenance of the Mendota Pool Bypass and improvements in the San Joaquin River channel in Reach 2B to convey at least 4,500 cubic feet per second (cfs). The Project area (Figure 1-1 and Figure 1-2) extends from the Chowchilla Bypass Bifurcation Structure to approximately 1 mile below

the Mendota Dam. The extent of Project area boundaries will depend on the final alternatives considered. The Project area is in Fresno and Madera counties, near the town of Mendota.

Paragraph 11(a)(1) of the Settlement stipulates the creation of a bypass channel around the Pool to ensure conveyance of at least 4,500 cfs from Reach 2B downstream to Reach 3. Paragraph 11(a)(2) of the Settlement stipulates modifications in channel capacity, incorporating new floodplain habitat and related riparian habitat, to ensure conveyance of at least 4,500 cfs between the Chowchilla Bypass Bifurcation Structure and the new Mendota Pool Bypass. Because the functions of these channels may be inter-related, the design, environmental compliance, and construction of the two are being addressed as one project. The Project shall be implemented consistent with the Settlement and the San Joaquin River Restoration Settlement Act (Public Law 111-11).

The Mendota Pool Bypass would include bypassing the Pool to convey at least 4,500 cfs from Reach 2B to Reach 3, and a method to direct upmigrating adult salmon into the bypass channel. This action would include the ability to divert 2,500 cfs to the Pool and may consist of a bifurcation structure in Reach 2B. The bifurcation structure would be designed to direct fish into the bypass channel and minimize or avoid fish entrainment to the Pool. The Project will help determine specific bypass alignments and facilities locations.

Improvements to Reach 2B would include modifications to the San Joaquin River channel from the Chowchilla Bypass Bifurcation Structure to the new Mendota Bypass Bifurcation Structure to provide a capacity of at least 4,500 cfs with integrated floodplain habitat. The options under consideration include potential levee set backs along Reach 2B to increase the channel floodplain capacity and provide for floodplain habitat. Floodplain habitat is included along the Reach 2B portion of the Project as required by the Settlement; floodplain habitat is being considered along the Mendota Pool Bypass channel because Central Valley floodplains have been shown to be of value to rearing juvenile salmon as they migrate downstream (Jeffres 2008, Grosholz 2006, Sommer 2001, and Sommer 2004).

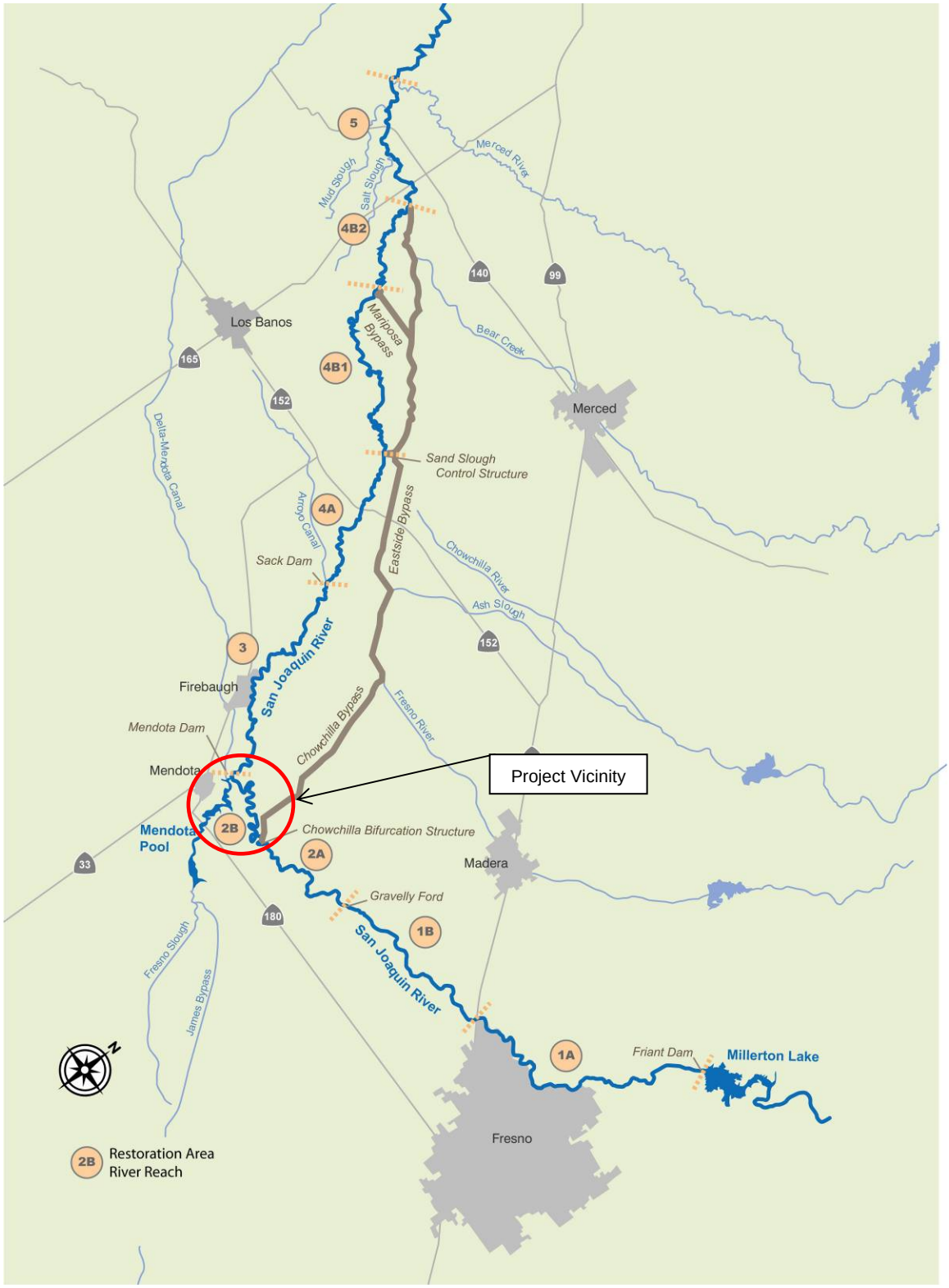

Figure 1-1.
Overview of the SJRRP Restoration Area and the Project Vicinity

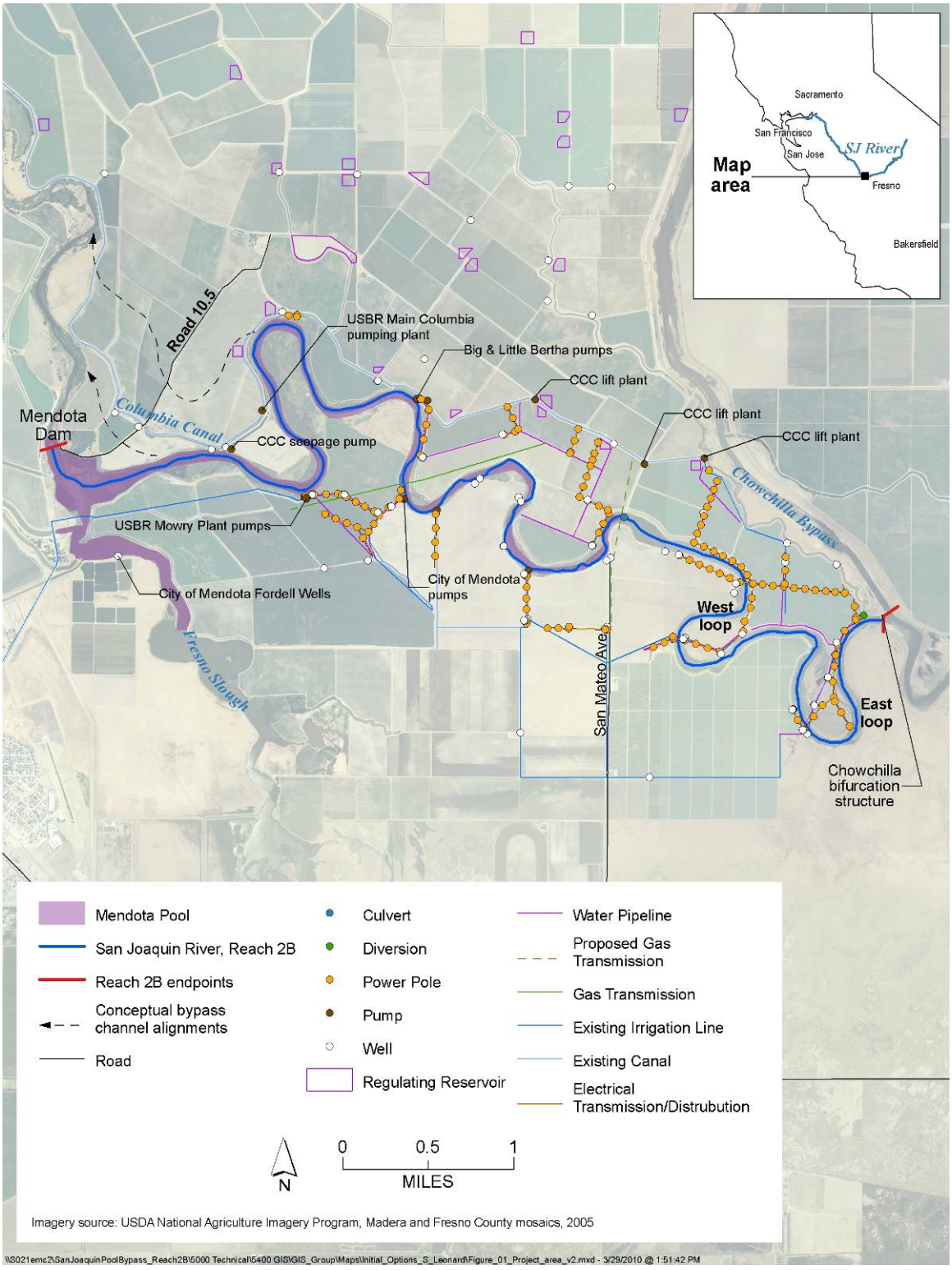

Figure 1-2.
Mendota Pool Bypass and Reach 2B Channel Improvements Project Area

1.3 Organization of this Technical Memorandum

The content and format of this TM are intended to dovetail with the future Project EIS/R, which will meet the requirements of NEPA, as set forth by the Council on Environmental Quality (CEQ) and Reclamation's NEPA policy and guidance, including the U.S Department of the Interior Implementation of NEPA and Final Rule, and CEQA and the State of California's CEQA Guidelines. The TM is organized as shown below.

Section 1.0 Introduction – summarizes Project background, scope of this TM, proposed analytical tools, and TM organization.

Section 2.0 Analytical Tools and Approach for Alternatives Evaluation and Developing the Project Description – presents the approach and methods for evaluating the Project initial alternatives for critical resource areas.

Section 3.0 Analytical Tools and Approach for NEPA/CEQA Assessment of Resource Areas – presents the approach and methods for assessing the environmental consequences to the resource areas.

Section 4.0 Acknowledgements – provides a list of those who contributed to the development of this document.

Section 5.0 References – provides a bibliography of sources cited throughout this TM.

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2.0 Analytical Tools and Approach for Alternatives Evaluation and Developing the Project Description

This section describes the analytical tools and approach to formulate, develop, and analyze the performance of each initial alternative in preparation for writing the Project Description for the Project EIS/R. Initial alternatives will be evaluated using a multi-criteria analysis matrix. Criteria to be used in the evaluation are aimed at determining whether an alternative meets the goals and objectives outlined in the *Mendota Pool Bypass and Reach 2B Improvement Project Initial Options Technical Memorandum* (Initial Options TM) (SJRRP 2010b).

The process diagram shown in Figure 2-1 describes how criteria and analytical tools described in Section 2.0 are related back to the Settlement requirements. The Settlement Paragraphs 11(a)(1) and 11(a)(2) along with the Settlement Restoration and Water Management Goals were used to develop goals and objectives specific to the Project, then the initial Project options were selected and will be refined with an aim towards meeting the Settlement requirements and the Project goals and objectives. The Project goals and objectives and the initial options were documented in the Initial Options TM (SJRRP 2010b). The evaluation criteria outlined in this TM were selected as the means with which to evaluate whether the Project initial alternatives meet the Project goals and objectives, as well as to compare amongst initial alternatives. The analytical tools described in this TM were then selected as the tools to analyze the Project initial alternatives and develop the input for the evaluation criteria matrix. Following the initial alternatives evaluation, the Project Description will be developed for inclusion in the Project EIS/R.

The sections below identify and describe the:

- Evaluation criteria for the initial alternatives
- Available analytical tools
- Approach to quantifying the evaluation criteria
- Data gaps and methods for obtaining data

Evaluation criteria presented herein serve two purposes for the Project initial alternatives:

1. To provide an objective means for evaluating whether the initial alternatives meet the Project goals and objectives for flow conveyance, fish habitat and passage, habitat restoration, seepage, and geomorphology presented in the Initial Options TM

2. To provide an objective means for comparing the impacts of the initial alternatives (e.g., costs, environmental impacts, etc.)

Both evaluations together will determine which initial alternatives will be incorporated into the Project description as final alternatives. Initial alternatives that do not, as determined by the evaluation, sufficiently meet the Project goals and objectives will be eliminated from the list of alternatives and will not be subject to future assessment in the Project EIS/R.

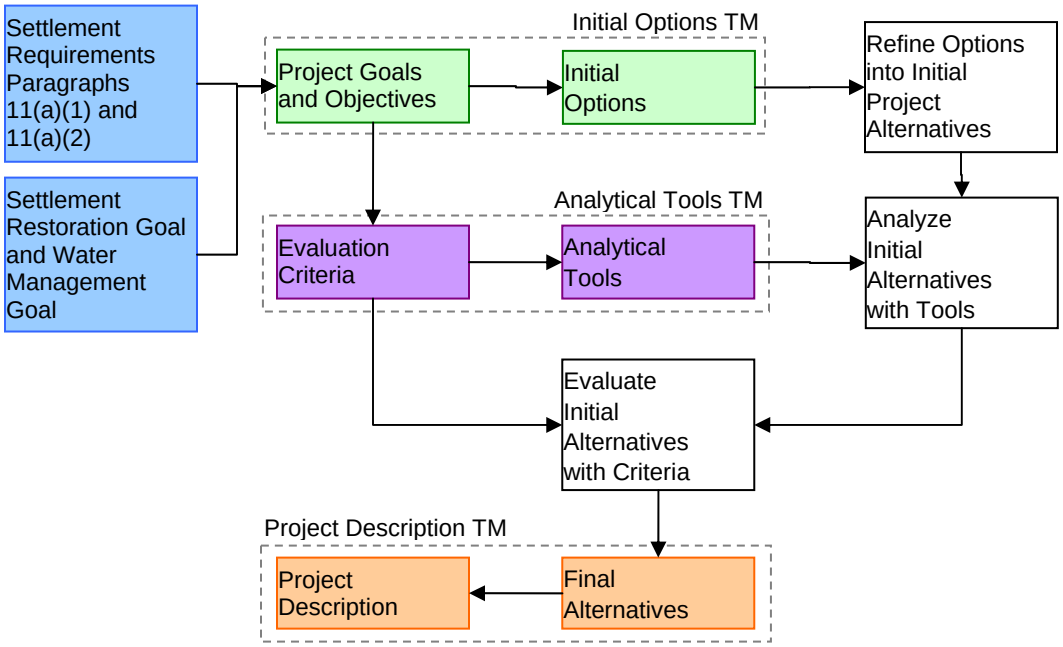

Figure 2-1.
Initial Alternatives Evaluation and Analytical Tools Process Diagram

2.1 Flow Conveyance, Hydrologic and Hydraulic Modeling and Operations

Analysis of the Project initial alternatives to determine if the Project goals and objectives will be met requires support from an analysis of the hydrology and the hydraulics of the reach. Hydrology includes a description of the anticipated flows in the reach including the frequency and rate of flows. Hydraulics includes the calculation of water levels, velocities, widths, and other physical parameters associated with the flow (e.g., shear stress).

Future flows in the Project will result primarily from releases of Restoration Flows from Millerton Lake. Flow volumes, magnitudes, durations, and management are outlined in the Settlement and are operated based on considerations that are not necessarily part of

the Project (e.g. flood management, irrigation, and the needs of other reaches of the river). Therefore, it is assumed that hydrology information such as daily flows, gage data, and the Exhibit B hydrographs (described below) will be utilized and that no hydrologic modeling will be conducted as part of the Project analysis. The flow data will be used to develop frequency curves such as a flow duration curve (i.e., percentage of time the flow exceeds a particular value) and a flood frequency curve (i.e., annual probability of exceeding a particular value).

The alternatives evaluation will compare the flow conveyance provided by the Project initial alternatives and evaluate the initial alternatives based on the criteria listed in Table 2-1. In addition, hydrologic and hydraulics tools will support alternatives evaluation for Habitat Restoration (see Section 2.3), Fish Habitat and Passage (see Section 2.2), and Geomorphology and Sediment (see Section 2.4).

Table 2-1.
Flow Conveyance Evaluation Criteria and Applicable Tools

Criteria	Tools
Convey the range of flows up to 4,500 cfs	HEC-RAS
Convey the range of flows up to 7,000 cfs	HEC-RAS

Hydraulic analysis will require modeling using an appropriate hydraulic model. The U.S. Army Corps of Engineers (USACE) Hydraulic Engineering Center – River Analysis System (HEC-RAS) model was selected for the modeling.

2.1.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with flow conveyance are as follows:

1. Convey the range of flows up to 4,500 cfs: This criterion evaluates whether the initial alternative meets the Settlement requirement to convey up to 4,500 cfs in Reach 2B and the proposed Mendota Pool Bypass.

2. Convey the range of flows up to 7,000 cfs: This criterion evaluates whether the initial alternative has the capacity to convey up to 7,000 cfs in Reach 2B for the purposes of accommodating 4,500 cfs in Restoration Flows coincident with 2,500 cfs in water deliveries to Mendota Pool.

2.1.2 Available Tools

The following list of analytical tools includes tools developed to support the Program Environmental Impact Statement/Environmental Impact Report (PEIS/R), in addition to tools developed by DWR or Reclamation to support the Project engineering studies.

Hydrology Information

There are various hydrology datasets which describe past and potential future magnitude, duration, and timing of flow in the river. There are four primary datasets proposed for use in the Project, each with different applications: the Exhibit B hydrograph, variable schedule daily time series, disaggregated daily flows, and historical gage data.

Exhibit B Hydrograph

Exhibit B of the Settlement outlines proposed Restoration Flow release schedules and accounting for the various restoration water year types. Paragraph 13(g) of the Settlement defines that the location immediately downstream of the Chowchilla Bifurcation Structure is designated as "Reach 3" on the Exhibit B hydrograph. Therefore, the values in Exhibit B's "Reach 3" column represent the flow anticipated to occur at the upstream end of the Project. However, it should be understood that the Restoration Flows will be managed as volumetric blocks of water, not as magnitudes of flow. The Restoration Administrator has the ability to modify the release magnitude for various reasons. The Exhibit B hydrograph flows are appropriate for describing the typical average flow in the Project area by water year type and time of year. The lowest flows in the Exhibit B hydrographs are also expected to approximately represent the minimum flow in the Project area. Therefore, these hydrographs will be used for determining the minimum flows within the Project.

Variable Schedule Daily Time Series

The scheduling of Restoration Flows will follow the recommendations developed by the Restoration Administrator in consultation with the Technical Advisory Committee as constrained by Exhibit B and other Settlement requirements. Evaluation of reach-specific alternatives requires assumptions on flow magnitude, frequency, and pattern. The same release volume allocation may result in different release flow patterns as a result of different objectives for the year, as well as flood control operations. Potential management objectives may include one or more of the following:

- Juvenile migration
- Floodplain rearing
- Geomorphic processes
- Temperature management

The following options were developed based on potential objectives and the need to evaluate performance criteria for site-specific alternatives:

1. Method 3.1 Gamma Default: flow releases based on Exhibit B blocks and distribution method gamma. This scenario represents a mid-range possibility for flow schedules. Maximum flows are limited to 3,855 cfs at Gravelly Ford. Riparian recruitment flows are released at a constant rate and not shaped.

2. Early Flexible Flows: releases would use as much water as possible as soon as possible. Flow blocks are shifted forward in time by 28 days and the last block of pulse flow volume in each year type would be releases to obtain 4,700 cfs at Gravelly Ford for as many days as possible. This scenario tests maximum temperature conditions as a result of returning to base flow conditions early in the year.

3. Late Flexible Flows: releases would be delayed for as long as possible resulting in a 4,700 cfs at Gravelly Ford sustained for as long as possible, but ending on May 28th. This schedule may not be consistent with the Settlement since the change in timing of individual flow blocks scheduled in the default for March 1st and March 16th exceeds

28 days. The approximation was deemed adequate for analysis in order to facilitate computation. This release tests maximum geomorphic work and minimum potential temperatures.

4. Span 1 Month: releases would be evenly spread over 1 month of the flexible flow period beginning March 1st to test an upper bound on geomorphic work potentially more reasonable than the flexible flow scenarios but with higher releases than Method 3.1 Gamma.

5. Span 2 Months: releases would be spread over the flexible flow period for 2 months similar to Method 4 to test a lower bound on geomorphic work.

6. Span 3 Months: releases would be spread over the flexible flow period for 3 months. Similar to methods 4 and 5, but potentially inconsistent with the Settlement and identified by the TAC as too unrealistic for further consideration. This method is included for reference.

Option 6 was later disregarded as a potential schedule variation due to the concerns cited above. Each of the five methods was then utilized to develop a daily time series of Restoration Flows based on the water year type for each year from 1922 to 2008. A flow-duration curve was developed from the daily data, and an annual maximum series was also generated. The annual maximum series was used to develop flow-frequency (annual non-exceedance probability) curves.

The variable schedule daily time series data do not include historical flood flows; they only include the Restoration Flows based on the Exhibit B allocation volumes and historical water year types. These data will be used to understand the range of flows implemented by the SJRRP.

Disaggregated Daily Flows

Disaggregated daily flow values (23-year period of record) have been developed previously by Reclamation to support the Project engineering studies. An adequate evaluation of many of the resource areas require flow values at a finer time step than the monthly output provided by DWR's water resources simulation model, or CalSim. These include the Sediment and River Hydraulics – One Dimension Model with Vegetation Component (SRH-1DV) (see Section 2.3.2) and the Hydraulic Engineering Center – Water Quality Model (HEC-5Q) (see Section 2.2.2) models. To meet this need, monthly water output from CalSim were disaggregated into daily water values using a spreadsheet model (SJRRP 2010c). Daily flow values in cfs are presented in a spreadsheet format. Available data include:

- Daily flow values at the head of Reach 2B for the study period (1980-2003) based on daily flows disaggregated from the CalSim model monthly output (SJRRP 2010c) and flow loss assumptions for the San Joaquin River between Friant Dam and Chowchilla Bifurcation Structure
- Flow duration curves based on the daily flow values

These data will be used to understand the changes in flood management releases as part of the implementation of the SJRRP.

Historical Gage Data

Historical gage data from the San Joaquin Below Bifurcation (SJB) gage (1974-2009) and from San Luis Delta-Mendota Water Authority records (1995-2010) were utilized to understand the magnitude, duration, frequency, and timing of flood flows in Reach 2B and deliveries to Mendota Pool. These data provide a check on the simulations involved for the daily disaggregated flows above as well as insight into historical operations.

HEC-RAS Model

A HEC-RAS model for Reach 2B has been developed previously by DWR to support the Project engineering studies. A discussion of the HEC-RAS model for purposes of the fisheries analysis is provided in Section 2.2.2. The following discusses use of the HEC-RAS model for the hydraulics modeling.

The HEC-RAS model performs one-dimensional hydraulic analyses on networks of natural or constructed open channels. The software is capable of performing steady flow calculations, unsteady flow calculations, sediment transport and mobile bed computations, and water temperature modeling. The basic steady flow computational procedure involves solving the one-dimensional energy equation, including friction and contraction/expansion energy losses. The momentum equation is utilized for rapidly changing water surfaces. The model also accommodates channel obstructions, such as bridges, culverts, and weirs, and can assess changes due to channel modifications and levees. The unsteady flow component incorporates the UNET solver into HEC-RAS, which utilizes the continuity and momentum equations.

The existing Reach 2B HEC-RAS model is capable of meeting the Project alternatives evaluation needs and has already been applied for the SJRRP. Mussetter Engineering, Inc. (MEI) developed and validated steady and unsteady HEC-RAS hydraulic models of the San Joaquin River and Bypass System between Friant Dam and the mouth of the Merced River for the SJRRP (Mussetter 2008a and Mussetter 2008b). These models provide a means of evaluating one-dimensional hydraulic conditions along the San Joaquin River over the range of flows specified in the Settlement, as compiled in the hydrology information discussed above. The existing models are based primarily on 1998/1999 bathymetry and overbank topography, with limited amounts of newer topography/bathymetry in specific areas. DWR is in the process of updating the existing conditions model by incorporating the Light Detection and Ranging remote sensing system (LiDAR) data that were collected in early 2008 to ensure that the models are using the most up-to-date information. This update has been completed for Reach 2B.

To support development of the initial options, DWR used the existing hydraulic model to preliminarily estimate the size of the floodplain required to pass the design flood under several possible vegetation scenarios. Manning's n was the model parameter used to represent existing and proposed vegetation. The assumption used in DWR's analysis was that the average depth of flow on the floodplain at 4,000 cfs would be 18 inches. These

results provided a range of possible floodplain widths for a range of vegetation types and coverages, which are summarized in the Initial Options TM (SJRRP 2010b).

