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Abbreviations & Acronyms

AFRP	Anadromous Fish Restoration Program
AFSP	Anadromous Fish Screen Program
BA	Biological Assessment
BDCP	Bay Delta Conservation Plan
BDPAC	Bay Delta Public Advisory Committee
BO	biological opinion
CBDA	California Bay-Delta Authority
CCWD	Contra Costa Water District
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CFS	conservancy fairy shrimp
CNDDB	California Natural Diversity Database
Corps	U.S. Army Corps of Engineers
CVI	Central Valley Chinook salmon ocean harvest index
CVP	Central Valley Project
CVP	Central Valley Pumps
CVPIA	Central Valley Project Improvement Act
dB	decibels
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin Delta
Delta	Sacramento-San Joaquin River Delta
Delta	San Joaquin Delta
DFG	Department of Fish and Game
DOI	Department of the Interior
DPSs	distinct population segments
DSM2	Delta Simulation Model II

DWR	Department of Water Resources
EFH	essential fish habitat
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
EWA	Environmental Water Account
EWP	Environmental Water Program
FMPs	fishery management plans
FMWT	Fall Midwater Trawl Survey
FRFH	Feather River Fish Hatchery
GGS	Giant Garter Snake
GGS	Giant Garter Snake
HORB	Head of Old River Barrier
IEP	Interagency Ecological Program
JPE	Juvenile Production Estimates
LSNFH	Livingston Stone National Fish Hatchery
LSZ	low salinity zone
LWD	large woody debris
mm	millimeters
NMFS	National Marine Fisheries Service
NPS	non-point source
OMR	Old and Middle Rivers
PAHs	polycyclic aromatic hydrocarbons
PCE	Primary Constituent Elements
PFMC	Pacific Fishery Management Council
POD	Pelagic Organism Decline
Project	2-Gates Project
PTM	particle tracking model
RBDD	Red Bluff Diversion Dam
RM	river mile
RMA	Resource Management Associates
RPA	Reasonable and Prudent Alternative
SDTB	South Delta Temporary Barriers
SEL	sound exposure level
SKT	Spring Kodiak Trawl
SMSCG	Suisun Marsh Salinity Control Gates
SRA	shaded riverine aquatic
SWP	State Water Project
SWP	State Water Pump
SWRCB	State Water Resources Control Board
TBI	The Bay Institute
TNS	Townet Survey
USFWS	U.S. Fish and Wildlife Service

VAMP	Vernalis Adaptive Management Plan
VPFS	vernal pool fairy shrimp
VPTS	vernal pool tadpole shrimp
WAP	Water Acquisition Program
YOY	young-of-the-year

SECTION 6

Cumulative Effects

6.1 OVERVIEW

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BA. Future Federal actions that are unrelated to the Project are not considered in this section because they require separate consultation pursuant to Section 7 of the Endangered Species Act (ESA).

Non-Federal actions that are reasonably certain to occur in the Action Area include: (1) on-going non-Federal water diversions for irrigated agriculture and managed wetlands; (2) State and/or local levee maintenance activities; (3) stormwater and/or irrigation discharges; (4) point and non-point source pollution; (5) oil and gas produce discharges; (6) invasive species introductions; and, (7) climate change.

Planning efforts such as the Bay Delta Conservation Plan and the Governor's Delta Vision process are anticipated to have both adverse and beneficial effects to listed species and designated critical as a result of planned actions. However, the effects are anticipated in the long-term and are not likely to occur within the 5-year time frame of the 2-Gates Project. In addition, these efforts are expected to have a federal nexus and will be the subject of future State and Federal ESA consultations.

6.2 NON-FEDERAL WATER DIVERSIONS

There are a number of unscreened non-Federal water diversions within the action area. Depending on the size, location, and period of operation, these unscreened diversions are believed to entrain various life stages of aquatic species, including listed salmonids and delta smelt. Although, the results of a study conducted by Nobriga et al. (2004) suggest that entrainment of very many delta smelt is not likely. In general, the littoral location and low-flow operational characteristics of these diversions are thought to reduce the risk of entraining delta smelt. Similar information is not currently available for salmonids.

6.3 STATE AND LOCAL LEVEE MAINTENANCE ACTIVITIES

Levee maintenance activities by State and local entities within the action area are expected to continue and may……. The study areas on Bacon Island and Mandeville Island are actively farmed, and land surrounding the agricultural fields is regularly disked. Portions of Holland Tract are under cultivation; but in the study area, the fields are fallow. Adjacent fields on Holland Tract were utilized as rangeland for cattle at the time of the field visit. Maintenance dredging occurs in the agricultural ditches on all islands. The alternate storage site on Holland Tract was grazed by cattle at the time of the site visit.

Most of the land bordering the study areas is farmland, rangeland, and open space. There are several unused structures (old farmhouses) located on Bacon Island in the Old River location; a large barn is located on Holland Tract. There is a structure visible on aerial photography at Mandeville Island near the access bridge.

Levees have been constructed along both banks of Old River and Connection Slough. The roads on the Old River levees are private. The road on the Bacon Island side of Connection Slough is public, while the road on

Mandeville Island is private. Periodic levee maintenance includes the control of vegetation and repairs of the riprap above the waterline.

6.4 STORMWATER AND IRRIGATION DISCHARGES

Adverse effects to designated critical habitat for delta smelt, Central Valley (CV) spring-run Chinook salmon and CV steelhead, and proposed critical habitat for the southern distinct population segments (DPSs) of North American Green Sturgeon may result from stormwater and/or irrigation discharges which change the balance of important habitat constituents (i.e. salinity, turbidity, water temperature, etc) within the action area.

6.5 POINT AND NON-POINT SOURCE POLLUTION

Adverse effects to designated critical habitat for delta smelt, CV spring-run Chinook salmon and CV steelhead, and proposed critical habitat for the southern DPSs of North American Green Sturgeon may result from stormwater and/or irrigation discharges which change the balance of important habitat constituents (i.e. salinity, turbidity, and water temperature, etc.) within the action area.

6.6 OIL AND GAS PRODUCT DISCHARGES

The introduction of contaminants from oil and gasoline product discharges as a result of on-going commercial and private shipping and boating within the action area is expected to continue. Implicated as potential stressors to aquatic species, these contaminants may adversely affect reproductive success and/or survival.

6.7 INVASIVE SPECIES

Invasive species introductions are also expected to continue although it is difficult to predict the types of species introduced and the magnitude of the effects. Adverse effects from these introductions may include changes in water quality (i.e. turbidity), reductions in food supply, competition for space, and predation.

6.8 CLIMATE CHANGE

Global warming and climate change is an issue that has become more prominent over the past decade and one that certainly warrants consideration in the long-run. It has been predicted that global warming will increase Central Valley ambient air temperatures by 2^{o}C to 7^{o}C by the end of this century. Such an increase is anticipated to have a profound effect on Central Valley run-off and local hydrology. Within the Delta, anticipated effects are expected to include changes in seasonal flow patterns and increased water levels (as a result of general sea level rise). While difficult to predict, it is anticipated that such events will affect the distribution, and possible even the abundance, of many aquatic species currently occupying the Delta seasonally or year round.