Data required for the hydraulic analysis includes:

- Geometry data describing the channel and floodplain (topographic and bathymetric data)
- Vegetation cover (DWR 2002)
- Channel roughness
- Upstream and downstream boundary conditions
- Structure Geometry
- Mendota Pool operation rules and data
- Chowchilla Bypass operation rules and data
- Flood and water delivery operations rules and data

2.1.3 Approach to Criteria Evaluation

The HEC-RAS model for Reach 2B will be reviewed and, if necessary, modified to better reflect potential future conditions (refined initial alternatives). This will be completed during the refinement of initial options into initial alternatives. Anticipated model modifications include the following:

- Revising channel and floodplain geometry with 2008/2009 LiDAR and bathymetry data, if necessary
- Incorporating refined vegetation (roughness) components for each alternative
- Incorporating refined floodplain and channel grading for each alternative
- Incorporating additional cross-sections at fish passage-limited locations, as necessary

It is expected that multiple iterations of the HEC-RAS model geometry will be required to refine the roughness and incorporate grading, as necessary, in order to formulate the initial alternatives. Once initial alternatives have been modeled, it is not anticipated that additional HEC-RAS model runs will be required to complete the evaluation of initial alternatives.

The HEC-RAS model provides as output water surface elevation, depth and velocity. Inundation maps by depth could be created with the output and a Geographic Information System (GIS) application or by utilizing HEC-GeoRAS, a georeferenced version of the software that works with GIS. These maps will provide a two-dimensional picture of the depth in the channel and on the floodplain for a given vegetation and flow condition. Maps for each initial alternative could be created, as necessary to support the evaluation.

A profile of the reach showing the water surface elevation from the Chowchilla Bifurcation Structure through the end of the reach, including the Mendota Pool Bypass, could be created, as necessary to support the evaluation.

Since the HEC-RAS model is one-dimensional, only average velocities can be obtained from the model results. Profiles of average velocities along the length of the main channel and the Mendota Pool Bypass in the channel and on the floodplain could be created, as necessary to support the evaluation.

The approach to quantify each specific flow conveyance criteria is summarized in the text below.

Convey the Range of Flows up to 4,500 cfs

The channel, floodplain, and structure alternatives will be modeled using the latest Reach 2B HEC-RAS model. Depending on the channel and floodplain roughness characteristics, floodplain width, and structure geometry associated with each initial alternative, levee heights sufficient to contain 4,500 cfs and appropriate freeboard will be estimated. All alternatives will convey up to 4,500 cfs. This criterion applies to both Reach 2B and the Mendota Pool Bypass.

Convey the Range of Flows up to 7,000 cfs

The channel, floodplain, and structure alternatives will be modeled in the HEC-RAS model. Based on the levee alignments developed for the alternatives conveying 4,500 cfs, levee heights will be increased until there is sufficient capacity to contain 7,000 cfs with the appropriate freeboard. This criterion applies only to Reach 2B.

2.1.4 Data Gaps & Approach to Obtain

For the HEC-RAS model, the primary data gaps are associated with the process for refining initial options into initial alternatives. The following is a summary of data gaps associated with this process:

1. Since the Project is primarily driven by fisheries and habitat goals, data on associated ideal or recommended floodplain characteristics and acreages are required. This data is being developed based on input on the initial options and through coordination with DWR, Reclamation, FMWG, and Consultant Team technical staff. Data includes desired vegetation type and coverage and desired water depth or range of depths (see discussion in Section 2.2.1). The criteria on water depths presumably would apply to certain flow rates, for example the average flow, 2-year or 5-year event.

2.1.5 Summary

Table 2-2 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to flow conveyance.

Table 2-2.
Flow Conveyance Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Convey the range of flows up to 4,500 cfs	cfs conveyed	HEC-RAS	Updated flow loss curves (as necessary), target habitat acreages and features	Flow depth and vegetation criteria for fisheries habitat
Convey the range of flows up to 7,000 cfs	cfs conveyed	HEC-RAS	Not applicable (n/a)	none

2.2 Fish Habitat and Passage

Prior to the start of Interim Flows, the Reach 2B channel has been dry upstream of San Mateo Avenue and backwatered by Mendota Dam downstream of San Mateo Avenue. For proposed initial alternatives, fish passage conditions and floodplain rearing habitat conditions will be evaluated with regard to life history stages and strategies of spring-run and fall-run Chinook salmon, Central Valley steelhead, and native fishes that may also use habitat in Reach 2B. No spawning habitat exists in Reach 2B for salmonids.

The analytical approach for fish passage within the Project evaluates the initial alternatives based on passage conditions at artificial in-channel structures such as the Mendota Pool Bypass drop structures, the San Mateo Avenue Road crossing, and the Chowchilla and Mendota Pool bifurcation structures. The approach to evaluating fish habitat involves assessing potential quantity and character of seasonal salmonid rearing habitat provided by the different floodplain alternatives.

The approach addresses migration (fish passage) and habitat use (seasonal rearing habitat for salmonids and rearing for other native species) goals of the Project (SJRRP 2010b) by evaluating and quantifying or qualifying environmental factors, so relative comparisons of potential migration and rearing success can be made for different initial alternatives.

The alternatives evaluation will compare the fish passage and habitat conditions that would result from implementation of the Project initial alternatives and evaluate the initial alternatives based on the evaluation criteria listed in Table 2-3 and described in the following sections.

Table 2-3.
Fish Passage and Habitat Evaluation Criteria and Applicable Tools

Criteria	Tools
Floodplain inundation depth, velocity, and area	HEC-RAS, hydrology information
Floodplain habitat based on floodplain features	SRH-1DV, geomorphic techniques
Passage conditions at structures	HEC-RAS, passage design criteria
Water temperature during migration	HEC-5Q

2.2.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with fish passage and habitat are as follows:

1. Floodplain inundation depth, velocity, and area: Floodplain depth of flow and floodplain velocity will be integrated to define functional habitat within the inundated area based on recommended design objectives pertaining to floodplain rearing habitat.

    - Floodplain depth and velocity: Depth of flow and velocities on the floodplain are important factors keyed to fish use. The amount, in acres, of inundated floodplain for given depth ranges with velocities greater than 0 feet per second (fps) will be calculated for the initial alternatives. The amount of floodplain can be used to estimate how many juvenile salmonids could be supported at combinations of various flows, setbacks or floodplain reconfigurations based on the number and life history stage of salmonids supported per unit area (fish densities) for comparable floodplains.
    - Floodplain connectivity: The quantity of floodplain associated with a given channel length is a method of assessing connectivity of the channel to floodplain rearing habitat.

2. Floodplain habitat based on floodplain features: The functional floodplain habitat available to fish including seasonal ponds, secondary channels, and vegetation types.

3. Passage conditions at structures: Proposed design for all structures will meet minimum fish passage requirements for salmonids. Structures could be evaluated at selected restoration index flows for their ability to meet jump, velocity, depth, and entrance and exit requirements for both salmonids and other native fishes. Additionally, each initial alternative will be evaluated for the total number of artificial structures fish would need to pass.

4. Water temperature during migration: The number of days each month during the migration period that water temperature criteria are met by each initial alternative.

2.2.2 Available Tools

The following list of analytical tools includes tools developed to support the PEIS/R, in addition to tools developed by DWR or Reclamation to support the Project engineering studies.

HEC-RAS Model and Hydrology Information

A discussion of the existing HEC-RAS model and hydrology information for hydraulics modeling purposes is provided in Section 2.1.2. Hydraulic performance of the proposed channel and floodplain will drive the ability of the proposed initial alternatives to meet the project objectives related to fish passage and habitat. Output from the hydraulic modeling, coupled with statistical information pertaining to the variable schedule daily time series, will be utilized as input data for the approach to quantify the majority of fisheries related evaluation criteria.

SRH-1DV

A discussion of the existing Sediment and River Hydraulics – One Dimension Model with Vegetation Component (SRH-1DV) model is provided in Section 2.3.2.

EDT Model

The FMWG is currently developing the EDT (Ecosystem Diagnosis and Treatment) model tool. The model is initially being developed specifically for spring-run Chinook salmon in the San Joaquin River and has four major components: spatial structure, stream reach data, species habitat rules, and fish population life history. The stream reaches are the basic spatial structure for the model and constitute the maximum resolution of the picture developed by the model. Stream reach data requires information that is reach-specific for environmental conditions between Friant Dam and the Merced River confluence. The species habitat rule would be based on a library of species-habitat relationships yet to be developed for the San Joaquin River. The fish population life history links the reaches and life stages to complete the model.

The EDT model requires a significant amount of data for successful development. The kind of habitat found in the San Joaquin River (sand bed river traversing a wide exposed valley floor) is extremely different from typical salmonid habitat upon which most of the literature is based, and it compounds the challenge of supplying the input data requirements. Hence, it may be difficult, or at least take some time, to develop an EDT model applicable to the San Joaquin River. At the present time, the EDT model is not expected to be ready to assist in evaluating the initial alternatives, but it may be useful in evaluating the effects of the Project during the development of the Project EIS/R.

HEC-5Q Model

Two temperature models have been developed in support of the SJRRP. CE-QUAL-W2 was used to model the temperatures in Millerton Lake, and USACE's HEC-5Q was used to model the temperature in the San Joaquin River.

The HEC-5Q model, Simulation of Flood Control and Conservation Systems (including Water Quality Analysis), was developed by USACE to utilize decision criteria based on flood control, hydropower, instream flow, and water quality requirements to decide how to regulate a network of reservoirs.

The model performs two separate functions. The first, based on the HEC-5 model embedded in the HEC-5Q modeling platform, routes water through the San Joaquin River and bypass system from Millerton Lake to the confluence with the Merced River. This portion of the model handles the physical diversion of water between the Chowchilla, Eastside, and Mariposa bypasses and the San Joaquin River, local accretions and depletions along the channels, and hydrologic routing of water to develop daily flows throughout the system. The second function uses flows and historical meteorology to simulate temperatures.

Input data to the HEC-5Q model include temperature and flow rate of inflows into the reach, in addition to meteorology data on a sub-daily time scale (e.g., hourly).

2.2.3 Approach to Criteria Evaluation

Existing analytical tools or other appropriate methods will be utilized to evaluate initial alternatives by determining applicable parameters associated with initial alternatives, potentially comparing those parameters to recommended thresholds (as applicable), and eventually comparing results between initial alternatives (Project Description TM).

Recent research projects have developed useful measures of floodplain suitability that can be used in some cases to develop design criteria or criteria thresholds. These design criteria or thresholds will be used to evaluate channel passage conditions, passage conditions at existing structures or structures to be constructed or modified, and the in-channel and floodplain habitat suitability in Reach 2B. Depth of flow and velocity are important factors to evaluate for migrating adult spring- and fall-run Chinook salmon (and Central Valley steelhead). Channel habitat conditions (including the amount of bordering riparian habitat) are important for rearing juveniles during life history stages as they are supported by the Project. Inundation duration and flow depth for the different initial alternatives will be used to characterize floodplain habitat for juvenile rearing. The following studies and documents were identified as sources of applicable fish passage and habitat information and data:

- Determining stream flows for fish life (Thompson 1972)
- Habitat Requirements of Salmonids in Streams. In Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats (Bjornn 1991)
- Fisheries Handbook of Engineering Requirements and Biological Criteria (Bell 1990)
- Quantifying Activated Floodplains on a Lowland Regulated River: Its Application to Floodplain Restoration in the Sacramento Valley (Williams 2009)
- Priming the productivity pump: flood pulse driven trends in suspended algal biomass distribution across a restored floodplain (Ahern 2006)
- Ephemeral Floodplain Habitats Provide Best Growth Conditions for Juvenile Chinook Salmon in a California River (Jeffres 2008)
- The Influence of Flood Cycle and Fish Predation on Invertebrate Production on a Restored California Floodplain (Grosholz 2006)
- *Anadromous Salmonid Passage Facility Design* (NMFS 2008)

The approach to quantify specific fisheries evaluation criteria is summarized in the text below.

Floodplain inundation depth, velocity, and area

The HEC-RAS modeling output will be used to evaluate the flood-up and high water levels and relate these to depth and velocity conditions on the floodplain during the time periods they would be useful to juvenile salmonids. These tools can be used to compare the amount of functional floodplain habitat for differing Restoration Flows.

Recommended design criteria for depth of flow and velocity will be developed for spring and fall-run Chinook salmon and steelhead and for juvenile out-migration based on

published references such as Thompson 1972, Bjornn 1991, and Bell 1990. Velocities in the natural channel are not anticipated to present upstream migration problems through the low gradient Reach 2B channel.

Floodplain habitat based on floodplain features

Floodplain surfaces are variable features which change during large events resulting in swales, ponds, secondary channels, scour holes and sand splays. These features may exist on some of the floodplain areas presently available in the Project, but most would evolve over time under the Restoration Flows.

On the floodplain, primary and secondary rearing can be important to salmon rearing in the San Joaquin River. Primary rearing supports direct use of the channel or floodplains by juvenile salmonids while secondary rearing provides food resources for juvenile salmonids in the adjacent and downstream channel segments. One factor that is difficult to predict will be the change from existing to future expected geomorphic conditions for the floodplain and the active channel. This difficultly is due to Reach 2B having been either mostly dry or permanently inundated for approximately 50 years.

A qualitative approach will be used to enumerate the different types of features presently occurring or anticipated on available floodplains. The area of each feature type would be summed using the LiDAR maps or other aerial maps. The type of vegetation on the floodplain will also affect habitat value for rearing salmonids. The amount of each predicted vegetation type on the floodplain would be used to evaluate habitat conditions for rearing salmonids using the SRH-1DV model.

Floodplain habitat benefits are linked to floodplain complexity, inundation timing, depth of inundation, velocity, duration of the flood, as well as periods between inundations. The definition of frequently activated floodplain (FAF) is the river stage that occurs in two out of three years for at least seven days in the mid-March to mid-May period and activated floodplains are those lands inundated at that stage (Williams 2009). Some relevant conclusions for the San Joaquin River about the activated floodplain area based on four representative reaches along the lower Sacramento River and the Yolo Bypass include: the area of active functional floodplain is likely to be less than commonly assumed based on extent of riparian vegetation, and levee setbacks may not increase the extent of this type of ecologically-productive floodplain without either hydrologic or topographic changes (Williams 2009).

Passage conditions at structures

Structures could be evaluated based on their ability to meet velocity and depth requirements and approach and exit conditions associated with selected restoration index flows during the salmonid migration. This could be completed through independent hydraulic calculations at structure locations, or through processing of HEC-RAS modeling output.

Assuming that all flow depth and velocity criteria are met in the design phase of the structures, the total number of structures associated with each initial alternative a fish would need to pass would be used as an evaluation tool.

Water temperature during migration

The water temperature in the Project will be highly dependent upon the temperature of water delivered from Reach 2A, which in turn is dependent primarily upon regional and local climatic conditions and on operations at Millerton Lake with respect to release timing and magnitude. The temperature in the San Joaquin River will progress towards equilibrium temperature as the San Joaquin River flows downstream. Equilibrium temperature is the temperature at which the net heat flux across the water surface is zero (i.e., the water is losing heat at the same rate it is gaining it). Once the river reaches equilibrium temperature, there is little that can be done as part of the Project to control the San Joaquin River temperature. Prior to reaching equilibrium, the primary factor that can be affected by the Project is the amount of shading provided along the San Joaquin River. While the release magnitude and durations of flows significantly affect water temperature, factors including flood management, irrigation, and the needs of other reaches of the river are considerations that this Project does not have direct control over.

Temperature could limit passage through Reach 2B for upstream-migrating adults in the fall and could affect the duration of the downstream-migrating juveniles from mid to late spring. The HEC-5Q model will be used to predict the temperature in the Project and evaluate the relative effects on San Joaquin River temperature resulting from the initial alternatives. The inputs to the HEC-5Q model will need to be modified to incorporate the different levels and types of riparian vegetation and floodplain configurations proposed in the initial alternatives.

Results from the HEC-5Q model will be utilized to generate a graph of temperature at the bottom and upstream ends of the reach versus time to determine the effect of each initial alternative on temperature.

2.2.4 Data Gaps & Approach to Obtain

The following is a summary of data gaps associated with the various tools proposed for criteria evaluation:

1. Minimum and optimal quantities of floodplain rearing habitat features should be finalized prior to refinement of initial options into initial alternatives. This will be done through coordination between DWR, Reclamation, the FMWG, and the Consultant Team.

2. Inflows and water temperatures at the head of Reach 2B could be updated, as necessary, for the HEC-5Q scenarios that will be analyzed in the Project evaluation. The HEC-5Q results for different Millerton release schedules and design options in Reaches 1 and 2A data should provide this input.

3. For the EDT to be meaningful in an evaluation of Project initial alternatives, it would need to predict the number of fish delivered from upstream reaches. At this time, the development of the EDT has not progressed sufficiently to provide this information for The Project. Therefore, the evaluation of the initial alternatives will proceed on the basis of the physical habitat that can be evaluated or quantified. Since no salmon

or steelhead are presently in Reach 2B, a salmon population model for the San Joaquin River could be useful, if feasible within the project schedule constraints.

2.2.5 Summary

Table 2-4 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to fish passage and habitat.

Table 2-4.
Fish Habitat and Passage Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Floodplain inundation depth, velocity, and area	Floodplain acreage by depth range	HEC-RAS, hydrology information	Modeling results for flow magnitudes of interest	none
	Floodplain acreage by velocity	HEC-RAS, hydrology information	Modeling results for flow magnitudes of interest	none
	Floodplain connectivity	HEC-RAS, hydrology information	Modeling results at representative cross-sections for flow magnitudes of interest	none
Floodplain habitat based on floodplain features	Acreage of different vegetation communities and geomorphic features	SRH-1DV, geomorphic principles	Acreage of secondary channels, ponds, swales, sand splays	Unknown features on future floodplains
Passage conditions at structures	Jump height, velocity and depth of flow, number of artificial structures in migratory path	HEC-RAS, passage design criteria	Modeling results for proposed structures and structures selected for inclusion in alternatives	Design for some structures
Water temperature during migration	Days meeting criteria during migration periods	HEC-5Q	Starting water temperature from Reach 2A, climatic data, shaded area	none

2.3 Habitat Restoration

The Project initial alternatives will include the preservation, enhancement, and creation of riparian, wetland, and upland habitats in some areas and, potentially, the removal of similar habitats in other areas. The initial alternatives evaluation will compare how the initial alternatives will affect the floodplain habitats and wetlands, waters, and other jurisdictional habitats.

This section focuses on the analytical tools and approach that will be used to quantify, qualify, and compare the habitat changes in order to evaluate the initial alternatives. The initial alternatives will be compared based on the evaluation criteria listed in Table 2-5 and described in the following sections.

Table 2-5.
Habitat Restoration and Impacts Evaluation Criteria and Associated Tools

Criteria	Tools
Total vegetation cover by vegetation alliance	SRH-1DV
Shaded riverine aquatic habitat area	SRH-1DV
Floodplain vegetation species diversity	SRH-1DV
Invasive species establishment potential	SRH-1DV
Wetlands and other waters of the U.S area	SRH-1DV, wetland delineation
Listed plant species extent	SRH-1DV, listed plant surveys
Listed wildlife species extent	SRH-1DV, wildlife habitat surveys

2.3.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with habitat restoration are as follows:

1. Total vegetation cover by vegetation alliance: This criterion represents the projected vegetation cover acreage within the floodplain corridor by plant community. The floodplain corridor will be the area associated with each of the initial alternatives confined by the levees.

2. Total shaded riverine aquatic habitat area: Projected extent of vegetation overhanging the riverine water surface associated with the initial alternatives will be estimated and expressed in square yards (sq. yd.).

3. Floodplain vegetation species diversity: The diversity of the floodplain vegetation is critical for a sustainable and healthy riparian corridor. The stability of an ecosystem and its resistance to exotic species invasions increases substantially with the number of native species that are present in such an ecosystem. The number of species projected to be surviving in the various habitats within the confines of the levees will be estimated.

4. Invasive species establishment potential: Invasive species introduction and establishment can have a significant harmful impact on establishment and success of native species, and associated habitat. Initial alternatives will be evaluated on their ability to limit the extent of invasive species by estimating the acreage of potential invasive species habitat, including non-native, invasive fishes.

5. Wetlands and other waters of the United States area: Based on the project wetland delineation, the acreage of potential changes to wetlands and other non-wetland waters of the United States, including enhancement, preservation, restoration, and removal, will be evaluated.

6. Listed plant species extent: Based on the listed plants survey results, the acreage of potential changes to existing listed plant species within the Project area will be estimated. The future extent (after a 5-year monitoring and maintenance period) of plant species re-introduced as part of the Project will also be evaluated.

7. Listed wildlife species extent: Based on the listed wildlife survey results, the acreage of potential changes to existing listed species habitat within the Project area will be estimated. The future extent (after an approximate 5-year monitoring and maintenance period) of habitat created as part of the Project will also be evaluated.

2.3.2 Available Tools

The following list of analytical tools includes tools developed to support the PEIS/R, in addition to tools developed by DWR or Reclamation to support the Project engineering studies.

Vegetation Mapping

Vegetation mapping completed for the San Joaquin River in 2002 includes wetland and riparian vegetation and is considered sufficient for identifying acreages of these vegetation types in The Project. The following additional data sources were identified as applicable to riparian vegetation:

- DWR Riparian Vegetation of the San Joaquin River (DWR 2002)
- San Joaquin River Restoration Study Background Report, Chapter 8: Vegetation (McBain and Trush 2002)
- *San Joaquin River Restoration Study Background Report*, Chapter 9: Special Status Plants and Wildlife (McBain and Trush 2002)
- Historical Riparian Habitat Conditions of the San Joaquin River – Friant Dam to Merced River (Jones & Stokes 1998b)
- Restoration Objectives for the San Joaquin River (Stillwater 2003)
- DWR Water Data Library for high-watertable occurrences within 2 miles of the Project area (DWR 2010)
- Reach 2B Preliminary Monitoring Well Data Maps (SJRRP 2010d)
- Hydrologic and geomorphic changes to the San Joaquin River between Friant Dam and Gravelly Ford, and implications for restoration of Chinook salmon (*Oncorhynchus tshawytscha*) (Cain 1997) and Analysis of Physical Processes and Riparian Habitat Potential of the San Joaquin River: Friant Dam to the Merced River, California (Jones and Stokes 1998a) for summaries of physical processes and historical and existing morphology of the San Joaquin River.
- 1937/1938 aerial photographs obtained from Exchange Contractors and Bureau of Reclamation extend from Ledger Island (river mile (RM) 263) downstream to Sack Dam (RM 182) (Pre-1937 aerials do not exist.)
- 1998 aerial photographs obtained from Bureau of Reclamation extend from Friant Dam (RM 267.5) to the Merced River confluence (RM 118)
- 1998/1999 topographic data, 2-foot contour interval, DTM format, NAVD29 (Ayres 1998, 1999) (Does not cover land area outside the San Joaquin River levees.)
- 2008 LiDAR, 1-foot contours combined with 2008-2009 bathymetry (under development)

- Operations rules and data for Mendota Pool and Chowchilla Bifurcation for flood and water delivery operations
- Design flow rates, flow duration curves, vegetation type and density, and other results from the hydraulic models and previous studies

Wildlife Habitat Mapping

The following data sources will be utilized and supplemented with field-gathered data to prepare wildlife habitat mapping in the Project area:

- California Natural Diversity Database (CNDDB) (CDFG 2009a): All records from the Mendota Dam USGS 7.5-minute quadrangle in this database, maintained by CDFG, and all records from the surrounding eight quadrangles (Jamesan, Tranquility, Coit Ranch, Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch, and Gravelly Ford) were reviewed. All species with records from these quadrangles and meeting the status criteria for inclusion (described below) are addressed in this TM.
- USFWS Sacramento Species List (USFWS 2009a): All species on this list generated at the Sacramento USFWS website for the Mendota Dam quadrangle are addressed in this TM.
- Audubon Society Important Bird Area species list for the Mendota Wildlife Area (Audubon Society 2009): All species reportedly observed at the Mendota Wildlife Area and meeting status criteria for inclusion are addressed in this TM.
- *San Joaquin River Restoration Study Background Report* (McBain and Trush 2002)
- California Interagency Wildlife Task Group, California Wildlife Habitat Relationships species accounts (CDFG 2005)
- Endangered Species Recovery Program species profiles (ESRP 2006)

SRH-1DV Model

An SRH-1DV model for the Project has been developed previously by Reclamation to support the Project engineering studies. The Sedimentation and River Hydraulics Group developed SRH-1DV by adding vegetation components to the core sediment transport model SRH-1D to describe vegetation establishment, growth, competition, and mortality in the river floodplain. The SRH-1DV is a one-dimensional flow, sediment transport, and vegetation growth model that can be used to assess river response, including changes to vegetation, resulting from management actions. The core of the SRH-1DV model is the one-dimensional sediment transport model, SRH-1D, written by Reclamation's Sedimentation and River Hydraulics Group. Inputs to the sediment transport model include flow hydrographs, lateral flows and seepage losses, bed material grain sizes, flow and sediment boundary conditions, and hydraulic and sediment transport parameters. The data needs for these inputs can be derived from other models and analytical tools expected to be described in the PEIS/R and also in this TM such as the SRH-1D (sediment transport), SRH-2D (hydraulics), and CalSim (water operations) models. The SRH-1DV model links physical and ecological processes to management actions, to predict vegetation response to changes in flow management and the subsequent impacts

on hydraulic capacity, regeneration of the native cottonwood/willow population, and spread of invasive species. In addition to flow and sediment transportation computations the SRH-1DV model tracks: vegetation age, root growth, stem growth, canopy growth, growth seasons, germination periods, seed viability, distance to groundwater, capillary fringe, and mortality due to scour, desiccation, inundation, competition, shading, and senescence.

Additional details about the application of the SRH-1DV vegetation model and details of the simulation results are expected to be included in the PEIS/R.

SRH-1D model results will be presented in GIS map format accompanied by summary tables that will enumerate the pertinent vegetation characteristics for each proposed initial alternative. By estimating the riparian vegetation extent, changes and other parameters for each initial alternative, this format will meet the Project's analytical needs.

2.3.3 Approach to Criteria Evaluation

The SRH-1DV model has been identified as a tool to evaluate vegetation changes resulting from the project alternatives. The model will aid in understanding baseline conditions and in examining system-wide affects of mechanical and hydrologic changes associated with the Project initial alternatives.

SRH-1DV model is capable of meeting the Project alternatives evaluation needs and has already been modified and applied for the SJRRP. Further modification will be required during the concept refinement process to update the model to reflect refined initial alternatives, and associated hydraulic characteristics. In addition, the parameterization of the model will need to be reviewed and, if necessary, modified to accurately reflect species tolerances and competition rules by:

- Adding large-scale vegetation density capabilities
- Linking vegetation growth or removal to channel resistance (hydraulic capacity)
- Adding a function relating Fremont cottonwood and Goodding's black willow seed release to temperature
- Incorporating a function that accounts for potential seed dispersal from upriver reaches

Ongoing vegetation studies being prepared for the PEIS/R focus on a comparison of alternatives and do not address the ideal recruitment flow levels. The future baseline CalSim flows were used for the vegetation analysis modeling, but flows have the potential to differ in the future. Flow inputs need to be reviewed and, if necessary, modified to better reflect potential future conditions. See Section 2.1.2 for more information.

Total vegetation cover by vegetation alliance

The Project will affect the extent of the floodplain vegetation communities by increasing plant productivity for some species, while decreasing it for others. The impact analysis for the plant communities in the floodplain will center on the potential effects of project-

related construction activities and the future hydrologic regime, which will alter and affect vegetation alliances along the channel.

To assess these changes, the SRH-1DV model will be the primary analytical tool, and the Reach 2B daily flows and HEC-RAS model output will provide the necessary information on flow duration and flood frequency. The SRH-1DV model will be used to predict changes in vegetation extent and percent cover. The baseline extent of the vegetation alliances within the current proposed Project area will be determined during the botanical surveys that will be conducted in the spring of 2010 and 2011.

Shaded riverine aquatic habitat area

Insects and plant material such as woody debris that fall from riparian plants into the river enhance the aquatic food webs. Many aquatic invertebrates develop inside fallen logs, and these insects are eventually eaten by fish. Trees and shrubs growing along river banks create shaded areas of rivers that help keep water temperatures lower during the summer, which is important for fish. Additionally, the roots, branches and other submerged plant material provide protection for young fish, as well as nutrients and an additional source of invertebrates. When trees, shrubs, grasses, and herbaceous plants are adjacent to the river channel, they create shaded riverine aquatic habitat. The vegetation creates a microclimate of cooler water temperatures where many fish will congregate to feed and seek cover. Shaded riverine aquatic habitats are important for one or more life stages of most fishes that inhabit the San Joaquin Valley rivers. The loss of shaded riverine aquatic habitat has directly contributed to declines in populations of associated native fishes and reduced an important source of nutrients and allochthonous material in streams and rivers. (Stillwater 2003).

SRH-1DV and qualitative methods will be used to predict the species and aerial extent of overhanging vegetation. The prevailing species of overhanging vegetation will influence the amount and type of invertebrate and allochthonous fall.

Floodplain vegetation species diversity

Qualitative and quantitative methods will be used to predict native plant species diversity within the floodplain area of each of the initial alternatives. Species diversity is defined as the number of different species in a particular area (i.e., species richness) weighted by some measure of abundance such as relative abundance, number of individuals or biomass. Another measure of species diversity can be the species evenness, which is the relative abundance with which each species is represented in an area. An ecosystem where all the species are represented by the same number of individuals has high species evenness. An ecosystem where some species are represented by many individuals, and other species are represented by very few individuals has low species evenness. This is a condition that is often seen in disturbed ecosystems, where uncommon species become even less common, and common species become even more common as a result of the disturbance. There may even be an increase in the number of species in some disturbed ecosystems but, this may occur with a concurrent reduction in the abundance of individuals or local extinction of the rarer species.

The species diversity will be measured by the number of native plant species currently present multiplied by the abundance factor for each species. The abundance factor of one through three will be determined during the plant surveys based on whether each species is abundant (3), occasionally common (2), or uncommon (1). The initial alternatives potential for species abundance will be based on assumptions of which species would be planted, the SRH-1DV vegetation model results, and the current abundance of these species as observed in the field.

Invasive species establishment potential

A preliminary simulation of the SRH-1DV model was capable of predicting plant productivity and mortality for native and invasive species for the entire Project area. The model was spatially applied to the Project area in two large sections that covered the Reach 2B river channel and the bypass. The model may not be useful in evaluating changes in areas that are outside the zone of inundation under the initial alternatives but that may be affected by the project through construction activities. The most common exotic invasive plant species occurring in the Project area will be identified during the 2010 and 2011 botanical surveys. The preferred habitat type and cultural requirements (e.g. sun, water, and soil) will be identified for each non-native plant that is rated as highly invasive by the California Invasive Plant Council and that is observed in the Project area. Based on the results of the vegetation model, the acreage of invasive exotic species habitat potentially created by each initial alternative will be estimated.

Wetlands and other waters of the United States area

Wetland delineations will be used to determine the current extent of wetlands and waters of the U.S. (including State jurisdictional features such as isolated wetlands) within the Project area and the effect of each initial alternative on these federally protected features within the Project area. Data mapping and vegetation monitoring conducted between 2000 and 2002 by Stillwater Sciences and Jones & Stokes will be also helpful in developing conservative estimates of the effect on wetlands. The SRH-1DV model will be used to determine the potential future extent of wetland and non-wetland waters of the United States.

Listed plant species extent

Listed plants and their geographical extent in the Project area will be determined during the botanical surveys. Based on this field information and the results of the SRH-1DV model, the effects of each initial alternative on the extent of each listed species will be evaluated. The SRH-1DV model will also help identify potential areas where listed plants could be re-introduced.

Listed wildlife species extent

Listed (threatened and endangered) wildlife and the geographical extent of their habitat in the Project area will be determined during the wildlife surveys. Based on this field information and the results of the SRH-1DV model, the effects of each initial alternative on the extent of each listed species will be evaluated. The SRH-1DV model will also help identify potential areas where the habitats associated with listed wildlife could be created or expanded.

2.3.4 Data Gaps and Approach to Obtain

The above resources provide good basis for the modeling and evaluation of the riparian vegetation under current conditions as well as for the proposed initial alternatives. However, mapping similar to the 2002 wetland and riparian mapping will need to be conducted for the Mendota Pool Bypass options, especially in areas of existing native vegetation and where the bypass will be reconnecting to the existing San Joaquin River channel, since these areas, which are outside of the current San Joaquin River corridor, were not surveyed previously. Additional refinement of the vegetation type data will be provided during plant and vegetation community surveys in the spring/summer 2010 and spring 2011, including:

- Wetlands and riparian vegetation should be evaluated in more detail. Approximate acreages of different wetland and riparian vegetation types should be identified and delineated on a map to assess potential impacts in the Project area. Previous mapping studies need to be extended to cover the Mendota Pool Bypass initial alternatives.
- To evaluate the effects of the project on other sensitive habitats, including vernal pools, and to obtain necessary permits, additional jurisdictional waters determinations and wetland delineation surveys may be required.
- Updated aerial photographs will be helpful in estimating acreages for all habitat types. The SJRRP is collecting five sets of aerial imagery over the spring and summer of 2010. This data may not be available prior to the alternatives evaluation, but should be available during the preparation of the EIS/R

2.3.5 Summary

Table 2-6 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to habitat restoration.

Table 2-6.
Habitat Restoration Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Total vegetation cover by vegetation alliance	Area (acre)	SRH-1DV, botanical surveys	Field update of past data, model results by plant community	Current conditions, modeling by plant communities
Shaded riverine aquatic habitat area	Area (sq. yd.)	SRH-1DV, GIS measurements	Measurements of current shaded habitat, model quantities and species	GIS calculations based on aerial photos, model results
Floodplain vegetation species diversity	Number of species	SRH-1DV, botanical surveys	Plant surveys, model results	Plant surveys, modeling by plant communities
Invasive species establishment potential	Area (sq. yd.)	SRH-1DV, botanical surveys	Invasive plant survey, model results	Plant surveys, modeling by plant communities

Wetlands and other waters of the U.S area	Area (sq. yd.)	SRH-1DV, wetland delineation, HEC-RAS	Wetland delineation, model results	Refined /expanded jurisdictional delineation, HEC-RAS surface water elevation results
Listed plant species extent	Area (sq. yd.)	SRH-1DV, botanical surveys	Plant surveys, model results	Plant surveys, modeling by plant communities.
Special status wildlife species extent	Area (sq. yd.)	SRH-1DV, wildlife habitat surveys	Wildlife surveys, model results	Wildlife surveys, modeling by plant communities

2.4 Geomorphology and Sediment

This section focuses on the hydro-geomorphic assessment required to quantify the relative ability of initial alternatives to establish geomorphic conditions suitable for salmon migration and rearing in The Project and to evaluate the channel's response to changes in floodplain capacity.

The proposed methodology was developed to predict future channel configuration of each initial alternative's active channel and compare it to the natural potential or state of dynamic equilibrium given the range of flows and sediment supply (Doyle 2007, Soar 2001, and Shields 2003). The predicted configuration provides a basis to evaluate potential changes in the San Joaquin River in response to Restoration Flows. Each initial alternative will be evaluated for its ability to allow or constrain the expected future channel configuration. The predicted configuration will be treated as an average condition within a range of variance. To address uncertainty, this approach combines geomorphic tools with an analytical assessment using the hydraulic and sediment transport models.

The evaluation of initial alternatives will compare the geomorphic conditions that would result from implementation of the Project initial alternatives and evaluate the initial alternatives based on the criteria listed in Table 2-7.

Table 2-7.
Geomorphology Evaluation Criteria and Applicable Tools

Criteria	Tools
Channel vertical stability	Spreadsheet-based sediment continuity calculations, SRH-1D
Potential to accommodate lateral migration	Bank energy index and shear stress calculations, levee set back distance
Potential to reach a stable channel configuration in dynamic equilibrium	Stable channel design methods (SAMwin and HEC-RAS v4.1), SRH-1DV

2.4.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with geomorphology and sediment are as follows:

1. Channel vertical stability: The estimated channel degradation or aggradation in response to Restoration Flows and sediment loads.

2. Potential to accommodate lateral migration: The estimated lateral migration in response to Restoration Flows, and the relative constraints on the lateral location of the San Joaquin River caused by levees, road crossings, and other structures.

3. Potential to reach a future stable channel configuration in dynamic equilibrium: A long-term estimate of the current channel's evolutionary trajectory and whether the channel will maintain its cross-section, meander pattern, and slope over time.

2.4.2 Available Tools

The following list of analytical tools includes tools developed to support the PEIS/R and tools developed by DWR or Reclamation to support the Project engineering studies.

HEC-RAS Model and Hydrology Information

A discussion of the HEC-RAS model and hydrology information for hydraulics modeling purposes is provided in Section 2.1.2. Hydrology will be represented by the flow duration curve and individually selected flow rates, for habitat (migration), effective discharge and design flows. Hydraulic performance of the proposed channel and floodplain configurations will drive the ability of the proposed initial alternatives to meet the project objectives related to geomorphology. Output from the hydraulic modeling, coupled with statistical information pertaining to the variable schedule daily time series will be used as input data for the approach to address evaluation criteria.

SRH-1D Model

A SRH-1D model for The Project has been developed previously by Reclamation to support The Project engineering studies. The SRH-1D is a one-dimensional flow and sediment transport model developed to simulate flows in rivers and channels with or without movable boundaries. The SRH-1D was written by Reclamation's Sedimentation and River Hydraulics Group. Output from the sediment transport modeling, as well as existing reports, will be used as input data for the approach to address evaluation criteria.

Additional details about the application of the SRH-1D model and details of the simulation results are expected to be included in the PEIS/R.

SRH-1DV Model

A discussion of the SRH-1DV model for habitat restoration purposes is provided in Section 2.3.2. Estimates of the future type and extent of vegetation will have an effect on geomorphic processes in the channel and on the floodplains. Output from the SRH-1DV model will be used as input for the approach to address evaluation criteria.

Stable Channel Design Method (SAMwin and HEC-RAS v4.1)

The methods developed for the SAMwin Hydraulic Design Package for Channels by the USACE Waterways Experiment Station have been incorporated into HEC-RAS v4.1 (USACE 2010). Three approaches are available for stable channel design: Copeland, regime, and tractive force methods. The Copeland method is an analytical approach

based on empirical equations that use sediment discharge and flow depth to solve for stable channel slope, width, and depth. Stability is assumed when sediment inflow equals sediment outflow. The regime method is based on empirical equations derived from sand bed trapezoidal canals. Stability is assumed when there is no net annual scour or deposition. The tractive force method is an analytical approach using critical shear stress. Stability is assumed when there is no appreciable bed load movement.

2.4.3 Approach to Criteria Evaluation

Existing tools and other methods described above will be utilized to evaluate initial alternatives by determining applicable parameters, comparing those parameters to geomorphically based configuration, and eventually comparing results between initial alternatives (Project Description TM).

Geomorphic and sediment analyses will incorporate data from other tools including the hydrology and hydraulics data discussed in Section 2.1. The following additional data sources were identified as applicable to the geomorphology analyses:

- Hydrologic and geomorphic changes to the San Joaquin River between Friant Dam and Gravelly Ford, and implications for restoration of Chinook salmon (Oncorhynchus tshawytscha) (Cain 1997) and Analysis of Physical Processes and Riparian Habitat Potential of the San Joaquin River: Friant Dam to the Merced River, California (Jones and Stokes 1998a) for summaries of physical processes and historical and existing morphology of the river.
- 1937/1938 aerial photographs obtained from Exchange Contractors and Reclamation extend from Ledger Island (RM 263) downstream to Sack Dam (RM 182) (Pre-1937 aerials do not exist.)
- 1998 aerial photographs obtained from Reclamation extend from Friant Dam (RM 267.5) to the Merced River confluence (RM 118)
- Interim Flows monitoring and gage data (SJRRP 2010d)

The following additional data sources were identified as applicable to the sediment transport analyses:

- Bed material size and gradation, Mussetter (Mussetter 2000a and Mussetter 2000b) sediment bulk samples
- Moveable boundary limits
- Bank height and material characteristics (soil type and cohesiveness)
- Upstream and downstream sediment supply boundary conditions

The approach to quantify each proposed geomorphology evaluation criteria is summarized below.

Vertical channel stability

Vertical stability will be assessed through the use of a spreadsheet-based sediment continuity analysis of the sediment transport balance. First, bed material transport

capacity rating curves (i.e., relationships between bed-material transport capacity and discharge) will be developed using the Engelund and Hansen equation (Engelund 1972) for each several subreaches within the Project area based on average hydraulic conditions for each discharge from the rigid-boundary, SRH-1D model results, and representative bed-material size-gradations. Then, the bed-material sediment supply to the Project reach is estimated based on the transport capacity of the supply reach and/or hydraulic and sediment characteristics of the bifurcation structure at the head of the reach. Finally, the transport capacity of each subreach is compared to the upstream supply.

Potential to accommodate lateral migration

Lateral migration that could lead to erosion of levees, adjacent agricultural or other resources is of concern in Reach 2B. Meander migration potential and lateral channel stability will be evaluated to understand the relative potential of the initial project alternatives to accommodate lateral migration. These analyses require integration of a range of different qualitative and quantitative techniques. Lateral stability can be strongly affected by the sediment balance in the reach because aggradation can lead to braiding and channel widening, and degradation can lead to over-steepened, unstable banks. However, it is important to understand that lateral migration is a normal process in alluvial streams, even when they are in approximate equilibrium from a sediment balance perspective.

An initial assessment involves understanding bank migration in an historical perspective. The banklines from the 1938 and 2004 photographs will be analyzed and any significant planform changes will be documented. This may provide insight into channel migration trends which may continue under the Restoration Flows. Next, the relative effect of the various initial project alternatives on proposed levees will be evaluated using the calculated bank energy index (Mussetter 1995) in conjunction with information about the bank materials (as available) and other site characteristics.

The potential to accommodate lateral migration will be assessed based on the proximity of the existing bankline to the levees for the initial alternative levee configurations, assessment of lateral erosion potential based on the existing bank soils and vegetation , and the relative change in erosive energy (as quantified by the bank energy index) under each alterative compared to baseline conditions. The potential change in character of the bank vegetation under the project alternatives will also be considered in this assessment. The length of bank requiring mitigation to protect it against potential increases in erosion will be estimated and compared amongst the alternatives. The potential for the river to create a meander cutoff will be also be investigated; particularly in the upstream portion of Reach 2B where there are two large recumbent meander loops in which the minimum distance between the banklines on the insides of the bends is only about of two channel widths.

Potential to reach a stable channel configuration in dynamic equilibrium

The potential to reach a stable channel configuration in dynamic equilibrium will be based on the results of the effective discharge calculations, vertical channel stability analysis, and the lateral migration analysis. Stable channel design functions in SAMwin

and HEC-RAS v4.1 will be utilized to calculate approximate channel dimension and slope.

The effective discharge will be estimated using either the existing conditions bed material transport capacity rating curves, or rating curves developed from the modeled hydraulic conditions for proposed channel conditions, as appropriate, based on the procedures recommended by Biedenharn (2000). As a general rule, the cross sections will adjust so that the bankfull capacity is consistent with the effective discharge.

The results of the flow analysis, hydraulic and sediment transport models will be used to evaluate long-term channel stability. The potential for channel changes (degradation and aggradation) as estimated for the vertical channel stability analysis as well as the potential for meander migration and lateral bank erosion as estimated for the lateral migration analysis will be incorporated.

The resulting slope, width, and depth from this process must be used with caution, however. There is significant uncertainty in these calculations and the channel should not be expected to attain these dimensions without exception. These calculations are most informative if done in a comparative sense. For example, the stable channel design approach could be used to compute the response of the channel to an increase in discharge or a decrease in sediment load. The effect of vegetation on the stable channel can be significant and this effect will be considered in this analysis using the output from the SRH-1DV model.

The difference between the predicted geomorphically stable channel configuration and the current configuration will be used to predict potential changes to the current channel once it is subjected to the Restoration Flows. The proposed initial alternative levee configurations will be overlaid as constraints, and each initial alternative will be evaluated based on whether it facilitates or constrains the expected future stable channel configuration, including planform, bed forms and fish passage.

2.4.4 Data Gaps & Approach to Obtain

This following list describes the hydro-geomorphology data gaps and recommends certain data be collected to support ongoing modeling and concept refinement, and subsequently inform the alternatives evaluation:

1. The current channel's response to the Interim Flows may provide significant information regarding the future active channel dimensions, including width, depth, and bar/floodplain surface elevations. Investigations of the active channel formed by the Interim Flows should be completed during the summer of 2010.

2. Field measurement of the amount of sediment stored in and being transported from portions of the San Joaquin River upstream of the Project could be conducted to build on the sediment transport studies completed by Reclamation to this point. The long-term supplies and incoming sediment load are important boundary conditions for the analytical assessment. These data may determine if the long-term sediment supply to the Project will be adequate to replace the material transported out of the reach. DWR

is currently preparing a sand source assessment for areas upstream of the Project, USGS conducted some suspended sediment sampling during the 2010 Interim Flows (SJRRP 2010e), and some measurements of bedload transport in Reach 2A have been conducted (DeFlitch 2010).

2.4.5 Summary

Table 2-8 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to geomorphology and sediment.

Table 2-8.
Geomorphology Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Vertical channel stability	Feet of degradation or aggradation	Spreadsheet-based sediment continuity calculations, SRH-1D	Sediment rating curve, SRH-1D results, sediment size gradation	None
Potential to accommodate lateral migration	Length of bank requiring erosion protection.	Bank energy index and shear stress calculations, levee set back distance	Levee locations and structure types, bank stability index results, bank materials and future bank vegetation	None
Potential to reach a stable channel configuration in dynamic equilibrium	Percent change in channel width and slope.	Stable channel design methods (SAMwin and HEC-RAS v4.1), SRH-1DV	Effective discharge, vertical channel stability results, lateral migration results	None

2.5 Groundwater

The alternatives evaluation will compare the anticipated changes in depth to groundwater that would result from implementation of the Project initial alternatives and evaluate the initial alternatives based on the criteria listed in Table 2-9.

Table 2-9.
Groundwater Evaluation Criteria and Applicable Tools

Criteria	Tools
Acres of land in which groundwater levels rise above monitoring threshold	Existing USGS CVHM model and cross-sectional seepage modeling (Surfact or SVFlux 2D)

2.5.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with groundwater are as follows:

1. Acres of land in which groundwater levels rise above monitoring threshold: The acreage of land outside the proposed levee alignments that is anticipated to have shallow groundwater elevations above the monitoring threshold and is thus subject to mitigation measures to prevent waterlogging.

2.5.2 Available Tools

The following list of analytical tools includes existing tools, tools developed to support the PEIS/R, and tools developed by DWR, Reclamation, or the Reach 2B consultant team to support The Project engineering studies.

CVHM

The U.S. Geological Survey's (USGS) Central Valley Hydrologic Model (CVHM) is a valley –wide numerical groundwater flow model (USGS 2009). The current CVHM is a transient three-dimensional, finite-difference model developed using the MODFLOW-2000 software that incorporates the Farm Process to simulate irrigated agriculture. The spatial discretization is a uniform 1x1 mile grid oriented parallel to the valley axis (34 degrees west of north). The CVHM is composed of 10 layers that generally thicken with depth, and the top layer (layer 1) is 50 feet thick. The temporal discretization is 12 monthly stress periods for each annual hydrologic cycle (to adequately simulate the growing season), with a further subdivision of each stress period into two time steps for water levels and flow calculations.

The existing one-mile resolution of the CVHM model is not refined enough to evaluate the initial alternatives without modification, and the necessary modifications to the CVHM are not expected to be completed in time for the alternatives evaluation. Therefore, a transitional tool (cross-sectional seepage modeling) will be used to augment the existing CVHM output for the initial alternatives evaluation. The USGS will be updating the existing CVHM to include the results of the HEC-RAS model for The Project in late summer 2010. After the HEC-RAS update to the CVHM the USGS will then refine the CVHM with finer grid spacing (CVHM-SJR) and layer detail for the

purposes of the SJRRP. It is anticipated that the CVHM-SJR and associated results will be available for the Project EIS/R assessment of the alternatives impacts and mitigation measures (see Section 3.12),

Cross-Sectional Seepage Modeling

A series of simplified, numerical seepage models of saturated and unsaturated flow will be generated at various distances along the Project area using a cross-sectional version of Surfact or SVFlux 2D. These models will use output from the HEC-RAS model (discussed below) and will be used to estimate the magnitude and lateral extent of groundwater rise adjacent to the river. This modeling analysis will also incorporate available LIDAR and other land surface elevation data and the results will be integrated with the output of the current CVHM simulation for comparison with the groundwater evaluation criteria. A GIS will be used with the output from the cross-sectional modeling to estimate the area of potential impact for each alternative, by delineating the distances from the levee at the various cross sections that indicate a potential for a water level rise above the local threshold,

HEC-RAS Model

A discussion of the existing HEC-RAS model and hydrology information for hydraulics modeling purposes is provided in Section 2.1.2. Water surface profiles for the proposed channel and floodplain will have an affect on seepage and groundwater elevations. Output from the hydraulic modeling will be used as input data for the CVHM groundwater flow model and the cross-sectional seepage modeling to quantify evaluation criteria.

2.5.3 Approach to Criteria Evaluation

Existing tools will be utilized to evaluate initial alternatives by determining applicable parameters associated with initial alternatives, comparing those parameters to groundwater seepage thresholds, and eventually comparing results between initial alternatives (Project Description TM).

The following data sources were identified as particularly relevant to groundwater in the Project area, and were reviewed before and/or referenced during its preparation:

- DWR Water Data Library for high-watertable occurrences within 2 miles of the Project area (DWR 2010)
- *San Joaquin River Restoration Study Background Report*, Chapter 4: Shallow Groundwater Hydrology (McBain and Trush 2002)
- Draft Groundwater Analytical Tools Selection Recommendation Process Technical Memorandum (SJRRP 2008b)
- Draft Groundwater Existing Conditions Technical Memorandum (SJRRP 2008c)
- Draft Methods for Determining Bank Seepage Technical Memorandum (SJRRP 2008d)
- Draft Seepage Management Plan (SJRRP 2009)
- SJRRP Reach 2B Preliminary Monitoring Well Data Maps (SJRRP 2010d)

- Groundwater Availability of the Central Valley Aquifer, California (USGS 2009)
- *California's Groundwater*, Bulletin 118, Update 2003 (DWR 2003)
- Groundwater Model of the San Joaquin River Riparian Zone, Friant Dam to the Merced River (S. S. Papadopulos & Associates (SSPA) 2000)

The approach to quantify the proposed groundwater evaluation criteria is summarized below.

Acres of land in which groundwater levels rise above monitoring threshold

Cross-sectional seepage modeling will be used to estimate the potential for water levels to exceed the monitoring threshold at distances within one mile of the river. Output from the cross-sectional seepage modeling will be exported to GIS and used to delineate the approximate areas where monitoring thresholds are exceeded.

Evaluation results will be presented as necessary in GIS map format that shows depth to water and highlights areas that have the potential to have shallow groundwater rise above the monitoring threshold (currently anticipated to be approximately six to eight feet below ground surface). Acreages of shallow groundwater will also be tabulated. The results format will meet the Project's analytical needs by allowing the number of acres that may be impacted by waterlogging to be compared for each initial alternative. The results of the alternatives evaluation will provide a relative comparison between alternatives; they are not intended for comparison to baseline conditions. Assessment of environmental effects will address comparisons to baseline conditions (see Section 3.12).

2.5.4 Data Gaps & Approach to Obtain

There are no data gaps that need to be filled for the alternatives evaluation. HEC-RAS results from the refinement of initial options to initial alternatives will feed into the groundwater evaluation as mentioned above.

2.5.5 Summary

Table 2-10 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to groundwater.

Table 2-10.
Groundwater Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Acres of land in which groundwater levels rise above monitoring threshold	Acres	Existing CVHM model and cross-sectional seepage model	CVHM output, HEC-RAS output, LIDAR topography	None

2.6 Land Use and Land Purchases

This section describes the analysis of land use and land purchases in analyzing initial alternatives for the Project. The land affected by the initial alternatives is in Fresno and

Madera Counties. There are no incorporated cities within the Project. Several existing levees protect agricultural land uses, which include annual crops, vineyards, and orchards (SJRRP 2010c). Nearly all land in the Project is privately owned with some small areas owned by governmental agencies, and the primary nonagricultural land use in the Reach is open space (SJRRP 2010c).

Land use impacts and land purchased will be considered as part of the alternatives evaluation. The key variables directly and indirectly related to land use include value of crop production and value of land that will be purchased under the various initial alternatives. The value of lost crop production and the prices of purchased land will have socioeconomic impacts throughout the area.

The alternatives evaluation will compare the land purchase costs that would result from implementation of the Project initial alternatives and evaluate the initial alternatives based on the criteria listed in Table 2-11.

Table 2-11.
Land Use and Land Purchase Evaluation Criteria and Applicable Tools

Criteria	Tools
Land costs	Available secondary information on agricultural land values in the area
Crop acreage	Data directly from landowners, water district managers, or secondary data from DWR

2.6.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with land use and purchase are as follows:

1. Land costs: The estimated cost of land expected to be purchased for the Project based on land value, crop value, and crop yield.

2. Crop acreage: The number of acres of land which will be permanently removed from production and which are currently cultivated in specific annual or permanent crops.

2.6.2 Available Tools

It was determined that no existing land use or land purchase analytical tools developed in support of the PEIS/R were appropriate for use to assess benefits and impacts associated with the initial alternatives.

Typical input data needed to address land use in the context of alternatives evaluation include:

- Existing land uses: Publicly-available information from the water agencies; data collected from landowners; California DWR Land Use Survey program (DWR 2000 and DWR 2001); California Department of Conservation Farmland Mapping and Monitoring Program (California Department of Conservation 2008)

- Planned future land uses: Madera County General Plan, last completed in 1995 (Madera County Planning Department 1995); Fresno County General Plan, last completed in 2000 (Fresno County Department of Public Works and Planning 2000)
- Land value information for broad areas: Annual publications of the American Society of Farm Managers and Rural Appraisers (ASFMRA 2009). In the Project area, the relevant categories include almonds, pistachios, tree fruit, citrus, cropland, and grapes in areas using well water, Reclamation water, and San Joaquin River Exchange Contractors Water Authority water. In each case, land values are expressed in ranges.
- Crop value data: Annual reports of the Fresno County Agricultural Commissioner (Fresno County Agricultural Commissioner 2010) and Madera County Department of Agriculture (Madera County Department of Agriculture 2010). The data include, by crop, acreage, yield, total production, value per unit of production, and total value of production.
- Data on the production practices on specific crops: UCCE (UCCE 2010). UCCE publishes production enterprise budgets for many different annual and permanent crops grown in the San Joaquin Valley and other regions of California. The budgets provide detailed information on the labor as well as purchased inputs such as seed, fertilizer, and chemicals required to produce each crop. The data can be utilized to assess the direct economic impacts of removing from production land on which various crops are grown. The UCCE production enterprise budgets include representative costs for land on which various crops are grown, but those budgets are for broad areas (e.g., the San Joaquin Valley) and are in some cases a few years old.

2.6.3 Approach to Criteria Evaluation

The approach to quantify the proposed land cost and land use evaluation criteria is summarized below.

Land Costs

For each alternative, data from the ASFMRA will be used with information on the number of acres of each crop that will be permanently removed from production (see below), and the value of output from that land. The related socioeconomic impacts on jobs and incomes (see Section 2.7) will include only qualitative measures associated with lost crop value and related information. This format will meet the analytical needs of the Project by showing the estimated production and land value expected to be permanently impacted by the initial alternatives.

Land costs for the Project analysis will be estimated using available secondary data from ASFMRA, and, if available, other publicly available sources.

Crop Acreage

For each alternative, data directly from affected landowners or water districts in the affected Project area will be collected on the number of acres of each crop that will be permanently removed from production. The related socioeconomic impacts on jobs and

incomes (see Section 2.7) will include only qualitative measures associated the value of land permanently removed from crop production. This format will meet the analytical needs of the Project by showing the permanent changes in land use expected to be impacted by the initial alternatives.

2.6.4 Data Gaps and Approach to Obtain

The primary data gaps for land use are land values and current cropping practices on those parcels expected to be affected by the initial alternatives.

1. Land values vary considerably even within specific areas because of differences in water supplies, micro-soil and micro-climate conditions, and other factors. As noted above, land values for broad areas are available from the ASFMRA. More narrowly-defined land value information can be purchased from commercial vendors which provide information on recent sales of specific parcels. In addition, independent appraisers may be retained to value specific parcels of land.

2. Current cropping practices are not available directly from secondary, public sources. California DWR land use information is collected infrequently for California counties and may not be reflective of current land use in the area. More reliable information would likely come from the affected landowners themselves or the agencies which provide irrigation water to the lands. Most water agencies compile crop acreage data annually and have information on the crops grown on specific parcels within their respective service areas. Using GIS coverages for the initial alternatives, it will be necessary to verify with each agency the crops grown on each affected parcel. Once specific land uses are identified, other relevant data can be obtained from available sources, e.g., property tax information available from the Assessor's Offices of Madera and Fresno Counties.

2.6.5 Summary

Table 2-12 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to land use and land purchases.

Table 2-12.
Land Use and Land Purchases Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Land costs	Dollars	Secondary land value information, UCCE budgets, as available	Existing and proposed land uses, land value, crop value, production yields	Value of specific land parcels affected by alternatives, cropping practices
Crop acreage	Acres, by crop or crop type	Spreadsheet tabulations	Direct data from landowners or water districts; secondary data from DWR	Acreages of land on which more than one annual crop is grown each year

2.7 Socioeconomics and Economics

This section describes the analysis of socioeconomic and economic variables which may be of use in selecting among initial alternatives for the Project. The framework defined herein provides for the qualitative assessments of land use impacts for each alterative. No estimate of direct or indirect jobs or incomes associated with the land use impacts will be developed for the alternatives evaluation.

The alternatives evaluation will compare qualitatively the economic benefits and impacts that would result from implementation of the Project initial alternatives and evaluate the initial alternatives based on the criteria listed in Table 2-13. The socioeconomic impacts for each alternative will be discussed in terms of their relative influence from the agricultural economic impacts on the values of crop production lost. The comparison will include a qualitative weighting of the socioeconomic impacts associated with the permanent removal from production of land on which permanent crops are grown relative to impacts associated with the permanent removal from production of land on which annual crops are grown.

Table 2-13.
Socioeconomics and Economics Evaluation Criteria and Applicable Tools

Criteria	Tools
Agricultural economic impacts	Secondary data, spreadsheet model

2.7.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with socioeconomics and economics are as follows:

1. Agricultural economic impacts: The effect of the Project on crop value and value of land removed from production.

2.7.2 Available Tools

It was determined that no existing socioeconomic or economics analytical tools developed in support of the PEIS/R were appropriate for use to assess benefits and impacts associated with the initial alternatives. A spreadsheet model will be developed and will include the value of crop production lost and the value of land permanently idled for each alternative.

Model considerations for socioeconomics and economics are as follows:

1. Crop production and crop revenues will be lost permanently from the purchased lands producing a negative impact. In addition to those impacts, the permanent idling of agricultural land will have negative impacts on the local demands for farm labor and purchased inputs such as seed and fertilizer. Land idling will also have a negative impact on property tax receipts in Madera and Fresno Counties. These impacts, other than crop production and crop revenue, will be addressed qualitatively for each alternative evaluation.

2. Purchases of affected parcels can have direct benefits as landowners selling their property have available funds for a variety of agricultural and non-agricultural purchases. These impacts will be addressed qualitatively for each alternative evaluation.

3. Construction and OM&R activities are related to the purchase of required goods and services within the Project area, and can have a positive economic impact attributable to purchases of materials and services and to labor usage. These direct impacts can sometimes offset, partially or totally, the negative impacts of permanently idling cropland. These impacts will be addressed qualitatively for each alternative evaluation.

Some of the data sources required for the socioeconomic evaluation of the alternatives are discussed in the Land Use section above. Those sources include crop acreage, crop value, land value, and crop enterprise budgets. Other data that will be required for the socioeconomic analysis include:

- Demographic information (population, race, income level, poverty rate, housing, and related data)
- Initial construction and ongoing annual operating, maintenance, and replacement (OM&R) costs for the initial alternatives
- Anticipated changes in groundwater depth and pumping costs
- Anticipated changes in recreation utilization in the area

The data listed above can also be utilized for the environmental justice assessment to be prepared for the Project EIS/R.

2.7.3 Approach to Criteria Evaluation

The socioeconomic and economics alternatives evaluation will rest on the use of the spreadsheet models and the qualitative assessments discussed above. The results of the alternatives evaluation for socioeconomics will be presented in tabular and graphic form, showing for each initial alternative the qualitative socioeconomic impacts. This format will meet the analytical needs of the Project by showing the socioeconomic impacts likely under each initial alternative.

2.7.4 Data Gaps and Approach to Obtain

No data gaps other than those described under the Land Use section of this TM are anticipated.

2.7.5 Summary

Table 2-14 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to socioeconomics and economics.

Table 2-14.
Socioeconomics and Economics Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Agricultural economic impacts	Dollars	Spreadsheet model	Data on crops grown on each parcel; average crop yields per acre and prices per unit quantity	None

2.8 Construction and Operation and Maintenance Cost Estimating

The alternatives evaluation will compare the design, construction, and operation and maintenance costs that would result from implementation of the Project initial alternatives and evaluate the initial alternatives based on the criteria listed in Table 2-15.

Table 2-15.
Construction and Operation and Maintenance Cost Estimating
Evaluation Criteria and Applicable Tools

Criteria	Tools
Capital improvement costs (design and construction)	n/a
Operation and maintenance costs	n/a

2.8.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with construction and operation and maintenance costs are as follows:

1. Capital improvement costs: The costs associated with designing and building the initial alternative in total dollars.

2. Operation and maintenance costs: The annual dollars required to operate and maintain the initial alternative.

2.8.2 Available Tools

Construction and operation and management cost tools will be developed during the alternatives evaluation process. Specific costing methods are discussed in the next section.

2.8.3 Approach to Criteria Evaluation

The methods to quantify costs for design, construction and operation and maintenance are described below.

Design Costs

The costs to prepare the final design package will be developed by breaking down the completed feasibility-level design work into related areas and estimating the effort required to perform the final design for each. Examples include the time and budget to design and to prepare drawings and specifications for:

- Site work
- Dams and embankments
- Planting and irrigation
- Concrete structures
- Metalwork
- Valves and equipment
- Electrical, including power and communications
- Contract procurement costs (e.g., advertising, job walk, etc.)

Construction Costs

Construction costs will be the combined cost of contractor payments and construction inspection/administration. Contractor payments will be estimated by itemizing the contract bid items and applying current labor and materials rates to develop the costs for each bid item. Contractor payments will be estimated by DWR Division of Engineering Cost Estimating Unit utilizing the same resources used to develop cost estimates for DWR Division of Engineering construction contracts. The cost of construction inspection and administration will be estimated using cost data from similar recent DWR Division of Engineering construction contracts.

Operations and Maintenance Costs

Annual operations and maintenance costs will be developed by estimating the items below. If the values are not available from Reclamation or the DWR Integrated Regional Water Management Division, DWR Division of Engineering may be able to estimate it

using similar DWR equipment/structures as a basis and obtaining representative costs from DWR Division of Operations and Maintenance.

- Annual power costs
- Annual equipment maintenance cost, including periodic replacement.
- Annual structure maintenance costs
- Annual vegetation management maintenance costs

2.8.4 Data Gaps and Approach to Obtain

Additional information and resources will be utilized to develop the cost estimates include:

1. Descriptions of any changes to the prior design that will be developed during refinement of the initial options into initial alternatives

2. Assumptions made in the prior phase should be confirmed (e.g., operational criteria) and updated as necessary during refinement of the initial options into initial alternatives

3. Data assumed in prior phases should be provided or obtained (e.g., subsurface conditions, ground contours, water elevations) to the extent possible during refinement of the initial options into initial alternatives

4. There may be significant variability in the availability and cost of the large volume of plants, pole cuttings, and native seed that would be needed to restore the extensive floodplain areas. Additionally, the availability and cost of quality imported topsoil that may be needed in some areas is another potential data gap. It is assumed that the Project Engineer will assist in locating potential borrow sites for topsoil and potential nursery areas.

5. Other data identified as the initial alternatives are developed

2.8.5 Summary

Table 2-16 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to construction and operation and maintenance cost estimating.

Table 2-16.
Construction and Operation and Maintenance Cost Estimating Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Capital improvement costs (design and construction)	Dollars	n/a	Early phase cost estimates, cost estimates for similar projects	Design assumptions; Availability and costs of large quantities of plants and topsoil
Operation and maintenance	Dollars	n/a	Cost estimates for similar projects	Design assumptions

2.9 Habitat Mitigation Cost Estimating

The alternatives evaluation will compare the habitat mitigation costs that would likely be required as a result of implementation of Project initial alternatives and evaluate the initial alternatives based on the criteria listed in Table 2-17. Mitigation sites could potentially be identified onsite, but may require identification of offsite property to meet mitigation requirements.

Table 2-17.
Habitat Mitigation Cost Estimating
Evaluation Criteria and Applicable Tools

Criteria	Tools
Habitat Mitigation costs	n/a

2.9.1 Evaluation Criteria Descriptions

Proposed evaluation criteria associated with required habitat mitigation costs are as follows:

1. Mitigation costs: The design, construction, maintenance, and monitoring costs associated with on or offsite mitigation areas that may be required for the Project.

2.9.2 Available Tools

The cost estimate associated with each initial alternative will be developed in an excel spread sheet using costs data available from similar recent projects. The same line items and unit cost will be used for each initial alternative, as applicable.

2.9.3 Approach to Criteria Evaluation

Cost estimates for on or offsite (including mitigation banks if available) habitat mitigation implementation will be based on local property costs (as necessary), and data available from similar habitat mitigation projects implemented in the San Joaquin Valley. Once initial alternatives are of sufficient detail, habitat mitigation cost estimates will be

developed based on the assessment of impacts, and the anticipated type and area of habitat required for mitigation.

2.9.4 Data Gaps and Approach to Obtain

For initial alternatives where mitigation needs cannot be met in the Project area, additional land may be required for off-site mitigation, and the circumstances and availability of this additional land have not heretofore been analyzed. If necessary, it is assumed that the DWR will assist in locating potential mitigation sites.

2.9.5 Summary

Table 2-18 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives with regard to habitat mitigation cost estimating.

Table 2-18.
Habitat Mitigation Cost Estimating Evaluation Criteria, Tools, and Data Summary

Criteria	Metric	Tools	Required Data	Data Gaps
Mitigation costs	Dollars	n/a	Cost estimates for similar recent projects	Offsite land costs

2.10 Summary

Table 2-19 summarizes the proposed evaluation criteria and associated approach to analytical tools required to assess project initial alternatives for each resource area.

Table 2-19.
Summary of Evaluation Criteria, Tools, and Data for the Alternatives Evaluation

Criteria	Metric	Tools	Required Data	Data Gaps
Flow Conveyance, Hydrologic and Hydraulic Modeling and Operations				
Convey the range of flows up to 4,500 cfs	cfs conveyed	HEC-RAS	Updated flow loss curves (as necessary), target habitat acreages and features	Flow depth and vegetation criteria for fisheries habitat
Convey the range of flows up to 7,000 cfs	cfs conveyed	HEC-RAS	n/a	none
Fish Habitat and Passage				
Floodplain inundation depth, velocity, and area	Floodplain acreage by depth range	HEC-RAS, hydrology information	Modeling results for flow magnitudes of interest	none
	Floodplain acreage by velocity	HEC-RAS, hydrology information	Modeling results for flow magnitudes of interest	none
	Floodplain connectivity	HEC-RAS, hydrology	Modeling results at representative cross-	none

Table 2-19.
Summary of Evaluation Criteria, Tools, and Data for the Alternatives Evaluation

Criteria	Metric	Tools	Required Data	Data Gaps
	duration (days)	information	sections for flow magnitudes of interest	
Floodplain habitat based on floodplain features	Acreage of different vegetation communities and geomorphic features	SRH-1DV, geomorphic principles	Acreage of secondary channels, ponds, swales, sand splays	Unknown features on future floodplains
Passage conditions at structures	Jump height, velocity and depth of flow, number of artificial structures in migratory path	HEC-RAS, passage design criteria	Modeling results for proposed structures and structures selected for inclusion in alternatives	Design for some structures
Water temperature during migration	Days meeting criteria during migration periods	HEC-5Q	Starting water temperature from Reach 2A, climatic data, shaded area	none
Habitat Restoration				
Total vegetation cover by vegetation alliance	Area (acre)	SRH-1DV, botanical surveys	Field update of past data, model results by plant community	Current conditions, modeling by plant communities
Shaded riverine aquatic habitat area	Area (sq. yd.)	SRH-1DV, GIS measurements	Measurements of current shaded habitat, model quantities and species	GIS calculations based on aerial photos, model results
Floodplain vegetation species diversity	Number of species	SRH-1DV, botanical surveys	Plant surveys, model results	Plant surveys, modeling by plant communities
Invasive species establishment potential	Area (sq. yd.)	SRH-1DV, botanical surveys	Invasive plant survey, model results	Plant surveys, modeling by plant communities
Wetlands and other waters of the U.S area	Area (sq. yd.)	SRH-1DV, wetland delineation, HEC-RAS	Wetland delineation, model results	Refined /expanded jurisdictional delineation, HEC-RAS surface water elevation results
Listed plant species	Area	SRH-1DV,	Plant surveys, model	Plant surveys, modeling by

Table 2-19.
Summary of Evaluation Criteria, Tools, and Data for the Alternatives Evaluation

Criteria	Metric	Tools	Required Data	Data Gaps
extent	(sq. yd.)	botanical surveys	results	plant communities.
Special status wildlife species extent	Area (sq. yd.)	SRH-1DV, wildlife habitat surveys	Wildlife surveys, model results	Wildlife surveys, modeling by plant communities
Geomorphology and Sediment				
Vertical channel stability	Feet of degradation or aggradation	Spreadsheet-based sediment continuity calculations, SRH-1D	Sediment rating curve, SRH-1D results, sediment size gradation	None
Potential to accommodate lateral migration	Length of bank requiring erosion protection.	Bank energy index and shear stress calculations, levee set back distance	Levee locations and structure types, bank stability index results, bank materials and future bank vegetation	None
Potential to reach a stable channel configuration in dynamic equilibrium	Percent change in channel width and slope.	Stable channel design methods (SAMwin and HEC-RAS v4.1), SRH-1DV	Effective discharge, vertical channel stability results, lateral migration results	None
Groundwater				
Acres of land in which groundwater levels rise above monitoring threshold	Acres	Existing CVHM model and cross-sectional seepage model (Surfact or SVFlux 2D)	HEC-RAS model output GIS, LIDAR, topography	None
Land Use and Land Purchases				
Land costs	Dollars	Secondary land value information, UCCE budgets, as available	Existing and proposed land uses, land value, crop value, production yields	Value of specific land parcels affected by alternatives, cropping practices
Crop acreage	Acres, by crop or crop type	Spreadsheet tabulations	Direct data from landowners or water districts; secondary data from DWR	Acreages of land on which more than one annual crops is grown each year
Socioeconomics and Economics				
Agricultural economic impacts	Dollars	Spreadsheet model	Data on crops grown on each parcel;	None

Table 2-19.
Summary of Evaluation Criteria, Tools, and Data for the Alternatives Evaluation

Criteria	Metric	Tools	Required Data	Data Gaps
			average crop yields per acre and prices per unit quantity	
Construction and Operation and Maintenance Costs				
Capital improvement costs (design and construction)	Dollars	n/a	Early phase cost estimates, cost estimates for similar projects	Design assumptions; Availability and costs of large quantities of plants and topsoil
Operation and maintenance	Dollars	n/a	Cost estimates for similar projects	Design assumptions
Habitat Mitigation Cost Estimating				
Habitat mitigation costs	Dollars	n/a	Cost estimates for similar recent projects	Offsite land costs

3.0 Analytical Tools and Approach for NEPA/CEQA Assessment of Resource Areas

This section describes the analytical tools and approach to assess the benefits and impacts of each final alternative on the resource areas to be addressed in the Project EIS/R. This approach, where applicable, builds upon the analyses conducted for the alternatives evaluation (see Section 2.0). The Project EIS/R should address all of the resource and issue areas that are expected to be addressed in the PEIS/R, which are:

- Air quality
- Biological resources
- Climate change
- Cultural resources
- Environmental justice
- Geology and soils
- Hydrology-flood management
- Hydrology-groundwater
- Hydrology-surface water supplies and facilities
- Hydrology-surface water quality
- Indian trust assets
- Land use planning and agricultural resources
- Noise
- Paleontological resources
- Power and energy
- Public health and hazardous materials
- Recreation
- Socioeconomics
- Transportation and infrastructure
- Utilities and service systems
- Visual resources
- Cumulative impacts for all of the preceding resources

However, the Project EIS/R will likely incorporate some of this material by reference and avoid unnecessary or duplicative analyses. The Project EIS/R proposes to address these resources and issues in a different format/organization in some cases, and in other instances it will add a resource (such as minerals to geology and soils). All incorporation by reference of material from the PEIS/R will include a brief summary of the incorporated material. Furthermore, the Project EIS/R will address both potentially significant beneficial and adverse effects. Effects that are less than significant or even "no effect" also need to be substantiated.

The level of analysis should be commensurate with the potential for there to be a substantial effect without being "pre-decisional" at this stage of the environmental impact analysis where the public has not reviewed or commented on the PEIS/R but has provided input during public scoping for the Project EIS/R (SJRRP 2010c).

The process diagram shown in Figure 3-1 describes how analytical tools described in Section 3.0 and future significance criteria (developed for the Project EIS/R) will be used to assess impacts to each resource area from the final Project alternatives.

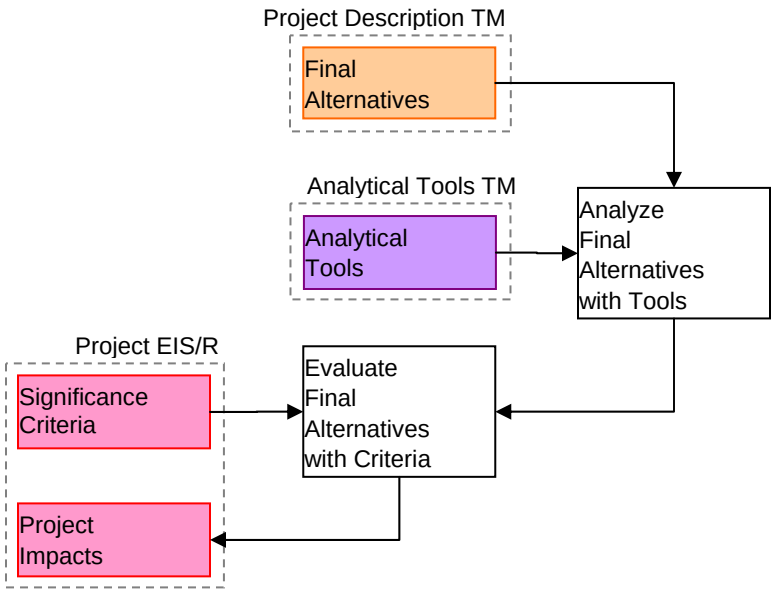

Figure 3-1.
Resource Assessment Process Diagram

The sections below identify and describe the:

- Existing data sources
- Data gaps and methods for obtaining data
- Analytical tools or models
- Approach to assess the Project impacts

Assessment of the following resource areas is anticipated for the Project EIS/R and addressed in this TM:

- Aesthetic and visual resources
- Air quality
- Agricultural resources
- Biological resources – fisheries
- Biological resources –vegetation
- Biological resources - wildlife
- Climate change and greenhouse gas emissions
- Cultural resources
- Environmental justice
- Geology and soils
- Hazards, hazardous materials, and public health
- Hydrology – groundwater and groundwater quality
- Hydrology –wetlands and other aquatic resources
- Hydrology – surface water resources and water quality
- Indian trust assets
- Land use
- Noise and vibration
- Paleontological resources
- Population and housing
- Public services and utilities
- Recreation
- Socioeconomics and economics
- Transportation and traffic

3.1 Aesthetic and Visual Resources

The aesthetic and visual resources assessment will compare the changes to the viewshed and to any critical public views that would result from implementation of the Project alternatives.

Due to the nature of the Project (e.g., river restoration, few public viewpoints), there may be no significant, long-term visual adverse impacts. Additionally, while the Project may have aesthetic and visual benefits, these benefits may not be significant because future public access to the Project area is expected to remain limited. The approach below describes how significant effects to aesthetic and visual resources would be assessed; however, if significance criteria are not met, then the approach would be more qualitative and rely on the assessment of visual resources expected to be included in the PEIS/R. The detailed assessment methods described below would not be utilized if it is determined that there are no potentially affected viewsheds or public views of the Project in either the short or long-terms.

3.1.1 Data Sources and Availability

The following data sources were identified as applicable to aesthetic and visual resources and are available:

- Project description of physical features of the project, their scale, design, color and texture
- GIS as appropriate to map viewshed and to locate land uses and scenic resources in Project area
- Aerial and satellite photography
- County general plans, elements, specific plans, redevelopment plans, public lands plans, etc., for references to, or protection of, public views
- Local policy documents and Caltrans list of Eligible and Officially Designated Routes

3.1.2 Data Gaps

The following additional data will be required to perform the assessment of aesthetic and visual resources:

- Site plans and design details of bifurcation structures, fish screens, road crossings, fish barriers, bypass drop structures and levees. Design details shown as dimensioned elevations, profiles, and plan views. It is assumed that the plans and details will be provided by the Project Engineer.
- Field site assessment to identify limiting factors, such as distance, climate, air quality, topography, vegetation, and existing development. It is assumed that the field assessment will be conducted by the Consultant Team.
- Color photographs and mapping showing specific viewpoints and angles of view. It is assumed that the photographs will be conducted by the Consultant Team during site assessment.
- Computer-generated simulations, as necessary, of project features as they would be seen in the specific critical public views evaluated. It is assumed that the simulations will be prepared by the Consultant Team during preparation of the Project EIS/R.

Certain data could be critical to the completion of the visual resources impact assessment. These include site plans and design details for the optional designs for bifurcation structures, fish screens, road crossings, fish barriers, bypass drop structures, and levees. The extent of design and site data needs will be determined after critical public views have been identified. Once the need for detailed designs and site plans has been identified, a request for this data will be made to the Project Engineers.

3.1.3 Tools and Tool Modifications

The methodology proposed for the SJRRP is the Visual Modification Class Approach (VMC) to preparing visual resource impact assessments (Headley 2010). The VMC approach conforms to the documentation requirements of NEPA and CEQA and has been applied by its author over the last 22 years to numerous EISs, EIRs, and joint EIS/R documents. The approach was developed specifically to address gaps in definitions, criteria, and procedures, as pertinent to the preparation of EISs and EIRs, which occur in the best-known federal visual analysis systems. These include those published by the

U.S. Forest Service (USFS 1974, USFS 1995), U.S. Department of Interior, Bureau of Land Management (BLM 1978), and U.S. Department of Transportation, Federal Highway Administration (FHWA 1981). Nonetheless, the VMC approach closely follows the concepts and principles of those federal methodologies.

The primary features of the VMC methodology distinguishing it from the federal systems of analysis, as well as from other methodologies, are that it provides:

- An approach to visual impact assessment which is compliant both with NEPA and CEQA
- A cross-jurisdictional methodology which may be applied to any proposed project/action regardless of the applicable jurisdiction, land use, or landscape character type (natural, rural, urban, commercial or industrial)
- A way to identify potential public concerns over possible adverse impacts to aesthetics and visual resources that are apart from concerns agencies have regarding attainment of their visual resource management objectives
- Definitions and criteria for what constitutes an adverse visual impact
- Criteria for identifying the intensity of impacts on visual resources and thresholds of significance

Steps in the VMC approach to visual impact assessment are summarized as follows:

- Identify those views potentially affected by a proposed project/action over which the public is most likely to express concern (critical public views) including legally protected views, designated areas of interest, sites of cultural/religious importance, scenic highways, and residential areas
- Identify any federal, state, county and local laws, ordinances, regulations, standards, as well as planning policies and objectives, that expressly protect or recognize the value of specific public views or view corridors
- Describe the existing visual conditions (character and quality, in terms of VMC ratings) of those potentially affected critically sensitive views
- Estimate the intensity of possible adverse visual impacts on those views (the degree to which the VMC rating would change)
- Evaluate the significance of the possible impacts (the relationship of impact intensity to public sensitivity)
- As applicable, consider possible mitigation measures that could lessen the impacts to a level of intensity that is less than significant.

Critical Public Views

Critical views are those sensitive public views that would be most affected by the subject action. Identifying critical public views starts with an inventory of sensitive viewing positions in the project/action vicinity. The proposed methodology will rely on indicators of public sensitivity commonly used by the federal agencies noted based on the concept

that sensitivity is a function of viewer expectations, activity, awareness, values, and goals.

A review of literature and maps, an inspection of the project/action site and the potentially affected environs, and a review of public scoping comments regarding proposed project/actions typically serve to identify indicators of public sensitivity. The range of sensitive views is then considered and several representative views in which the proposed features would be most noticeable are selected for detailed analysis. This decision is based primarily on proximity and degree and duration of project/action exposure. Consideration is also given to having the views be representative of the public experience; i.e., that they be from viewing positions frequently used by the public and readily located, based on the description and photographs presented in the visual impact assessment.

Existing Visual Condition

The existing visual condition of the landscape is the baseline against which the visual impacts of a proposed project/action or its alternatives are measured. It is assessed only at the identified critical public views. This baseline is the prevailing character of the affected setting and the degree to which past actions have adversely affected that character and its quality. Both the existing daytime visual conditions of the project/action vicinity and the existing night lighting conditions are considered.

Visual Impact Assessment

The visual resources assessment will focus on identifying visual impacts, their intensity, and whether they would be significant. The intensity of a visual impact will be measured as the degree to which the existing visual conditions change as a result of features of project/action construction and operation. A visual impact would be significant if it would cause a substantial adverse change in the visual resources of the affected environment.

Significance

The intensity of the impact is compared to the sensitivity of the affected view to determine whether a substantial or significant reduction in visual quality is likely to occur. A reduction in visual quality is one of four criteria for significance: the other three are interference with visual access, the duration of the impact, and consistency with laws, ordinances, regulations, and standards applicable to the protection of visual resources.

3.1.4 Results Format

The results of the visual impact analysis will be expressed in a narrative format, supported by photographs representing the affected viewsheds and their context, and by computer-generated visual simulations that accurately portray the Project's visual impacts relative to critical public views.

3.2 Air Quality

The air quality resources assessment will compare the impacts to air quality that would result from implementation of the Project alternatives.

3.2.1 Data Sources and Availability

The following data sources were identified as applicable to air quality resources and are available:

- Ambient air quality data from the California Air Resources Board (CARB) website (http://www.arb.ca.gov)
- CARB and San Joaquin Valley Air Pollution Control District (SJVAPCD) emission factors

3.2.2 Data Gaps

The following additional data will be required to perform the assessment of air quality resources:

- Type and number of heavy equipment and trucks utilized for construction and their timing and schedule. It is assumed that these data will be provided by the Project Engineer.

3.2.3 Tools and Tool Modifications

Analysis Approach and Models Used

Impacts to air quality from the Project would occur primarily during the construction period. There would be no operational air quality impacts as the Project would not expand or enhance recreational use of the area; however, there may be some air quality impacts associated with vegetation and levee maintenance post-construction. Air pollutants would be emitted from dust-generating activities such as earthmoving, travel on unpaved surfaces, and soil stockpiling. In addition, air pollutants would be emitted from combustion of fuel in heavy equipment and haul trucks. Emissions from these activities will be calculated using CARB and SJVAPCD emission factors and the construction activity and equipment schedule. The CARB emission models URBEMIS, OFFROAD, and EMFAC2007 will be used to estimate construction emissions. Results will be evaluated for compliance with the National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards (CAAQS), the SJVAPCD CEQA significance thresholds, and the USEPA General Conformity Rule. If emissions exceed applicable thresholds, mitigation measures to reduce emissions will be proposed.

In addition, potential health risks from toxic air contaminants to nearby sensitive receptors (e.g., residential areas, schools) will be evaluated. Diesel-fueled heavy trucks are a source of diesel particulate matter, which was found by the CARB to be carcinogenic. This health risk is based on a long-term, 70-year exposure. However, if diesel haul trucks would travel near sensitive receptors over the course of the construction period, this potential impact will be addressed. Diesel particulate matter emissions would be calculated using the CARB EMFAC2007 model, and the health risks

would be analyzed using the Hot Spot Analysis Reporting Program (HARP), also a CARB tool.

Greenhouse gas (GHG) emissions using CARB emission factors will also be quantified and discussed, including the recent legislation and regulatory background regarding GHG. Finally, any potential exposure of sensitive receptors to nuisance odors during construction will be qualitatively evaluated.

Additional Models

If the emissions analysis indicates that the project could exceed the above applicable standards and thresholds, dispersion modeling would be used as a refinement to the impacts analysis to evaluate compliance with the NAAQS and CAAQS. The EPA approved AERMOD model would be used for a refined analysis of project impacts. In addition, if an initial screening of truck routes and sensitive receptors reveals a concern for exposure to diesel particulate matter, the AERMOD model, together with Office of Environmental Health Hazard Assessment (OEHHA) cancer risk factors, could be used to calculate diesel particulate matter concentrations and associated health risk at nearby sensitive receptors.

3.2.4 Results Format

Results will be presented in a technical report that will summarize the existing conditions of the Project area, the analysis methodologies, and the results compared to appropriate significance thresholds.

3.3 Agricultural Resources

This section discusses the analytical tools and approach for the agricultural resource area. The alternatives for the Project will result in permanently removing from production varying acreages of agricultural land in the Project area. Estimation of the agricultural impacts of the alternatives will require data on the acreages of crops grown on the land to be removed from production.

3.3.1 Data Sources and Availability

The following data sources were identified as applicable to agricultural resources and are available:

- Data on crops grown on each parcel
- Average crop yields per acre

The key measure to estimate the impacts on agricultural resources by the Project is the acreage of crops grown on the lands which will be permanently removed from production. Limited cropping information on specific parcels of land is available from secondary sources. Land use maps from DWR are from 2000 and 2001 for Fresno and Madera counties, respectively, and much of the data is out-dated. Therefore, it is suggested that current crop data for the affected parcels be obtained from the managers of the water agencies which provide water to the lands.

Estimation of the agricultural impacts of the alternative will require data on crop acreages, discussed above, and information on crop yields. Because yields may differ considerably among growers, it is suggested that the average figures for Fresno and Madera Counties be used. The data would be taken from the annual crop reports published by the Fresno County Agricultural Commissioner (Fresno County Agricultural Commissioner 2010) and Madera County Department of Agriculture (Madera County Department of Agriculture 2010). The suggested approach is to use a five-year average for each measure to remove annual fluctuations.

The direct agricultural impacts of the alternatives can then be estimated by developing the total acreage of crops permanently lost.

The assessment of agricultural resources will also consider impacts related to conversion of important farmland to non-agricultural uses, as well as conflicts with Williamson Act contracts. The California Department of Conservation, as part of its Farmland Mapping and Monitoring Program (FMMP), classifies land across the state into a range of agricultural land use categories based on technical soil ratings and current land use. Land considered as "Important Farmland" consists of four categories: Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance. Another key program designed to help protect productive farmland in California is the Williamson Act. Under this program, agricultural land is voluntarily protected by landowners in return for certain tax benefits. The analysis will evaluate the extent to which Important Farmland and properties under Williamson Act contract will be affected by the project footprint using spatial analysis in GIS.

3.3.2 Data Gaps

There are no data gaps for this resource evaluation assuming acreage data on the crops grown on individual parcels can be obtained from water district managers or other readily-available sources.

3.3.3 Tools and Tool Modifications

The agricultural resource impacts would be estimated using tabulations of crop acreages for the affected parcels and published data on crop yields. It is anticipated that the only tool used for the estimation would be a spreadsheet model.

3.3.4 Results Format

The agricultural resource impacts will be presented in tabular and graphical formats, showing the acreages of affected farmland and quantities of crops that would be removed permanently from production by each alternative. This format will meet the analytical needs of the Project by showing the agricultural resource impacts likely under each alternative.

3.4 Biological Resources – Fisheries

The biological resources – fisheries assessment will compare the impacts to fisheries that would result from implementation of the Project alternatives.

3.4.1 Data Sources and Availability

The following data sources were identified as applicable to biological resources-fisheries and are or are expected to be available:

- Number, type, and an assessment of fish passage conditions at each artificial structure or in-channel migration barrier
- Construction footprints, timing, and methods
- Channel surveys and site visits
- Aerial photography
- Topographic maps (LiDAR and bathymetry)
- Habitat suitability (adequate depth of flow and velocity for passage)
- Temperature regime for migrating adult and migrating and/or rearing juvenile salmonids.

Structural migration barriers will be identified or enumerated from reports or aerial photographs and grouped by apparent function. Initial assessment of migration barriers will be based upon professional judgment of the structure type, approach and exit channel geomorphology and habitat conditions, and potential predation risk. Geomorphic barriers may result from wide, shallow sand bars or glides that exist or may develop in the Project. These would be identified using mapping and aerial photography. Impacts to warm-water fish populations in Mendota Pool resulting from construction will also be evaluated.

3.4.2 Data Gaps

The following additional data needs will be developed through coordination between DWR, Reclamation, the FMWG and the Consultant Team during the development of alternatives:

- Minimum and optimal quantities of floodplain rearing habitat features
- Project-specific desired floodplain acreage vs. flow depth, magnitude and duration tables
- Project-specific desired floodplain acreage vs. inundation depth and duration tables
- Project-specific desired floodplain acreage by vegetation type

The precise method for evaluating floodplain rearing and active channel habitat conditions does not currently exist. The Project Team is presently working with the FMWG to resolve these issues and agree on an approach that would then be implemented.

The FMWG has developed a series of tables that quantify a desired amount of total floodplain assumed for each reach. The floodplain habitat needs to be quantified by depth of flow and area relative to estimated floodplain widths, channel elevation, and flow

magnitudes for Reach 2B. This is a potentially valuable tool to quantify effects from the different alternatives.

3.4.3 Tools and Tool Modifications

Passage conditions at structures not yet built or to be modified will be designed using the latest reference and guidelines (National Marine Fisheries Service (NMFS) 2008). These will be assumed to meet agency criteria to provide fish passage. For purposes of modeling fish passage conditions in the channel, HEC-RAS and other standard hydrologic tools will be used. It will not be possible to evaluate the population level effects of a given alternative unless and until the EDT model is fully developed. Construction footprints, timing, and methods will be utilized to conduct a qualitative assessment of impacts to existing fish populations in the Mendota Pool.

3.4.4 Results Format

Results of the analyses will be presented in tabular and graphic formats by alternative. For floodplains, the analysis will compare acres of floodplain inundated at different depth ranges and over a defined duration period. For in-channel habitat, the analysis would compare the mean depth of flow, channel width, and frequency of pool-bar features and extent of riparian vegetation. These factors will also be used to evaluate physical rearing habitat conditions in the channel and on the floodplain for each species and life history stage. Results will compare rearing habitat in the channel and floodplain and fish passage criteria between the different alternatives and over a set of flow ranges for each fish run or race of interest (spring-run/fall-run Chinook salmon) or species (steelhead).

3.5 Biological Resources –Vegetation

The biological resources – vegetation assessment will compare the impacts to special status plants and vegetation alliances that would result from implementation of the Project alternatives.

Status Criteria for Plant Inclusion

Special-status plant species are defined as species that are legally protected under the federal Endangered Species Act (ESA), California Endangered Species Act (CESA) or other regulations, and species that are considered sufficiently rare or endangered by the scientific community to qualify for such listing. Special-status plants are species in the following categories:

- Listed or proposed for listing as threatened or endangered under the federal ESA or candidates for possible future listing as threatened or endangered under the federal ESA (50 Code of Federal Regulations (CFR) §17.12).

- Listed or candidates for listing by the State as threatened or endangered under CESA (Fish and Game Code §2050 et seq.)[1].
- Listed as rare under the California Native Plant Protection Act (Fish and Game Code §1900 et seq.)[2].
- Meet the definition of rare or endangered under CEQA §15380(b) and (d). Species that may meet the definition of rare or endangered include the following:
- Species considered by the California Native Plant Society (CNPS) to be "rare, threatened or endangered in California" (Lists 1A, 1B and 2)
- Species that may warrant consideration on the basis of local significance or recent biological information
- Some species included on the California Natural Diversity Database's (CNDDB) Special Plants, Bryophytes, and Lichens List (California Department of Fish (DFG) and Game 2008)

Status Criteria for Vegetation Alliance Inclusion

For the purpose of this TM, special status vegetation alliances are defined as natural communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects. These natural communities may or may not contain special status species or their habitat. The current version of the *List of California Vegetation Alliances* (DFG 2009a) indicates vegetation alliances of high inventory priority as globally or State ranked 1-3 (critically imperiled, imperiled and vulnerable) for conservation status. Most types of wetlands and riparian communities are considered special status vegetation alliances due to their limited distribution in California. These high priority vegetation alliances often contain special status plants (defined under "Status Criteria for Plant Inclusion").

DFG and its collaborators use a suite of factors to assess the conservation ranking of vegetation alliances. These assessments lead to the designation of a conservation status rank. All California vegetation alliances are described, ranked, and assembled into a list. DFG then issues the ranked list of California vegetation alliances for the public's use, for CNDDB mapping efforts and for project impact assessment. Until fall 2009 the basis for determination of a plant community's rank was *List of California Terrestrial Natural Communities* (DFG 2003). In December 2009, a new, substantially revised *List of California Vegetation Alliances* (DFG 2009a) was introduced. It is based on the extensive work of several authors – John Sawyer, Todd Keeler-Wolf and Julie Evens. Their vegetation classification and mapping effort throughout California culminated in the publication of *A Manual of California Vegetation*, 2nd edition in 2009 (Sawyer 2009).

[1] Species, subspecies, or variety of plant is endangered when the prospects of its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, over-exploitation, predation, competition, disease, or other factors (Fish and Game Code §2062). A plant is threatened when it is likely to become endangered in the foreseeable future in the absence of special protection and management measures (Fish and Game Code §20671).

[2] A plant is rare when, although not presently threatened with extinction, the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens (Fish and Game Code §1901).

Based on this publication, the term "natural community" closely translates to "vegetation alliance" under the new National Vegetation Classification Standard (Federal Geographic Data Committee (FGDC) 2008).

DFG currently requires that the vegetation alliance nomenclature based on both the old (DFG 2003) and the current (DFG 2009a) systems is used when evaluating project impacts, however, only the most recent ranking list should be used to determine conservation status (Hickson 2009). Conservation ranks in this list provide an estimate of the risk of elimination for vegetation alliances. Ranks are based on a scale of one to five (NatureServe 2009), ranging from critically imperiled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales of the assessment (G = Global, N = National, and S = Subnational or State). The numbers have the following meaning:

1 = critically imperiled

2 = imperiled

3 = vulnerable

4 = apparently secure

5 = secure.

For example, G1 would indicate that vegetation alliance is critically imperiled across its entire range (i.e., globally). In this sense, the natural community/vegetation alliance as a whole is regarded as being at very high risk of extirpation. A rank of S3 would indicate the natural community/vegetation alliance is vulnerable and at moderate risk within a particular state or province, even though it may be more secure elsewhere.

3.5.1 Data Sources and Availability

Special Status Plant Data Sources

In order to evaluate which special status plants could potentially occur in the Project area, database searches and a literature review were conducted. Three primary databases were reviewed to obtain special status plant occurrence data from within 10 miles of the Project area:

- CNDDB (DFG 2009a): All records from the Mendota Dam USGS 7.5 minute quadrangle (DWR quadrangle 381D) in this database, maintained by DFG, as well as all records from the surrounding eight quadrangles (Jamesan, Tranquility, Coit Ranch, Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch, and Gravelly Ford) were reviewed. All species with records from these quadrangles and meeting the above status criteria for inclusion are addressed in this memorandum.
- U.S. Fish and Wildlife Service (USFWS) Sacramento Fish and Wildlife Office Species List (USFWS 2009): All species on this list generated at the Sacramento

Fish and Wildlife Office USFWS website for the Mendota Dam quadrangle are addressed in this memorandum.

- CNPS species list for Mendota Dam USGS 7.5 minute quadrangle (DWR quadrangle 381D). All plants in this database, maintained by CNPS, as well as all records from the surrounding eight quadrangles (Jamesan, Tranquility, Coit Ranch, Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch, and Gravelly Ford) were reviewed. All CNPS species with records from these quadrangles and meeting the above status criteria for inclusion are addressed in this memorandum.

Literature Review

The following reports or data sources were identified for use during the assessment of special status plants for the Project EIS/R:

- San Joaquin River Restoration Study Background Report (McBain and Trush, 2002)
- The Jepson Online Interchange - California Floristics (University of California, Berkeley 2009)
- The Jepson Manual: Higher Plants of California (Hickman 2003)
- Endangered Species Recovery Program (ESRP) Species Profiles (ESRP 2006)

For the majority of plant species, specific literature was reviewed in addition to the sources listed above.

Potential to Occur and Recommendations

The potential that species meeting the above status criteria occur in the Project area was evaluated using the database information and literature sources. The evaluation was based on three parameters:

- Historic and current distribution
- Presence of suitable habitat
- Documented occurrences from within 10 miles of the Project area

Consultant Team biologists developed a recommendation for each plant species based on the likelihood of presence in the Project area. The recommendations are intended to provide any additional data needed to develop project environmental documents and obtain regulatory agency permits for project construction. Special status plant species with potential to occur in the Project area are listed in Table 3-1.

Table 3-1.
Federally, State or CNPS Listed Plant Species

Scientific Name Common Name	Family	Federal/ State/ CNPS Status	Habitat/ Communities	Potential to Occur	Blooming Period	Elevation
Atriplex cordulata heartscale	Chenopodiaceae	--/--/1B.2	Chenopod scrub, meadows and seeps, and sandy/saline or alkaline valley and foothill grassland.	High potential to occur based on CNDDB observations within 5 miles of the project and suitable habitat.	Apr-Oct	3 - 1,230 feet
Atriplex depressa brittlescale	Chenopodiaceae	--/--/1B.2	Chenopod scrub, meadows and seeps, playas, valley and foothill grassland, and alkaline or clay vernal pools.	High potential to occur based on CNDDB observations within 10 miles of the project and suitable habitat.	Apr-Oct	3 – 1,050 feet
Atriplex minuscula lesser saltscale	Chenopodiaceae	--/--/1B.1	Chenopod scrub, playas, and alkaline or sandy valley and foothill grassland.	High potential to occur based on CNDDB observations within 10 miles of the project and suitable habitat.	May-Oct	50 - 660 feet
Atriplex persistens vernal pool smallscale	Chenopodiaceae	---/--/1B.2	Alkaline vernal pools.	High potential to occur based on CNDDB observations within 10 miles of the project and suitable habitat.	Jun-Oct	30 - 380 feet

Table 3-1.
Federally, State or CNPS Listed Plant Species

Scientific Name Common Name	Family	Federal/ State/ CNPS Status	Habitat/ Communities	Potential to Occur	Blooming Period	Elevation
Atriplex subtilis subtle orache	Chenopodiaceae	--/--/1B.2	Valley and foothill grassland.	High potential to occur based on CNDDB observations within 5 miles of the project and suitable habitat.	Jun-Aug (Oct*) *uncommon	130 - 330 feet
Atriplex vallicola Lost Hills crownscale	Chenopodiaceae	--/--/1B.2	Chenopod scrub, valley and foothill grassland, and alkaline vernal pools.	High potential to occur based on CNDDB observations within 5 miles of the project and suitable habitat.	Apr-Aug	165 - 2,080 feet
Castilleja campestris ssp. succulenta succulent ow'ls-clover	Scrophulariaceae	FT/SE/1B.2	Vernal pools (often acidic).	Low potential to occur based on habitat and elevation.	Apr-May	165 – 2,460 feet
Caulanthus californicus California jewel-flower	Brassicaceae	FE/SE/1B.1	Chenopod scrub, pinyon and juniper woodland, and sandy valley and foothill grassland.	Medium potential to occur based on habitat and elevation.	Feb-May	200 - 3,280 feet
Cordylanthus palmatus palmate-bracted bird's beak	Scrophulariaceae	FE/SE/1B.1	Chenopod scrub and alkaline valley and foothill grassland.	High potential to occur based on CNDDB observations within 5 miles of the project and suitable habitat.	May-Oct	15 - 510 feet

Table 3-1.
Federally, State or CNPS Listed Plant Species

Scientific Name Common Name	Family	Federal/ State/ CNPS Status	Habitat/ Communities	Potential to Occur	Blooming Period	Elevation
Delphinium recurvatum recurved larkspur	Ranunculaceae	--/--/1B.2	Chenopod scrub, cismontane woodland, and alkaline valley and foothill grassland.	High potential to occur based on CNDDB observations within 10 miles of the project and suitable habitat.	Mar-Jun	10 - 2,460 feet
Imperata brevifolia California satintail	Poaceae	--/--/2.1	Chaparral, coastal scrub, Mojavean desert scrub, meadows and seeps (often alkali), and mesic riparian scrub.	Medium potential to occur based on habitat and elevation.	Sep-May	0 - 1,640 feet
Layia munzii Munz's tidy tips	Asteraceae	--/--/1B.2	Chenopod scrub and alkaline clay valley and foothill grassland.	High potential to occur based on CNDDB observations within 5 miles of the project and suitable habitat.	Mar-Apr	490 – 2,300 feet
Leptosiphon serrulatus Madera leptosiphon	Polemoniaceae	--/--/1B.2	Cismontane woodland and lower montane coniferous forest.	Low potential to occur. No habitat and lower elevation.	Apr-May	980 – 4,265 feet

Table 3-1.
Federally, State or CNPS Listed Plant Species

Scientific Name Common Name	Family	Federal/ State/ CNPS Status	Habitat/ Communities	Potential to Occur	Blooming Period	Elevation
Monolopia congdonii San Joaquin woollythreads	Asteraceae	FE/--/1B.2	Chenopod scrub and sandy valley and foothill grassland.	High potential to occur based on CNDDB observations within 10 miles of the project and suitable habitat.	Feb-May	200 – 2,630 feet
Orcuttia inaequalis San Joaquin Valley Orcutt grass	Poaceae	FT/SE/1B.1	Vernal pools.	Medium potential to occur based on elevation.	Apr-Sep	30 – 2,500 feet
Orcuttia pilosa hairy Orcutt grass	Poaceae	FE/SE/1B.1	Vernal pools.	Medium potential to occur based on elevation.	May-Sep	150 - 660 feet
Sagittaria sanfordii Sanford's arrowhead	Alismataceae	--/--/1B.2	Assorted shallow freshwater Marshes and swamps.	High potential to occur based on CNDDB observations within 5 miles of the project and suitable habitat.	May-Oct	0 – 2,130 feet
Tropidocarpum capparideum caper-fruited tropidocarpum	Brassicaceae	--/--/1B.1	Alkaline hills valley and foothill grassland.	Medium potential to occur based on habitat and elevation.	Mar-Apr	1 – 1,500 feet

Table 3-1.
Federally, State or CNPS Listed Plant Species

Scientific Name Common Name	Family	Federal/ State/ CNPS Status	Habitat/ Communities	Potential to Occur	Blooming Period	Elevation
Key: U.S. Fish and Wildlife Service Federal Listing Categories: FE = Federally Listed as Endangered FT = Federally Listed as Threatened California Department of Fish and Game State Listing Categories: SE = State Listed as Endangered ST = State Listed as Threatened California Native Plant Society Listing Categories: List 1A = Plants presumed extinct in California List 1B.1 = Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California List 1B.2 = Plants rare, threatened, or endangered in California and elsewhere, fairly threatened in California List 1B.3 = Plants rare, threatened, or endangered in California and elsewhere, not very threatened in California List 2.1 = Plants rare, threatened, or endangered in California, but more common elsewhere; seriously threatened in California Protocol Plant Survey Dates: Blue = early survey period (February – April) Yellow = mid season survey period (Late April – June) Orange = late season survey period (late June - September)						

Special Status Vegetation Alliance Data Sources

In order to evaluate which special status vegetation alliances could potentially occur in the Project area, database searches and a literature review were conducted. The following sources of information were reviewed to obtain special status vegetation alliance occurrence data from the Project area and its 10-mile vicinity:

- CNDDB (DFG 2009a): All records from the Mendota Dam USGS 7.5 minute quadrangle (DWR quadrangle 381D) in this database, maintained by DFG, as well as all records from the surrounding eight quadrangles (Jamesan, Tranquillity, Coit Ranch, Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch and Gravelly Ford) were reviewed. All high priority inventory vegetation alliances (DFG 2009a) (terrestrial plant communities, DFG 2003) with records from these quadrangles and meeting the above rank criteria for inclusion are addressed in this memorandum.

Literature Review

The following reports or data sources were identified for use during the assessment of special status vegetation alliances for the Project EIS/R:

- *A Manual of California Vegetation* (Sawyer 2009): All high priority vegetation alliances with a potential to occur in the Project area and its 10-mile vicinity are addressed in this TM.
- The most recent version (December 7, 2009) of the *List of California Vegetation Alliances* (DFG 2009a)
- Terrestrial Vegetation of California (Barbour 2007)
- San Joaquin River Restoration Study Background Report (McBain and Trush 2002)
- California Interagency Wildlife Task Group, California Wildlife Habitat Relationships System species accounts (DFG 2005)
- ESRP Species Profiles (ESRP 2006)

For the majority of special status vegetation alliances, specific literature was reviewed in addition to the sources listed above.

Potential Special Status Vegetation Alliances
The following section lists special status vegetation alliances with a potential to occur in the Project area and the Project area 10-mile vicinity. The first vegetation alliance name is the 2003 terrestrial natural community designation (DFG 2003), the second and third are the current vegetation alliance common and scientific names (DFG 2009a). The vegetation alliances' global and state rank is noted in parentheses. Protocol surveys will be performed to identify special status vegetation alliances throughout the Project area.

Globally or State Ranked Critically Imperiled Vegetation Alliances
There are no globally or State ranked critically imperiled special status vegetation alliances known to occur in the Project area or within a 10-mile vicinity of the Project area.

Globally or State Ranked Imperiled Vegetation Alliances
- Box-Elder Forest, box-elder forest – *Acer negundo* alliance, (G5S2)
- Buttonbush Scrub, button willow thickets – *Cephalanthus occidentalis* alliance, (G5S2)
- Tar Plant Fields, tar plant fields – *Centromadia pungens* or other spp. herbaceous alliance (G2?S2?)
- Alkali Sacaton Grassland, alkali sacaton grassland – *Sporobulus airoides* alliance, (G4S2)
- Ditch-grass Wetland, widgeon-grass mats – *Ruppia* (*cirrhosa, maritima*) aquatic herbaceous alliance, (G4?S2)
- Western Sea-Purslane Marsh, Western sea-purslane marsh – *Sesuvium verrucosum* herbaceous alliance, (G3S2.2)

Globally or State Ranked Vulnerable Vegetation Alliances (G3/S3)
- Valley Sink Scrub, Iodine bush scrub – *Allenrolfea occidentalis* alliance, (G4S3)

- Northern Claypan Vernal Pool:
- Fremont's goldfields–saltgrass alkaline vernal pools - *Lasthenia fremontii – Distichlis spicata* alliance, (G4S3)
- Fremont's goldfields–Downingia vernal pools - *Lasthenia fremontii – Downingia (bicornuta)* alliance, (G3S3)
- Smooth goldfields vernal pool bottoms – *Lasthenia glaberrima* alliance, (G3S3)
- Valley Oak Forests and Woodlands, Valley oak woodland – *Quercus lobata* woodland alliance, (G3S3)
- Oregon Ash Riparian Forest, Oregon ash groves – *Fraxinus latifolia* forest alliance, (G4S3.2)
- California Sycamore Riparian Forest and Woodland, California sycamore woodlands – *Platanus racemosa* alliance, (G3S3)
- Fremont Cottonwood Riparian Forests and Woodlands, Fremont cottonwood forest - *Populus fremontii* alliance, (G4S3.2)
- Black Willow Riparian Forests and Woodlands, Black willow thickets – *Salix gooddingi*i alliance, (G4S3)
- Red Willow Riparian Forests, Red willow thickets – *Salix laevigata* woodland alliance, (G3S3)
- Spinescale Scrub, Spinescale scrub – *Atriplex spinifera* alliance, (G3S3)
- California Rose Riparian Scrub, California rose briar patches – *Rosa californica* alliance, (G3S3)
- Bush Seepweed Scrub, Bush seepweed scrub – *Suaeda moquinii* alliance (G5S3.2)
- Elderberry Scrub and Savanna, Blue elderberry stands – *Sambucus nigra* shrubland alliance, (G3S3)
- Alkali Heath Dwarf Scrub, Alkali heath marsh – *Frankenia salina* alliance, (G4S3)

3.5.2 Data Gaps

The riparian vegetation throughout the river corridor from Friant Dam to the confluence with the Merced River was surveyed by DWR in 2008; however, additional botanical surveys should be conducted in order to determine the exact extent of special status plant populations and vegetation alliances in the Project area. Botanical surveys will be conducted in accordance with *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (DFG 2009b). They will be conducted in a manner that will locate any listed species that may be present. Botanical surveys will be conducted prior to commencement of any activities that may modify vegetation, such as clearing, mowing, or ground-breaking activities. It is appropriate to conduct a botanical field survey when:

- Natural (or naturalized) vegetation occurs on site
- It is unknown if special status plant species or natural communities occur on site
- The Project has potential to affect directly or indirectly vegetation, special status plants, or natural communities have historically been identified on the project site
- Special status plants or natural communities occur on sites with similar physical and biological properties as the Project site.

3.5.3 Tools and Tool Modifications

In addition to the botanical survey protocol tools described in the *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Existing Environmental Conditions: Data Needs and Survey Approach* (Environmental Data Needs TM) (SJRRP 2010a), GPS mapping and GIS assimilation and overlay of the Project impact areas on the known distribution of the special status resources will be the primary tools used to determine how special status plant and vegetation alliances will be affected by the Project.

3.5.4 Results Format

The effect of each alternative on the existing special status plants and vegetation alliances will be determined by the use of GIS overlay. Impacts of each alternative will be tabulated and included in the Project EIS/R. The basis for the determination will be the botanical survey report and the proposed layout for each alternative.

The assessment of potential impacts to be included in the Project EIS/R will include:

- A discussion of the significance of special status plant populations in the Project area considering nearby populations and total species distribution
- A discussion of the significance of special status natural communities in the Project area considering nearby occurrences and natural community distribution
- A discussion of direct, indirect, and cumulative impacts to the plants and natural communities
- A discussion of threats, including those from invasive species, to the plants and natural communities
- A discussion of the degree of impact, if any, of the proposed project on unoccupied, potential habitat of the species
- A discussion of the immediacy of potential impacts
- Recommended measures to avoid, minimize, or mitigate impacts

3.6 Biological Resources – Wildlife

The biological resources – wildlife assessment will compare the changes to special status wildlife and their habitat that would result from implementation of the Project alternatives.

3.6.1 Data Sources and Availability

Data sources related to wildlife are identified and summarized in the Environmental Data Needs TM (SJRRP 2010a). Data sources identified in that document include database searches, reports and literature with information broadly applicable to the Project, as well as more specific reports and literature that contain information related to individual wildlife species.

Three primary databases were reviewed to obtain special status wildlife species occurrence data from the vicinity of the Project area, including the California Natural Diversity Data Base, the USFWS Species List for the Mendota Dam quadrangle, and the Audubon Society Important Bird Area species list for the Mendota Wildlife Area. Species were identified as occurring in or having potential to occur in the vicinity of the Project area, based on information extracted from these databases, there are 16 Federally and State listed and fully protected wildlife species, and an additional 25 species identified as USFWS birds of conservation concern and CDFG species of special concern and watch list species.

The species were evaluated for potential to occur in the Project area using occurrence information from the databases, a variety of readily available literary sources with species-specific information, and the following reports or data sources which were identified as particularly relevant for a number of species:

- San Joaquin River Restoration Study Background Report (McBain and Trush, 2002)
- California Interagency Wildlife Task Group, California Wildlife Habitat Relationships species accounts (DFG 2005)
- ESRP species profiles (ESRP 2006)

3.6.2 Data Gaps

In some cases sufficient information is currently available to evaluate the potential for individual wildlife species to occur in the Project area. In other cases additional information will be provided by conducting field surveys in the Project area. Proposed field surveys are described in the Environmental Data Needs TM (SJRRP 2010a). Proposed surveys include a reconnaissance survey and a habitat assessment survey, to be conducted during spring 2010, pending right-of-entry to private property in the Project area. Depending on the results of the initial surveys, focused surveys may be required if additional information is needed for some species. One exception is focused surveys for valley elderberry longhorn beetle, a species for which focused surveys have already been determined to be necessary. Those surveys will be completed prior to the elderberry host plants' winter dormancy period when transplants will occur.

Protocols for conducting focused surveys that may be needed are also described in the Environmental Data Needs TM (SJRRP 2010a) for species where published survey protocols are available. Focused surveys would be initiated as soon as possible following the point at which initial reconnaissance or habitat assessment surveys indicate that focused surveys are needed. All reasonable effort would be made to complete focused

surveys during the 2010 calendar year, but published protocols for some species require surveys to be conducted at specific times of year, often in spring, so the ability to complete focused surveys during the 2010 calendar year in some cases would depend on when right-of-entry to private property is obtained. In other cases protocol surveys require surveys conducted over multiple calendar years, in which case completion of the surveys would occur after 2010.

3.6.3 Tools and Tool Modifications

The analysis of Project effects on wildlife will be based largely on known or assumed presence of wildlife species in specific habitats in the Project area and predicted changes in the quantity and distribution of those habitats associated with Project implementation. This type of analysis will be particularly applicable for Federal and State listed species, where the quantity of affected habitat often affects mitigation requirements. Tools such as hydrology information, CalSim, and HEC-RAS models will be used to predict flow duration and flood frequency curves. Based on this information, combined with grading and planting schemes, it should be possible to predict which habitat types are most likely to establish and persist at various locations in the Project area. By comparing acreages of habitat types pre- and post-Project implementation, it will be possible to anticipate which species will gain habitat as a result of the Project, and which species will lose habitat.

3.6.4 Results Format

Acreages of habitat affected for various wildlife species will be reported in summary tables. For some species, the table may indicate different types of habitat affected, such as foraging habitat or breeding habitat. In some cases, the quantity of habitat affected will be tightly linked to mitigation requirements associated with permitting the Project. Habitat quality and habitat type (for example, breeding, foraging, or dispersal habitat) will likely factor into mitigation requirements associated with permitting for some species.

While impacts will be quantified in this manner where appropriate, another important part of the analysis will be more qualitative in nature. For extremely rare or critically endangered species, the acreage of habitat affected may not adequately represent the magnitude of the potential impact, for example, if the Project would result in take of individuals or loss of habitat for a species not known from other locations. Therefore, narrative descriptions of the nature and severity of impacts will support or substitute for the quantitative results of the impact analysis described above, for some species.

3.7 Climate Change and Greenhouse Gas Emissions

Global warming is the name given to 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 to be unequivocal (Intergovernmental Panel on Climate Change (IPCC) 2007) with global surface temperature increasing approximately 1.33 °F over the last one hundred years. Continued warming is projected to increase global average temperature between 2 and 11 °F over the next one hundred years.

The causes of this warming have been identified as both natural processes and as the result of human actions. The IPCC concludes that variations in natural phenomena such as solar radiation and volcanoes produced most of the warming from pre-industrial times to 1950 and had a small cooling effect afterward. However, after 1950, increasing greenhouse gas concentrations resulting from human activity such as fossil fuel burning and deforestation have been responsible for most of the observed temperature increase. These basic conclusions have been endorsed by more than 45 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries. Since 2007, no scientific body of national or international standing has maintained a dissenting opinion.

Increases in greenhouse gas concentrations in the Earth's atmosphere are thought to be the main cause of human induced climate change. Greenhouse gasses naturally trap heat by impeding the exit of solar radiation that has hit the Earth and is reflected back into space. Some greenhouse gasses 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 hundred years have decreased the amount of solar radiation that is reflected back into space, intensifying the natural greenhouse effect and resulting in the increase of global average temperature.

Maximum (daytime) and minimum (nighttime) temperatures are increasing almost everywhere in California but at different rates. The annual minimum temperature averaged over all of California has increased 0.33°F per decade during the period 1920 to 2003, while the average annual maximum temperature has increased 0.1°F per decade (Moser 2009).

With respect to California's water resources, the most significant impacts of global warming have been changes to the water cycle and sea level rise. Over the past century, the precipitation mix between snow and rain has shifted in favor of more rainfall and less snow (Mote 2005, Knowles 2006) and snow pack in the Sierra Nevada is melting earlier in the spring (Kapnick 2009). The average early spring snowpack in the Sierra Nevada has decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage (DWR 2008). These changes have significant implications for water supply, flooding, aquatic ecosystems, energy generation, and recreation throughout the state. During the same period, sea levels along California's coast rose seven inches (DWR 2008). Sea level rise associated with global warming will continue to threaten coastal lands and infrastructure, increase flooding at the mouths of rivers, place additional stress on levees in the Sacramento-San Joaquin Delta, and will intensify the difficulty of managing the Sacramento-San Joaquin Delta as the heart of the state's water supply system.

The earth's atmosphere naturally contains a number of gases, including (but not limited to) carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), which are collectively referred to as GHGs. For the Project, GHG emissions will be based on dominant GHGs: CO2, CH4, N2O, sulfur hexafluoride (SF6), perfluorocarbons (PFC), hydrofluorocarbons (HFC), and water vapor and will be reported as carbon dioxide equivalents (CO2e). CO2 is the primary GHG emitted by human activities in the United

States, representing approximately 84 percent of total GHG emissions (USEPA 2008). CO2 from fossil fuel combustion, the largest source of United States GHG emissions, accounted for approximately 80 percent of United States GHG emissions (USEPA 2008).

While scientists have established a connection between increasing GHG concentrations and increasing average temperatures, important scientific questions remain about how much warming will occur, how fast it will occur, and how the warming will affect the rest of the climate system. As the average temperature of the earth increases, weather may be affected, including changes in precipitation patterns, accumulation of snow pack, and intensity and duration of spring snowmelt. The sea level may rise, resulting in coastal erosion and inundation of coastal areas. Emissions of air pollutants and ambient levels of pollutants also may be affected in areas. Climate zones may change, affecting the ecology and biological resources of a region. There may be changes in fire hazards due to the changes in precipitation and climate zones. Increased air temperatures and reduced snow pack resulting from climate change may have an effect on salmon fisheries by increasing water temperatures and shortening the timeframe that water temperatures are adequate for fish.

3.7.1 Data Sources and Availability

The volume of grading, cut and fill, and amount of construction will be needed. Emission factors for the types of equipment and trucks used will also be necessary. Emission factors for trucks can be obtained from CARB's EMFAC2007 Motor Vehicle Emission Factor Model or from the California Climate Action Registry's General Reporting Protocol (CCAR 2009).

3.7.2 Data Gaps

Once alternatives and associated construction quantities are finalized there should be no data gaps.

3.7.3 Tools and Tool Modifications

GHG construction, operations, and maintenance emissions will be calculated based on the amount of construction cut and fill material required by the project, the heavy equipment usage, and the area undergoing grading. The calculation of GHG emissions will be based on the number of truck trips required for removal of material and/or the importation of material. For grading and construction the duration of equipment use will be used to estimate amount of GHG emissions.

No operational sources are assumed to exist.

3.7.4 Results Format

A list or table of the GHG emissions due to construction of the project will be generated.

3.8 Cultural Resources

The cultural resources assessment will compare the effects to cultural resources that would result from implementation of the Project alternatives.

3.8.1 Data Sources and Availability

The data gathered prior to field work will rely on existing information regarding previously recorded cultural resources for the Project area of potential effects (APE), as well as any pre-existing literature that is pertinent to understanding the environmental and cultural evolution unique to the Project area. The information gathered will encompass a variety of areas, including both prehistoric and historic cultural chronologies and lifeways, geomorphological evolution and landscape change over time, and environmental variables. To date, a cultural resources records search of pertinent survey and site data was conducted on December 22, 2009 by the South San Joaquin Valley Information Center (SSJVIC) (RS#09-479). The information center staff accessed the records for the Mendota (USGS) 7.5-minute quadrangle, including a half-mile and a one-mile radius around the Project area. The following references were also reviewed:

- National Register of Historic Places (NRHP) (2010)
- California Register of Historical Resources (CRHR) (2010)
- *Cultural Resources Sensitivity Study and Research Design for the San Joaquin River Restoration Program, Fresno, Madera, Merced, and Stanislaus Counties, California* (Far Western 2009)
- Office for Historic Preservation (OHP) Historic Property Directory (updated March 7, 2008)
- California State Historical Landmarks (1996 and updates) listing
- California Inventory of Historic Resources (1976 and updates)
- California Points of Historical Interest (1992 and updates) listing
- The Caltrans State and Local Bridge Survey (1986 and updates)
- Historic maps, including GLO Plat Maps

The results of this records search will be incorporated into the Cultural Resources Inventory Report for the Project.

In addition, the Native American Heritage Commission was contacted in December 2009 in order to request a database search for sacred lands or other cultural properties of significance to Native Americans within the Project area. The sacred lands files database did not indicate any sacred lands in the Project area. The Commission provided a list of people who may have specific information pertaining to cultural resources in the Project area, and letters will be sent to each person upon receipt of the contacts list. Any information gathered during this process will be incorporated into the impact analysis.

3.8.2 Data Gaps

A survey of the Project area will be conducted to document the presence of cultural resources, if any. The results of the survey will be utilized in the assessment of the effects of the Project on cultural resources for the Project EIS/R. The timing and availability of the results of the surveys is dependent on access to properties within the Project area.

3.8.3 Tools and Tool Modifications

Based on the results of the cultural resources survey, combined with grading and planting schemes, it should be possible to assess the effects of the Project for the purposes of the Project EIS/R. GPS mapping and GIS assimilation and overlay of the Project impact areas on the known locations of cultural resources will be the primary tools used to assess how cultural resources will be affected by the Project.

3.8.4 Results Format

Under Federal and State law, effects to significant cultural resources (e.g., archaeological remains, historic-period structures, and traditional cultural properties) must be considered as part of the environmental analysis of a proposed project. Criteria for defining significant cultural resources are stipulated in:

- 36 CFR Part 63 (Determinations of Eligibility for Inclusion in the NRHP)
- NHPA of 1966, as amended (NHPA; 16 United States Code (USC) 470 et seq.)
- CEQA (CEQA, revised 2005)

In addition, 36 CFR 800 outlines the compliance process for Section 106 of the NHPA.

The results of the literature review task and the field survey task will be applied to the significance criteria above to determine whether any identified cultural resources may be considered either historical resources (CEQA level term) or historical properties (Section 106/NEPA level term), that is, whether the resource is to be considered eligible for listing in either the CRHR or the NRHP.

The goal of the Cultural Resource Inventory Report is to support Reclamation in complying with Section 106 of the National Historic Preservation Act. The Inventory Report will discuss the results of the literature review and field survey and provide recommendations regarding the treatment of any identified cultural resources that may be considered significant. Formal evaluation, such as a formal excavation of a recorded archaeological site, of identified resources may be conducted for the purposes of the Inventory Report. Additionally, architectural resources or specimens of the built environment will be evaluated per State or Federal criteria. In both cases, recommendations will be provided to allow planners to avoid, minimize, or reduce adverse impacts—in this sequence of priority—to identified significant cultural resources.

3.9 Environmental Justice

This section describes the analytical tools and approach for environmental justice. Environmental justice analysis provides information on the demographic and social characteristics of a study area, data which are used to discern whether minority or low-income populations would be disproportionately, adversely affected by the alternatives. The assessment of potential environmental justice impacts of the alternatives will rest on a comparison of select social and demographic characteristics of the Project area with a

reference population, e.g., Fresno and Madera Counties and California. If the minority or low-income populations in the Project area are meaningfully greater than in the reference population, then an environmental justice location of concern can be assumed to be present and should be included in the analysis.

3.9.1 Data Sources and Availability

The Project would occur within unincorporated areas of Fresno and Madera Counties. The nearest incorporated community is the City of Mendota in Fresno County. The most recent data on environmental justice characteristics for the Project area are from the 2000 Census of Population and Housing (U.S. Census Bureau 2010). The land in the Project area is located in Fresno County Census Tract 83.01 and Madera County Census Tract 4. More current information on racial composition in the area is available only at the county level, i.e., Fresno and Madera Counties.

3.9.2 Data Gaps

The only data gap is one of timing rather than content. As noted above, the most recent data on the social and demographic characteristics in the Project area are from the 2000 Census of Population and Housing.

3.9.3 Tools and Tool Modifications

The tool used to assess the environmental justice impacts of the alternatives will be spreadsheet tabulations comparing the social and demographic characteristics of the Project area with reference data for Fresno and Madera Counties and California for 2000.

3.9.4 Results Format

The results of the environmental justice analysis will be presented in tabular form, showing for each alternative the specific environmental justice impacts associated with loss of agricultural land, construction, and other activities and the level of significance of those impacts.

3.10 Geology and Soils

This section describes the analysis of geological conditions to support the functionality of alternatives in the geology and soil resource areas. Geological concerns include:

- Levee stability
- Potential erosion and sedimentation caused by grading, excavation and other construction activities
- Potential land subsidence caused by placement of material on peat soils
- River meander migration and bank erosion
- Channel stability and sediment deposition and scour

3.10.1 Data Sources and Availability

The following data sources were identified as relevant to the work suggested in this TM:

- Geomorphology of Segmented Alluvial Fans in Western Fresno County, California (Bull 1964)
- *Geologic Map of California,* Santa Cruz Sheet (California Department of Conservation 1958)
- Soil Survey of Eastern Fresno Area, California (SCS 1971)
- Quaternary Geology of the Great Valley, California. In Quaternary Nonglacial Geology: Conterminous U.S., Geology of North America (Lettis 1991)
- Soil Survey of Madera Area, California (SCS 1962)
- Preliminary Geologic Map Showing Quaternary Deposits of the Northeastern San Joaquin Valley, California (Marchland 1978)
- Soil Survey of Fresno County, California Western Part (NRCS 2006)
- *Web Soil Survey,* http://websoilsurvey.nrcs.usda.gov (NRCS 2008)
- Appraisal Phase Geologic Survey Work Plan for Reach 2B and the Mendota Pool Bypass (SJRRP 2008a)
- California 7.5 Minute Series Topographic Maps (USGS)
- Aerial photographs in stereo pair
- LiDAR and aerial imagery
- *San Joaquin River Restoration Program Draft 1 2010 Annual Technical Report* (SJRRP 2010) – or later version as available

3.10.2 Data Gaps

Creating a detailed geomorphic map describing the deposits and landforms of the Project area will be considered, and completed as necessary. This would augment the existing soils map and geomorphic information expected to be outlined in the PEIS/R and help to better constrain the placement of geotechnical borings. A work plan for geotechnical exploration has been introduced (SJRRP 2008a) and seven monitoring wells and two piezometers have been installed, but no documentation of the boring or logs is yet available. The lithologic logs are expected to be available by June 2010. Geotechnical exploration, guided by the information gleaned from the soils and geomorphic maps is being conducted by DWR through summer 2010.

The geomorphology investigation prepared for the alternatives evaluation discussed in Section 2.4 will provide the foundation for the geomorphic assessment for the Project EIS/R, but additional detail should be developed to further the assessment. Two-dimensional hydraulic and sediment transport modeling of the channel and floodplain should be completed to provide more information for the geomorphology assessment.

3.10.3 Tools and Tool Modifications

The geomorphic assessment will leverage the data sources above as well as the DWR field investigation. Additional mapping will be completed as necessary and would involve interpreting stereographic aerial photographs, USGS topographic maps, and available high-resolution topographic data (e.g., LiDAR imagery) to create a detailed map of landforms such as natural levees, channels, floodplains, terraces and alluvial fans. The work would be field-checked to confirm the validity of judgments made using the remote sensing techniques. It is assumed at this time that the DWR field investigation will be used to field-check the assessment.

Models for the geomorphology assessment include HEC-RAS, SRH-1D, SRH-1DV, and SRH-2D along with geomorphic principles.

3.10.4 Results Format

The results will be presented in the form of a geologic site characterization report which will include soils and geomorphic maps and detailed descriptions of the surface and subsurface conditions including the results from both field and laboratory investigations. Tabular and graphical information will be presented for the geomorphological assessment.

3.11 Hazards, Hazardous Materials, and Public Health

The hazards, hazardous materials, and public health resources assessment will compare the effects on public health or associated with hazards and hazardous materials that would result from implementation of the Project alternatives.

3.11.1 Data Sources and Availability

Data sources to assess potential adverse impacts to public health are described in terms of anthropogenic (from or influenced by humans) hazards, West Nile virus (WNV), Valley Fever, naturally occurring asbestos (NOA), oil and gas wells, wildland fire, and aircraft safety. In addition to these data sources for potential direct public health hazards, other data sources will be assessed to determine logistical concerns for the proper management and disposal of contaminant soil and groundwater generated during project activities.

Anthropogenic Sources

The data sources identified to evaluate potential anthropogenic hazards to public health will largely be gathered by reviewing Federal, State and Local environmental databases. These databases list facilities that store, use or dispose of hazardous materials or hazardous wastes. Potential releases from these listed facilities may have resulted in adverse impacts to the proposed bypass project. Historical records may also be utilized as a secondary data sources for identifying potential adverse anthropogenic impacts.

Federal databases that contain sites that store, use, or dispose hazardous materials or wastes include:

- USEPA National Priorities List (NPL) sites list

- Resource Conservation and Recovery Act (RCRA) database
- Comprehensive Environmental Response Compensation Liability Information System (CERCLIS) sites list
- Resource Conservation and Recovery Act Information System (RCRIS) Treatment, Storage, and Disposal Facilities (TSD), Corrective Action Facilities (CORRACTS), and Generators sites lists
- Emergency Response Notification System (ERNS) sites list.

State databases that contain sites that store, use, or dispose of hazardous materials or wastes include:

- CalEPA Department of Toxic Substances Control (DTSC) Cal-Sites toxic sites including the Annual Workplan (AWP) and the former Abandoned Site Program Information System (ASPIS) lists and the Hazardous Waste Information System (HAZNET) sites lists
- State Water Resources Control Board (SWRCB) GeoTracker online database
- California Central Valley Regional Water Quality Control Board (RWQCB) Spills, Leaks, Investigations, and Cleanup (SLIC) and leaking underground storage tank (LUST), and registered underground storage tank (UST) sites lists
- California Integrated Waste Management Board (CIWMB) Solid Waste Information System (SWIS) Solid Waste Active and Inactive Landfills (SWF/LF) site list

Local databases that contain sites that store, use, or dispose of hazardous materials or wastes include the various Departments within the City and County of Fresno. Likely Departments include the following: Health, Environmental, Emergency Response, Fire, Public Safety, Assessor, Building and Planning.

Historical sources that may identify sites that store, use, or dispose of hazardous materials or wastes that may have previously caused adverse impacts to public health or the environment include historical aerial photographs, topographical maps, Sanborn fire insurance maps and city directories.

West Nile virus

WNV is transmitted to humans by infected mosquitoes. WNV is monitored by the U.S. Centers for Disease Control and Prevention (USCDC) and the California Department of Public Health.

Valley Fever

Valley Fever is an infection, usually targeting the lungs, which results from inhalation of fungus (*Coccidiodes immitis*). The CDC monitors the exposure of Valley Fever and considers it being endemic in California.

Naturally Occurring Asbestos

NOA is considered to be a toxic air contaminant by CARB. The California Geological Survey has documented the source of NOA is commonly associated with ultramafic rocks and has prepared *A General Location Guide for Ultramafic Rocks in California – Areas More Likely to Contain Naturally Occurring Asbestos* (California Department of Conservation 2000).

School Safety

School Safety concerns are primarily a consequence that school-aged children are considered to be particularly sensitive to adverse effects resulting from exposure to hazardous materials, substances, or waste. California Public Resources Code 21151.4 requires that lead agencies evaluate projects with a quarter-mile of a school to assess whether a release of hazardous air emissions or hazardous substances, resulting from implementation of any of the proposed alternatives, would pose a human health or safety hazard. Hazardous substances existing naturally (e.g., Valley Fever) or from anthropogenic sources (e.g., NPL or SLIC sites) could be emitted from ground-disturbing activities in the vicinity of the proposed project.

Oil and Gas Wells

Oil and gas wells may pose impacts to public health if they were not properly abandoned or if disturbed during program activities. The California Department of Conversation, Division of Oil, Gas, and Geothermal Resources documents abandoned wells in California. They maintain a list of the status and locations of documented abandoned wells in the area. However, wells are granted confidentiality for up to two years. Confidential wells and undocumented wells may be encountered during ground disturbance activates that could in result in adverse impact to public health or the environment.

Wildland Fires

Wildland fires present a hazard to both persons and property in many areas if California. CAL FIRE developed a fire hazard severity scale that considers vegetation, climate, and slope to evaluate the level of wildfire hazard in all State Responsibility Areas. The designation of State Responsibility Areas and Local Responsibility Areas is used to identify responsibility for providing basic wildfire protection assistance.

Aircraft Safety

Aircraft safety can be compromised by wildlife. Airports within two miles of a Project area may be affected by land use changes that attract hazardous wildlife. According the Federal Aviation Administration (FAA), numerous birds in the area are considered hazardous to airport operations.

Management of Contaminated Soils and Groundwater

Contaminated soils and water may be generated as part of the Project activities and would require appropriate management under regulations of the CIWMB and SWRCB.

The above data sources are available to the public.

3.11.2 Data Gaps

The agency and historical record reviews should be sufficient to assess documented potential public health impacts along the planned project. Potential significant data gaps are undocumented impacts such as illegal dumping that will be assessed through field surveys of the Project area. The field surveys to assess undocumented impacts would be conducted during the development of the Project EIS/R.

A second data gap is whether the generation of contaminated soil and groundwater is properly managed. Contaminated soil will be disposed at a local licensed landfill regulated by CIWMB. Contaminated groundwater will be treated as appropriate and discharged at either a sanitary sewer to a local Publicly Owned Treatment Works (POTW) or to a storm water system under a National Pollutant Discharge Elimination System (NPDES) permit under regulations of the SWRCB. A potential concern is the ability of a landfill or POTW to accept the amount of material generated during project activities.

A third data gap is the proper monitoring of potential hazardous materials during construction activities.

Mitigation measures will be developed to make these potential concerns less than significant by the implementation of proper controls.

3.11.3 Tools and Tool Modifications

The various agencies that maintain databases of potentially contaminated properties are available for public review either online or by requesting a file review at their office. Historical records are available at the University of California Berkeley Map Library or other local libraries. Although it is possible to review each agency or library individually, this is very arduous and time-consuming process. The search is commonly completed through a specialty firm that maintains up to date listings, such as Environmental Data Resources (EDR). Within a designated search radius, EDR can provide a list of specific properties that have the potential to adversely impact to public health or the environment as well as to provide historical records that may indicate an adverse impact to public health or the environment at a nominal fee.

For other public health issues not related to a specific property, the various agencies will be contacted to assess each adverse potential impact on proposed project.

Once a list of potential adverse impacts is prepared, field surveys of the Project area will be completed as necessary to further assess the likelihood of significant impacts to the proposed project. Field surveys will also be completed as necessary to assess potential undocumented releases such as those in the vicinity of the road crossing of the San Mateo Avenue.

3.11.4 Results Format

The findings of the agency database review, historical record searches, and field surveys will be presented on a GIS map format as well as in tabular format referencing the various potential public health impacts to the proposed project. A written summary of

each of potential impacts will be provided. This results format will meet the Project's analytical needs and permitting requirements by identifying specific potential significant impacts that will allow the development of reasonable mitigation measures for the protection of public health for each alternative of the Project.

3.12 Hydrology – Groundwater and Groundwater Quality

The hydrology – groundwater and groundwater quality resources assessment will compare the effects on those resources that would result from implementation of the Project alternatives.

3.12.1 Data Sources and Availability

The data sources identified as particularly relevant to the groundwater and groundwater quality resources are summarized in Section 2.5 above. Full references for the above documents are provided in Section 5.0. USGS and DWR staff were also consulted, as acknowledged in Section 4.0.

3.12.2 Data Gaps

USGS is currently refining the existing CVHM model to include smaller grid spacing and thinner layers, new topographical data, and additional soil and well data.

3.12.3 Tools and Tool Modifications

Tools that will be used to for the Project EIS/R include input and output data from updated simulations of the USGS' CVHM (USGS 2009), which is described above in Section 2.5.2

The HEC-RAS stage rating tables and the final alternatives will be provided to the USGS for incorporation into the CVHM. Additionally, significant modifications to the CVHM are planned by the USGS for the Project EIS/R assessment of alternatives and development of mitigation measures, including using recent drillers' logs and the 2009 monitoring well borings for the refinement of the CVHM hydraulic parameters (particularly Layer 1 hydraulic conductivities). These modifications will also include the refinement of the grid size in the monitoring corridor using the Local Grid Refinement MODFLOW package. These modifications will result in the CVHM-SJR groundwater modeling tool, which is currently anticipated to be available in the spring of 2011. Depending on the timing and availability of the CVHM-SJR, the Draft Project EIS/R may utilize the tools described in Section 2.5

3.12.4 Results Format

Results from the CVHM will be presented in a GIS map format that shows depth to water and highlights areas that have the potential to have shallow groundwater above the monitoring threshold (currently anticipated to be approximately six to eight feet below ground surface). The extent of water level rises will be qualitatively assessed for each final alternative to determine the relative area of potentially impacted land. The USGS will provide the updated CVHM results, which will have utilized the HEC-RAS output for the Project, as GIS maps showing the depth to water for each initial alternative,

including the No-Action alternative. GIS will then be used to calculate the acreage that exceeds the monitoring threshold for each alternative, giving a quantitative measure of the potential impacts of each alternative and a basis for evaluating levee design requirements and mitigation measures. The results format will meet the Project's assessment needs by allowing the number of acres that may be impacted by water level rises above the monitoring threshold to be compared for each final alternative and to evaluate mitigation measures.

3.13 Hydrology – Wetlands and Other Aquatic Resources

For the purpose of this document and to determine data needs and a survey approach, wetlands and other aquatic resources (e.g., rivers, streams and natural basins) includes those features that are a subset of "waters of the United States", which are Federally protected, but also includes isolated wetlands (e.g. vernal pools) that are within the jurisdiction of the State of California. The USACE has the primary Federal responsibility for administering regulations that concern waters and wetlands. In this regard, USACE acts under two statutory authorities, the Rivers and Harbors Act (Sections 9 and 10), which governs specified activities in "navigable waters," and the Clean Water Act (Section 404), which governs specified activities in "waters of the United States," including wetlands. In addition, the State Water Quality Control Board and the Department of Fish and Game have State responsibilities for regulating these features under statutory authority of the Porter–Cologne Water Quality Control Act and the California Fish and Game Code.

3.13.1 Data Sources and Availability

In order to evaluate where wetlands and other aquatic resources could potentially occur in the project area, all records from the Mendota Dam USGS 7.5 minute quadrangle (DWR quadrangle 381D) in the National Wetlands Inventory (NWI) database, maintained by USFWS (USFWS 2009), as well as all records from the surrounding eight quadrangles (Jamesan, Tranquillity, Coit Ranch, Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch and Gravelly Ford) were reviewed. All potential wetlands and other aquatic resources identified in the NWI are addressed in this memorandum.

Literature Review

The following reports or data sources were identified as particularly relevant to wetlands and other aquatic resources:

- San Joaquin River Restoration Study Background Report (McBain and Trush 2002)

Potential to Occur and Recommendations

Based on the presence of wetlands and other aquatic resources in the Project area, a methodology for wetland and other aquatic resources field surveys was developed; it is intended to provide sufficient data needed to develop project environmental documents and obtain regulatory agency permits for project construction.

Jurisdictional wetlands and "other waters of the United States" are Federally protected under the CWA and Rivers and Harbors Act.

The USACE and the USEPA define wetlands as, "those areas that are saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for the life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

"Waters of the United States" as defined in Code of Federal Regulations (33 CFR 328.3(a), 40 CFR 230.3(s)) include:

1. All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

2. All interstate waters including interstate wetlands;

3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural basins, the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters which are or could be used by interstate or foreign travelers for recreational or other purposes; or from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or which are used or could be used for industrial purposes by industries in interstate commerce;

4. All impoundments of waters otherwise defined as waters of the United States under the definition;

5. Tributaries of waters identified in paragraphs (1) through (4);

6. Territorial seas; and

7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (1) through (6).

Additional information about these natural resources can be found in the following documents:

- Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE 2008b)
- A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States, a Delineation Manual (USACE 2008a)
- Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (USACE 2008c)

Waters that are themselves wetlands, as mentioned in item 7 above, while they may or may not be under Federal jurisdiction, typically are under State jurisdiction. “Waters of the State” as defined in the Porter–Cologne Water Quality Control Act §13050 are “any surface water or groundwater, including saline waters, within the boundaries of the State”.

3.13.2 Data Gaps

Based on the reconnaissance surveys, the Project area and its 10-mile vicinity include numerous wetlands. Wetlands and other waters of the United States should be delineated in Project areas that would potentially be affected by project implementation. It is assumed that the Consultant Team will collect this data for the Project EIS/R.

3.13.3 Tools and Tool Modifications

In addition to the wetland delineation protocol tools, GPS mapping and GIS assimilation and overlay of the project impact areas on top of the known distribution of the wetland resources will be the primary tools used to determine how special status plant and vegetation alliances will be affected by the project. Wetland delineation in the Project area will be conducted in accordance with the methodology presented in the *Corps of Engineers Wetlands Delineation Manual* (USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West* (USACE 2008c). Prior to the field surveys Consultant Team biologists will review the following sources of information relevant to the project:

- Aerial photographs of the project site and vicinity
- USDA Soil Surveys of Fresno and Madera Counties, California (NRCS 2006, SCS 1971, SCS 1962)
- Standard biological references and field guides including the Jepson Manual (Hickman 2003)
- NWI Maps

Wetland Delineation Field Survey Methodology

The following presents a summary of the wetland delineation field survey methodology for the Project. A full description of the methodology was provided in the Environmental Data Needs TM (SJRRP 2010a).

The hydrology, soils and vegetation of the Project will be examined along several transects and the resulting data will be used to determine wetland boundaries. Typically, a pair of sampling points will be analyzed for hydrophytic vegetation, hydric soils, and wetland hydrology at each potential wetland. Initially, a low-lying point will be sampled to confirm a wetland location. Subsequently, a point in an adjacent upland area will be analyzed to determine its status. After examining the hydrology, soils, and vegetation of each data point, the wetland boundary location will be interpolated using contours, wetland vegetation, and obvious hydrologic indicators between corresponding wetland and upland points. Each data point will be marked with a wooden stake set flush with the ground and marked to correspond with the point’s data form. Wetlands and other waters

of the United States boundaries will be marked with pin-flags and recorded using a GPS unit. A list of vegetation observed within the mitigation site will be prepared.

Non-Wetland Waters of the United States

Additional features will be identified as non-wetland waters of the United States based on the presence of defined bed and banks, drift lines and/or ordinary high water marks (OHWM, average 2 year return frequency). These features, typically streams or ditches, will be mapped using a combination of field measurements and aerial photography.

3.13.4 Results Format

The effect of each alternative on the existing wetlands and other waters of the United States will be determined by the use of GIS overlay. Impacts of each alternative will be tabulated and included in the Project EIS/R. The basis for the determination will be the jurisdictional wetland delineation report and the proposed layout for each alternative.

3.14 Hydrology – Surface Water Resources and Water Quality

While water backs up in Reach 2B from Mendota Pool to San Mateo Avenue, under baseline conditions, there is generally no positive flow condition in Reach 2B except for occasional flood flows. Water that is released from Millerton Lake typically either infiltrates to groundwater or is diverted from the River above Reach 2B. The primary source of water that will flow into Reach 2B after restoration will be water from Millerton Lake. There will also be smaller sources such as agricultural or urban return flows and the upstream tributaries: Little Dry Creek and Cottonwood Creek. Water in Millerton Lake is generally of good quality so it is expected that there would be no adverse impacts to water quality in the Project due to the release of Millerton Lake water. Water quality impacts, if any, would likely be related to sediment or any toxics entrained by the Restoration Flows.

The only constituent listed in the Clean Water Act (CWA) Section 303(d) list of impaired water bodies for the San Joaquin River between Friant Dam and Mendota Pool is exotic species. This issue will be addressed under the Biological Resources – Special Status Plants and Vegetation Alliances Section of the Project EIS/R. In addition, selenium is listed for Mendota Pool. A TMDL for selenium in Mendota Pool has not yet been completed. Additionally, the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (Basin Plan) (Central Valley RWQCB 2009) contains water quality objectives with water quality standards specific to this portion of the San Joaquin River. The Basin Plan currently contains site-specific standards for the following parameters: fecal coliform, dissolved oxygen, lead, pH, electrical conductivity, and turbidity. Water quality in Reach 2B should also comply with the California Toxics Rule and the National Toxics Rule promulgated by EPA under 40 CFR Part 131.

This section of the Project EIS/R will discuss the changes and impacts to water quality in the Project during construction and after completion of the restoration. Downstream

benefits and impacts from the SJRRP are expected to be addressed in the PEIS/R (SJRRP 2010c)

3.14.1 Data Sources and Availability

Water quality data collected in Millerton Lake, Mendota Pool, and in the San Joaquin River during Interim Flows will be used as the basis for determining water quality impacts. The significance level of the impact for CEQA will be based on a comparison of expected water quality and water quality objectives (WQO) for the San Joaquin River. The Basin Plan lists both cold and warm water beneficial uses for the San Joaquin River between Friant Dam and Mendota Pool. Contact recreation is also listed as an existing beneficial use. For purposes of the analysis and to be consistent with the fisheries goals of the Project, cold water WQOs will be used as the basis for impacts as well as contact recreation WQOs.

As part of the Interim Flows, water quality data are being collected in the San Joaquin River. At the Gravelly Ford monitoring station, real-time data includes flow, stage, temperature, and electrical conductivity (EC). At the San Joaquin River Below Bifurcation monitoring station, real-time data includes flow, stage, temperature, EC, dissolved oxygen (DO), pH, turbidity, and chlorophyll. These water quality data and additional water quality analytes (e.g., coliforms, metals, and pesticides) are also collected manually or with real-time sensors at various other locations along the San Joaquin River. Other data are potentially available from local water agencies that supply domestic water since they are required routinely to monitor their supply water. Historical water quality data is limited.

Mendota Pool is listed on the 303(d) list as an impaired water body for selenium. As a consequence, Reclamation monitors the selenium concentration in Mendota Pool on a regular basis. This data should be available to include in the analysis.

3.14.2 Data Gaps

Data on the water quality in the San Joaquin River above Mendota Pool are scarce except for data being collected as part of the Interim Flows. Since Millerton Lake is the major source of water to the San Joaquin River and is also used for drinking water supply, data on its water quality should be available, but data quality will need to be reviewed to ensure it is adequate for the assessment of environmental impacts. Although Millerton Lake is the major source of water there are potentially other minor sources of water between Millerton Lake and Reach 2B. Although their contribution is expected to be minor, there is no water quality data available to confirm this.

3.14.3 Tools and Tool Modifications

The level of impact to water quality due to restoration will be mainly based on a comparison between existing water quality data and WQOs. Where the Project has the potential to alter existing water quality, analytical methods will be utilized to determine the significance of the effect and potential mitigation measures. For turbidity and constituents in sediment suspended by the Project, analytical methods for calculating suspended sediment concentration will be used in conjunction with calculated erosion rates, data on sediment gradations, and constituent partition coefficients.

The Project could potentially generate suspended sediment loads to the River during construction and post-construction. Though construction BMPs will likely be implemented to minimize the discharge of sediment to the river to the extent that construction occurs during the rainy season, there could be a discharge of sediment during storm events. Depending upon how the design proceeds and the type of construction required, tools may need to be developed to estimate the size and effectiveness of BMP measures such as sedimentation ponds, swales, or filter strips that may be required during construction. Post-construction, some alternatives may release suspended sediment related to channel downcutting or widening until the channel reaches an equilibrium. Analytical methods will be used to estimate erosion and suspension rates and turbidity and constituent concentrations for use in comparing to the WQOs.

3.14.4 Results Format

A report will be prepared that follows the NEPA and CEQA guidance for analyzing the water quality resource area. The report will include tables showing all the water quality data and relevant WQOs compiled for the report. A map showing the locations where the data were collected will also be included.

If any analysis of proposed construction BMPs is needed, a report describing the BMPs, the tools used for their analysis, and the results of the analysis will be included. A report describing sediment erosion rates and the derived suspended sediment and constituent concentrations will also be included.

3.15 Indian Trust Assets

The Indian trust assets assessment will compare the effects on any Indian trust assets that would result from implementation of the Project alternatives.

3.15.1 Data Sources and Availability

Indian Trust Assets (ITAs) are property interests held in trust by the United States for the benefit of Indian tribes or individual Indians. Common ITAs are Indian reservations, rancherias, and public domain allotments. The land associated with these ITAs as well as the resources within the boundaries (e.g., trees, minerals, oil and gas) are considered trust assets. Other ITAs include traditional-use areas and fishery resources. Hunting and fishing rights may be considered ITAs but are regulated by the DFG.

Reclamation's Mid-Pacific Region maintains a GIS database of ITAs that was created in the mid-1990s in support of the Central Valley Project (CVP) Improvement Act EIS. Information in the PEIS/R is expected to show the reservations, rancherias, and public domain allotments in the overall SJRRP Area. The Reach 2B Project team will request that Reclamation provide this information to check for ITAs within the Project area. However, previous searches of this database for other projects within the San Joaquin River Exchange Contractors Service Area (URS 2004) did not yield any ITAs; consequently, none are anticipated.

3.15.2 Data Gaps

Because Reclamation maintains an ITA database which has been accessed in preparation for the PEIS/R (SJRRP 2010c), no further searches are required. The information from the database will be incorporated into the Project EIS/R. Reclamation will consult with the Native American Affairs Specialist to ensure no impacts to ITA.

3.15.3 Tools and Tool Modifications

No tools or modifications are required.

3.15.4 Results Format

The Project EIS/R will reference the PEIS/R. See Section 3.15.2 above.

3.16 Land Use

This section describes the analytical tools and approach for land use. The land that will be affected by the alternatives is in Fresno and Madera Counties. There are no incorporated cities within the Project area. Several levees protect agricultural land which is planted in a variety of annual and permanent crops (SJRRP 2010c). Nearly all land in the Project area is privately owned, and the primary nonagricultural land use in the Reach is open space (SJRRP 2010c).

The key variables directly and indirectly related to land use include the value of crop production that will be lost and the value of land that will be purchased under the various alternatives. The value of lost crop production and the prices of purchased land will have impacts throughout the area.

3.16.1 Data Sources and Availability

Several data sources will be required to analyze land use among the alternatives. These include information on existing and planned land uses in and adjacent to the Restoration Area. Because all land in the Project area is in private ownership, it will be necessary to use both publicly-available secondary information and data from other sources, such as the water agencies which serve land in the Project area.

The specific current land use information required will be the crops currently grown on the parcels that will be affected by each alternative. Secondary data is available from the California DWR Land Use Survey program (DWR 2000 and DWR 2001), which periodically publishes agricultural land use maps for various California counties. The most current map for Fresno County is for 2000 and that for Madera County is for 2001.

Other land use information is available through the California Department of Conservation Farmland Mapping and Monitoring Program (California Department of Conservation 2008), which provides data on prime farmland, farmland of statewide importance, unique farmland, and farmland of local importance. The most recent such maps, and GIS coverages, are 2006 for Fresno County and 2008 for Madera County.

3.16.2 Data Gaps

The primary data gaps for land use are current cropping practices on those parcels which will be affected by the alternatives. Land values vary considerably even within specific areas because of differences in water supplies, micro-soil and micro-climate conditions, and other factors. Land values for broad areas are available from the publications of the American Society of Farm Managers and Rural Appraisers (American Society of Farm Managers and Rural Appraisers 2009). More narrowly-defined land value information on recent land sales can be purchased from commercial vendors. In addition, independent appraisers may be retained to value specific parcels of land.

Current cropping practices are not available at a project level of detail directly from secondary, public sources. California DWR information is dated and may not be reflective of current land use in the area. More reliable information should be available from the agencies which provide irrigation water to the lands. Most water agencies compile crop acreage data annually and have information on the crops grown on specific parcels within their respective service areas.

Assuming GIS coverages are available for the alternatives, it would be necessary to verify with each agency the crops grown on each affected parcel. Once specific land uses are identified, other data that will affect the socioeconomics resource area can be collected from available sources, e.g., property tax information available from the Assessor's Offices of Madera and Fresno Counties.

3.16.3 Tools and Tool Modifications

The primary tools that will be used to evaluate the impacts of the alternatives on land use will be a spreadsheet model and an input-output model. The spreadsheet model will include data on acreages of land that will be removed from production, the crops grown on those lands, and land values. The direct impacts of permanent land idling and associated purchases from landowners will be input into a regional input-output model in estimating the overall regional impacts of the alternatives. The inputs will include crop production lost, land purchases, construction and operation, maintenance, and repair expenses, and other direct impacts associated with each alternative. The input-output model will be developed for Fresno and Madera Counties combined, using IMPLAN data and software. An IMPLAN model includes every economic sector present within a study region and measures the economic linkages present among those sectors.

3.16.4 Results Format

The results of the impacts of the alternatives on land use will be will be presented in tabular form along with other related economic impacts such as construction and operation, maintenance, and repair expenses and recreation. The tabulations will show for each alternative the number of acres of each crop that will be permanently removed from production, the value of output from that land, and the value of the land itself.

3.17 Noise and Vibration

The analysis of Project noise effects will be based on the assessment of change in noise exposure and established noise threshold criteria. Existing ambient noise exposure will be determined and potential changes in noise exposure attributable to the Project will be assessed based on an acoustical modeling of the project construction and operational activities. The significance of future noise levels will be based appropriate threshold criteria as determined by literature review. Potential vibration effects will be assessed based on available source level data, industry standard methodology and literature review.

3.17.1 Data Sources and Availability

The following data sources were identified as applicable to the assessment of potential noise impacts:

- Project description of physical features of the project
- GIS as appropriate to map Noise/Vibration Sensitive Areas (NVSAs) in Project vicinity
- Existing land uses:
- Publicly-available information from the water agencies
- Data collected from landowners
- California DWR Land Use Survey program (DWR 2000 and DWR 2001)
- California Department of Conservation Farmland Mapping and Monitoring Program (California Department of Conservation 2008)
- Planned future land uses:
- Madera County General Plan, last completed in 1995 (Madera County Planning Department 1995)
- Fresno County General Plan, last completed in 2000 (Fresno County Department of Public Works and Planning 2000)
- Aerial and satellite photography
- Existing noise data from county general plans, noise elements, specific plans, redevelopment plans, public lands plans, etc.
- Madera County Noise Ordinance
- Fresno County Noise Ordinance
- California Department of Fish and Game, Natural Diversity Data Base (CNDDB)

3.17.2 Data Gaps

The following additional data will be required to perform the assessment of potential noise and vibration impacts:

- Identification of NVSAs in the Project area and haul routes. NVSAs include residential areas, schools, libraries, sensitive wildlife habitats, or other areas where quiet is an important attribute of the environment. It is assumed that the Consultant Team will, based on literature and mapping reviews and a site visit, compile a list of NVSAs.
- Ambient noise data. Ambient noise measurements will be conducted by the Consultant Team to describe the existing noise environment in the vicinity of NVSAs.
- Source noise level and vibration data for major equipment operational, maintenance, and construction noise sources. A description of construction methods, construction phases, timing, and duration is also required. It is assumed that these data will be provided by the Project Engineer.
- Type and number of heavy equipment and vehicles, including worker vehicles, utilized for construction and their timing and schedule. It is assumed that these data will be provided by the Project Engineer.

3.17.3 Tools and Tool Modifications

The potential noise impacts of the alternatives will be assessed using ambient noise data for the area that will be affected by each alternative and predicted noise level data at NVSAs based on modeled noise exposure. Noise exposure will be modeled using Cadna/A®. Cadna/A® is a three dimensional software program for prediction and assessment of noise levels in the vicinity of industrial facilities, construction sites and other noise sources. Cadna/A® uses internationally recognized algorithms (International Organization for Standardization (ISO) 9613 2) for the propagation of sound outdoors to calculate noise levels and presents the resultant noise levels in an easy to understand, graphically-oriented format. The program allows for input of all pertinent features (such as terrain or structures) that affect noise, resulting in a highly accurate estimate of existing and future noise levels.

Cadna/A® will be used to create a virtual model of the Project area. Topography data (2008/2009 LiDAR and bathymetry) will be used to account for elevation and terrain features, and aerial photographs will be used to model the existing structures. Source noise emission levels will be input using octave band levels, to accurately estimate noise propagation and attenuation effects. Attenuation due to spherical wave divergence, topographic features, barriers, and standard atmospheric absorption (70 percent relative humidity, 60˚ F) will be included in the calculation of predicted noise levels.

Vibration analysis will be conducted using industry standard vibration propagation models.

3.17.4 Results Format

The Cadna/A® model output predicted noise levels at several discrete locations and areas of equal noisiness around the project site. These levels will be compared to ambient noise levels and established significance criteria to determine areas of potential noise impact. Vibration levels at NVSAs will be determined in terms of VdB and compared to established significance criteria to determine areas of potential vibration impact.

3.18 Paleontological Resources

This section describes the analytical tools and approach for the assessment of potential impacts to sensitive paleontological resources during construction in the Project area. The paleontological assessment will provide an overview of the existing and regulatory paleontological sensitivity setting of the paleontological resources within the Project area.

3.18.1 Data Sources and Availability

Data gathered prior to the field work will rely primarily on published and available information. Data will be collected via a literature review and museum records search. A one-mile radius around the footprint of the Project and all alternatives will be adopted for the paleontological records search. Only records for vertebrate fossils will be requested. A topographic map showing the Project and alternatives footprints and a one-mile radius around them will be sent to each institution queried with a request for information on the localities producing vertebrate fossils within the one-mile radius. These institutions will be the University of California Museum of Paleontology (UCMP), Buena Vista Museum of Natural History in Bakersfield, and the Natural History Museum of Los Angeles. Pertinent geological maps and literature on the geology and paleontology of the area will also be obtained.

3.18.2 Data Gaps

A survey of the Project area will be conducted to document the presence of paleontological resources, if any. The survey will involve looking for natural or artificial exposures of sediments within and immediately adjacent to the Project and alternative boundaries. The buffer zone to be surveyed will be defined as 100’ either side of or around project footprint. The types of invertebrate and vertebrate fossils will be noted and the localities will be recorded with a GPS device. Photographs may also be made of select fossils and localities. Easily collected small bones and teeth will be collected rather than let them be lost to processes of erosion. Each specimen collected will be assigned a field number and the specimen and the locality data will be entered in a field notebook.

3.18.3 Tools and Tool Modifications

To assess if a sensitive paleontological resource could potentially be impacted, the literature review will follow the recently signed into Federal law, Paleontological Resources Preservation Act, CEQA, and guidelines developed by the Association of Environmental Professionals and the Society of Vertebrate Paleontology (SVP). Sedimentary Rock units are classified by SVP as having (a) high (or known) potential for containing significant nonrenewable paleontological resources, (b) low potential for containing nonrenewable paleontological resources, or (c) undetermined potential. The

review will consist of reviewing geologic maps to determine which surficial and near surface formations that could be impacted, a review of UCMP for these formations followed by additional research, as needed, to conclude the paleontological potential for each formation.

Upon completion of a paleontological literature and museum reviews, a field survey will be completed at the formations that have the potential to contain significant paleontological resources. These field reconnaissance activities will further document on a formation and on a site-specific location basis, the potential impacts to significant paleontological resources.

3.18.4 Results Format

The results of the paleontological assessment will be summarized in narrative and tabular form and include the findings of the literature and museum reviews, field survey, potential paleontological impacts, and mitigation measures.

3.19 Population and Housing

This section describes the analytical tools and approach for the analysis of population and housing in the Project area. The Project area includes land in unincorporated areas of Fresno and Madera Counties.

3.19.1 Data Sources and Availability

The most recent population and housing data for the Project area is in the 2000 Census of Population and Housing. Data from that source can be compared to similar information from the 1990 Census of Population and Housing, but more recent information is not available at the Project area level of detail. The available data allow the estimation of changes in population and housing in each of the unincorporated areas between 1990 and 2000. More current population data is available from the California Department of Finance Demographic Research Unit. However, that information is available only for incorporated cities and for the total unincorporated area within each county.

3.19.2 Data Gaps

As noted above, the most recent data on population and housing in the Project area is from the 2000 Census of Population and Housing. It is not expected that updated data will be available, so assessment of the effects of population and housing will be based on the 2000 data.

3.19.3 Tools and Tool Modifications

Alternatives assessment of effects on population and housing is qualitative in nature. The impacts of the alternatives on population and housing will be assessed using information on the area that will be affected by each alternative as well as estimated agricultural and non-agricultural impacts. The permanent idling of agricultural land under the alternatives can be expected to have an adverse impact on agricultural labor, which in turn may influence population if some presently-employed laborers move out of the area.

3.19.4 Results Format

The population and housing effects will be presented in tabular formats showing the estimated changes for each alternative. This format will meet the needs of the Project by providing a comparison of the estimated impacts among alternatives.

3.20 Public Services and Utilities

This section discusses existing utilities and public service systems which include wastewater collection, fire protection services, law enforcement services, emergency services, solid waste management, utility crossings (including natural gas, electrical transmissions, and communication utilities), surface water supply distribution, and energy resources.

Wastewater Collection

The primary sanitary sewer disposal method is by individual or community septic systems. None of the Project area is served by a municipal wastewater collection system.

Fire Protection Services

Fire protection services are provided by the Fresno County Fire District.

Law Enforcement Services

Law enforcement services are provided by the Fresno County Sheriff's Department.

Emergency Services

Emergency services are provided by the California Highway Patrol (CHP) and the Fresno County Sheriff's Department.

Solid Waste Management

Solid waste services are provided by the Fresno County Resources Division.

Utility Crossings

PG&E-owned electrical distribution lines cross the San Joaquin River in this reach and all of them are overhead. PG&E also owns underground gas transmission lines that may be located within the Project area. Additionally, the Gill Ranch Gas Storage Project proposes to install a new underground gas pipeline across the San Joaquin River within Reach 2B. Most communication facilities are located in road or railroad rights-of-way.

Energy

The facilities within the Project area include a number of small pumps used to divert water for irrigation purposes. The number, size, and use of the pumps are not known. The flow changes in the SJRRP are not expected to have an impact on the usage of the pumps, except those located within the Mendota Pool upstream of the proposed Mendota Pool Bypass alignments.

Water Supply Diversions
The increased flows in the SJRRP are not expected to have an impact on the usage of the diversions for irrigation or water supply, except those located within the Mendota Pool upstream of the proposed Mendota Pool Bypass alignments.

School services and facilities
These resources are not discussed because none of these facilities would be affected.

3.20.1 Data Sources and Availability
The evaluation of potential impacts on utilities and public services systems will be based on document reviews and available literature from the following resources:

- Documents and web-based information published by Federal, State, county, and municipal agencies, including applicable elements from the general plans of Fresno and Madera counties.
- Consultation with appropriate agencies and utility providers.
- Aerial and ground photography of the study area and local environs.

Currently, there is no analytical model that would address impacts on intake structures and diversions. CalSim is a planning model designed to simulate operations of the CVP and State Water Project (SWP) reservoirs and water delivery system for current and future facilities, flood control operating criteria, water delivery policies, and instream flow and Sacramento-San Joaquin Delta outflow requirements. CalSim is the best available tool for modeling the CVP and SWP and is the only system-wide hydrologic model being used by Reclamation and DWR to conduct planning and impact analyses of potential projects. CalSim model outputs include river stage and flow data.

3.20.2 Data Gaps
Information under preparation for the PEIS/R regarding the diversions along the Project area may be missing data such as an identifier, diversion type, discharge type, screen type, operation status, primary use and estimated maximum diversion capacity. Attempts at filling these data gaps may be conducted by consultation with local property owners and/or agencies.

Information under preparation for the PEIS/R may be missing the status or specific location of underground natural gas or electrical transmission lines. PG&E may be contacted to identify the specific location within the Project area and fill the data gap.

Underground Service Alert (USA) or other private underground utility surveyors can be used to identify underground utilities in areas that may be physically impacted by restoration grading or excavation activities.

3.20.3 Tools and Tool Modifications
A suite of modeling tools will be used to evaluate the potential effects of the SJRRP on surface water supplies and facilities operations (including CalSim and hydraulic modeling described in Section 2.1). For public utilities and water supply diversions, a

specific analytical tool may not be warranted. Qualitative descriptions and assessments will be the primary analysis tools.

3.20.4 Results Format

The document review results will be presented in a table format and location maps. This format will meet the Project's analytical needs by identifying utilities and public services that may be impacted by restoration activities for each alternative.

The results format will meet the Project's analytical needs by examining flow data and river stage tables derived from the CalSim model as an input for evaluating impacts for each alternative.

3.21 Recreation

The recreational opportunities in the immediate Project area are very limited. No direct public access is available to the Project area because the most proximate vehicle access is by San Mateo Avenue, a public right-of-way ending about 0.6 miles south of the channel. Recreational use of the river therefore requires crossing private land. The primary nearby water-related recreational opportunities are at Mendota Pool, about four miles from San Mateo Avenue, which offers angling.

The primary recreation activity currently in the Project area site is off-highway vehicle use in areas upstream of San Mateo Avenue. This activity would likely be constrained or eliminated by the Project because of potential damage to emerging and successional vegetation in proposed habitats. Other unauthorized vehicle access to the Restoration Area would also likely be constrained or eliminated for similar reasons.

It is likely that future recreational demands in the area would increase at rates common for population growth in the west side of the San Joaquin Valley. Activities such as hiking and wildlife viewing may be permitted, but it is expected that other activities which could endanger salmon or result in trespassing would be restricted.

3.21.1 Data Sources and Availability

The primary publicly-available data that could be used to estimate future recreation demand is population statistics from the California Department of Finance Demographic Research Unit. That agency annually publishes population estimates for all incorporated cities in California and, for each county, total aggregate population in all unincorporated areas. The pertinent data would include the population for the City of Mendota and other nearby cities (e.g., City of Firebaugh). Other information would be collected from recreation-related venues in the area (e.g., the Mendota Public Works Department, which administers parks in the city) and private venues (e.g., Jack's Resort on West Whitesbridge Avenue in Mendota).

3.21.2 Data Gaps

Data on recreational activities and recreational use in the study area are not available from published public sources. An indication of recreational use will be obtained by contacting the sources noted above.

3.21.3 Tools and Tool Modifications

No analytical tools are anticipated for the assessment of effects on recreation resources.

3.21.4 Results Format

The recreation effects will be presented in tabular formats showing the estimated changes for each alternative. This format will meet the needs of the Project by providing a comparison of the estimated impacts among alternatives.

3.22 Socioeconomics and Economics

This section describes the analytical tools and approach for evaluating socioeconomics and economics. The Project is likely to have several types of economic impacts, including:

- Loss of agricultural production values (revenues) based on permanently-idled cropland
- Purchase of affected land from existing landowners
- Initial construction and ongoing operation, maintenance, and repair costs
- Displacement of farm labor (with associated potential environmental justice issues)
- Indirect impacts on agricultural businesses
- Recreation
- Tax revenue to local agencies and local jurisdictions

3.22.1 Data Sources and Availability

Loss of Agricultural Production Values based on Permanently-Idled Cropland

The physical impacts on agricultural operations in the project area are discussed in Section 3.3. This section will utilize that information in conjunction with data on crop yields and prices to estimate changes in agricultural revenues. Information on crop yields and prices will be obtained from County Agricultural Commissioner reports, which are readily available. It will be important to understand representative cropping patterns in the project area in order to select the appropriate crop data to use in the analysis.

Purchase of Affected Land from Existing Landowners

It is assumed that any land permanently removed from its existing agricultural or non-agricultural use will be purchased in a willing seller-willing buyer transaction. Agricultural land prices will be obtained initially from the annual land valuation reports prepared by the Association of Farm Managers and Rural Appraisers (ASFMRA 2009).

As noted previously, those publications provide ranges of farmland values defined for specific crops and for relatively broad geographic areas. Should greater detail be required for the analysis, data on specific transactions could be purchased from a commercial vendor or an independent appraiser retained.

Initial Construction and Ongoing OM&R Costs

The costs for project construction and ongoing operation, maintenance, and repair activities will have socioeconomic and economic impacts on the area. Project construction will comprise purchases of goods and services, hiring of labor, and other activities. Each will have impacts on specific industries in the immediate Project area and beyond. It is assumed that these data will be provided by DWR.

Displacement of Farm Labor (with associated Environmental Justice Issues)

As farmland is permanently removed from production, some farm labor will be displaced. The number of employees displaced will depend directly on the number of acres of land removed from production and the crops grown on those lands.

Indirect Impacts on Agricultural Businesses

Agricultural production is a goods-producing industry that affects and is affected by many other industries in a local area. As crop acreage expands or contracts, so also will the purchases of such inputs as seed, chemicals, fertilizers, and machinery. As these related industries are affected, they change their purchases of goods and services required in their respective operations. The culmination of the series of buying and selling transactions across many sectors is a total economic impact typically much greater than the initial direct impact.

The indirect impacts on agricultural businesses by the Project alternatives will be assessed using an input-output model of the Fresno and Madera County region. Once developed and validated, the model will be used to estimate the indirect and total impacts of the alternatives.

3.22.2 Data Gaps

No data gaps other than those described under Land Use (see Section 3.16) are anticipated. Estimation of the socioeconomic and economic impacts of the alternatives will require data for several areas, including construction and operation, maintenance, and repair costs, prices of purchased land, and lost agricultural production.

3.22.3 Tools and Tool Modifications

The primary tool that will be used for socioeconomic analysis is an input-output model developed using IMPLAN software and data (Minnesota IMPLAN Group (MIG) 2010). IMPLAN is a commercial vendor which sells software and data for every county in the United States. An IMPLAN model includes every economic sector present within a region of one or more counties and captures the manifold interlinkages among those sectors. For the Project analysis, it is expected that an IMPLAN model will be developed for the region including Madera and Fresno Counties. IMPLAN models can be developed for sub-regional areas, e.g., zip codes and cities. However, such models are often unreliable unless the city or zip code modeled includes a relatively complete cross section

of industries. For the Project area, the reliability of a zip code or city model would be highly suspect.

The IMPLAN model will be validated using information from, among other sources, the production enterprise budgets of the UCCE (UCCE 2010). The UCCE data for specific crops will be utilized to evaluate whether the production "recipe" for each crop within the IMPLAN model is accurate. If the information appears representative, the model will not be modified. If the UCCE data varies widely from the IMPLAN sectoral model, the latter will be modified to conform more closely to the UCCE data.

The IMPLAN model will be utilized to assess the impacts of construction and operation, maintenance, and repair costs, land purchases, reduced agricultural production, recreation, and other direct measures on the regional economy. Each direct impact will be input into the model in one or more entries.

3.22.4 Results Format

The results of the socioeconomics resource area evaluation will be presented in tabular and graphic form, showing for each alternative the direct, indirect, and total socioeconomic impacts. This format will meet the analytical needs of the Project by showing the overall socioeconomic impacts likely under each alternative.

3.23 Transportation and Traffic

This section describes the approach to analyzing the various roadway (local and State Routes) crossings of the San Joaquin River within the Project area, as well as the existing traffic conditions in the vicinity of the Project area for the purposes of the Project EIS/R. The following roads are located adjacent to the river in the immediate vicinity of the Project:

- N San Mateo Avenue / Road 13
- Chowchilla Canal Road
- Bass Avenue / Helm Canal Road
- Eastside Drive
- Drive 10.5 / Columbia Road
- SR 33
- SR 180 / W Whitesbridge Avenue

The following local routes and intersections have the potential to be affected by construction traffic and may be assessed as part of the Project EIS/R:

- Route 180 and North San Mateo Avenue
- Route 33 and Bass Avenue
- Bass Avenue and Helm Canal Road/Columbia Road/Drive 10 ½

- Drive 10 ½ and Eastside Drive
- Eastside Drive and North San Mateo Avenue/Road 13

River crossings in the Project and the roads listed above are under either the State's, Madera or Fresno County's jurisdiction, and these agency standards and guidelines will influence the design and construction. In addition to Reclamation's Standards and Design Criteria, the following Codes, Regulations, and other Agency Standards may govern the design as they apply.

- American Concrete Institute
- American Society for Testing and Materials
- American Association of State Highway and Transportation Officials
- California Department of Transportation
- Federal Highway Administration
- Madera County Transportation Commission
- Fresno Council of Governments' Regional Transportation Plan
- Geotechnical Report and other reports prepared for the overall SJRRP and for the Project area.

Also, the proposed design plans will be prepared in accordance to the local agency goals and policy related to traffic and circulation.

3.23.1 Data Sources and Availability

Several data sources for collecting the traffic data, as-built plans, topographic mapping, utility maps, and other relevant information are identified as follows:

- California Department of Transportation
- Madera County Transportation Commission
- County of Fresno
- City of Mendota
- Reclamation
- Utility Companies
- Private property owners, if needed

The above agencies will be contacted to collect documents relevant to the evaluation of existing conditions.

Data Collection and Review and Site Reconnaissance

Coordination with the above agencies will be necessary to identify and collect data relevant to the project such as as-built plans, details of the planned development projects affecting the Project area, related technical reports, right-of-way/easement records, traffic

and accident data. Utilities information gathered for the Public Services and Utilities assessment (see Section 3.20) will also be reviewed.

The data collection effort will establish a database of existing traffic volumes and related data for the Project area. Information already available such as traffic count data and traffic forecasting models may be relied upon. Traffic related data and information that may be required for the Project includes:

- The most recent traffic count data collected by the local agencies, Caltrans, and past or current studies undertaken by Reclamation
- Volume and speed data
- Traffic Accident Surveillance and Analysis System from Caltrans
- Aerial Photography of the Project area

Existing collections of data developed from other projects in the vicinity will also be reviewed. It is assumed that the Consultant Team will coordinate and collect this data, as available, and the information will be supplemented with a site visit. Access for the site visit is conditional on temporary entry permits for private property, local facilities, and Caltrans facilities.

Field Verification of Survey Data

Field verification of survey data may be necessary to confirm the location or presence/absence of drainage facilities, pavement conforms, obstructions, lighting fixtures, fences, drainage swales and ditches and any other features potentially affected by the Project alternatives. It is assumed that much of this information will have been verified by Reclamation or DWR; however, the Consultant Team may verify certain facilities during a site visit.

3.23.2 Data Gaps

Additional data required to assess the effects on transportation and traffic include:

- Traffic data
- Lane geometrics details (travel lane and shoulder width)
- Speed limit
- Pavement condition report
- Structure maintenance report
- Traffic signal phasing or timing details
- Existing utility information
- Right of way maps
- Construction vehicle types, timing, and schedule
- Environmental constraints or limitation
- Work zone capacity

- Construction working hours
- Construction staging areas
- Potential construction ingress and egress points

Traffic count data will be collected and used to evaluate the effects on traffic during the construction of the project based on the construction staging. The construction staging sequence should be developed in a way that impacts to the traffic are minimized. In order to conduct the traffic impact analysis additional information such as type and number of trucks required during construction, construction schedule, and maximum number trips anticipated in a day will be needed. This information and the 24-hour traffic volume from Caltrans and other local agencies will be used in the traffic delay analysis.

In order to determine the hourly volumes along affected routes/roads, 24-hour traffic volume collected from Caltrans and other agency will be used. Existing Average Daily Traffic (ADT) of current design year for affected routes/roads will be used with a growth factor of 1 percent per year to calculate ADT for the projected construction year to analyze for worst case scenario.

3.23.3 Tools and Tool Modifications

Traffic

This section summarizes the approach to evaluate the impacts of the construction related and operations traffic generated by the Project for the purposes of the Project EIS/R. The daily and peak trip generation related to the construction will be estimated and compared to daily road segment volumes, intersection operations and volumes, and/or roadway designs, as appropriate. Additionally, the assessment may review additional levels of delay associated with the construction.

Transportation System

The following analyses will be prepared based on the data collection:

- Lane closure analysis using the 24-hour traffic volume
- Transportation management analysis according to Caltrans guidelines
- Detour traffic analysis (if needed)
- Right-of-way requirement analysis

Traffic impacts on the transportation infrastructure due to the addition of the traffic from the proposed project should be evaluated. For the purpose of the Project EIS/R, traffic analysis for the base year, construction year, and future year would be conducted. Mitigation measures to mitigate intersections and roadway segments projected to be significantly impacted due to the addition of traffic from the Project would also be assessed.

3.23.4 Results Format

Based on the above analyses, the following issues will be addressed in the Project EIS/R:

- Traffic operational impacts
- Reduced traffic circulation and roadway capacity
- Lane closure chart
- Detour traffic analysis (if needed)
- Transportation Management Plan
- Right of way impacts (temporary construction easements)
- Impact to local communities and businesses

The results of the transportation and traffic resource area evaluation will be presented in tabular and narrative form, showing for each alternative the direct, indirect, and total transportation and traffic impacts. This format will meet the analytical needs of the Project by showing the overall transportation and traffic impacts likely under each alternative.

3.24 Summary

Table 3-2 summarizes the environmental effects and associated analytical tools required to assess the final alternatives for each resource area.

Table 3-2.
Summary of Tools for the Environmental Assessment

Resource Area	Environmental Effect	Tools
Aesthetic and Visual Resources	Changes to the viewshed and to any critical public views	Qualitative assessment using Visual Modification Class Approach
Air Quality	Construction-related air pollutant emissions: NOX, SOX, CO2, CO, PM10 Dust Toxic air contaminants Greenhouse gases Health risks from air pollutants Air dispersion, if needed	CARB and SJVAPCD emission factors URBEMIS OFFROAD EMFAC2007 HARP AERMOD, if needed
Agricultural Resources	Changes in agricultural acreage and crop production	Spreadsheet model using crop acreages, published data on crop yields and prices
Biological Resources – Fisheries	Changes in in-channel habitat, floodplain habitat, passage, temperature regime	HEC-RAS, hydrology information, frequency duration curves, SRH-1DV, geomorphic principles
Biological Resources – Vegetation	Changes in acreage or quality of special status plants and vegetation alliances	SRH-1DV, listed plant surveys
Biological Resources – Wildlife	Changes in acreage or quality of special status wildlife habitat	SRH-1DV, wildlife habitat surveys

Table 3-2.
Summary of Tools for the Environmental Assessment

Resource Area	Environmental Effect	Tools
Climate Change and Greenhouse Gas Emissions	Construction related emissions	EMFAC2007
Cultural Resources	Disturbance of cultural resources	Field surveys and database/document review
Environmental Justice	Disproportionate, adverse effects to minority populations	Spreadsheet model using demographic data
Geology, Soils, and Mineral Resources	Levee stability, erosion and sedimentation, land subsidence, and changes in river geomorphology	Flow duration curve, HEC-RAS, SRH-1D, geomorphic principles, bank stability indices
Hazards, Hazardous Materials, and Public Health	Changes in health exposure to hazards materials, West Nile virus, Valley fever, naturally occurring asbestos, wildland fires, oil and gas wells. Effects on school safety, aircraft safety.	Database/document review and field surveys
Hydrology – Groundwater and Groundwater Quality	Changes to seepage affected areas and groundwater elevation	CVHM
Hydrology – Jurisdictional Wetlands and Other Waters of the United States	Changes in acreage or quality of jurisdictional wetlands and waters	Field surveys and mapping
Hydrology – Surface Water Resources and Water Quality	Changes 303(d) listed constituents	Qualitative assessment
Indian Trust Assets	Changes to Indian trust assets	Database review
Land Use	Changes to land use	Spreadsheet model with land acreage, crops, and land values and IMPLAN
Noise and Vibration	Changes in noise exposure	Ambient noise data and Cadna/A®
Paleontological Resources	Disturbance of paleontological resources	Field surveys and database/document review
Population and Housing	Changes to agricultural and non-agricultural land use and labor	Qualitative assessment
Public Services and Utilities	Changes to wastewater collection, fire protection services, law enforcement services, emergency services, solid waste management, utility crossings, energy, water supply diversions, and school services and facilities	HEC-RAS and qualitative assessment
Recreation	Changes to recreation availability and access	Qualitative assessment
Socioeconomics and Economics	Changes to agricultural production, purchases of affected land from	IMPLAN

Table 3-2.
Summary of Tools for the Environmental Assessment

Resource Area	Environmental Effect	Tools
	existing landowners, construction and operation, maintenance, and repair costs, displacement of farm labor, indirect impacts on agricultural businesses, and recreation	
Transportation and Traffic	Changes to traffic patterns and volume and the transportation system	Traffic counts and Highway Capacity Manual

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