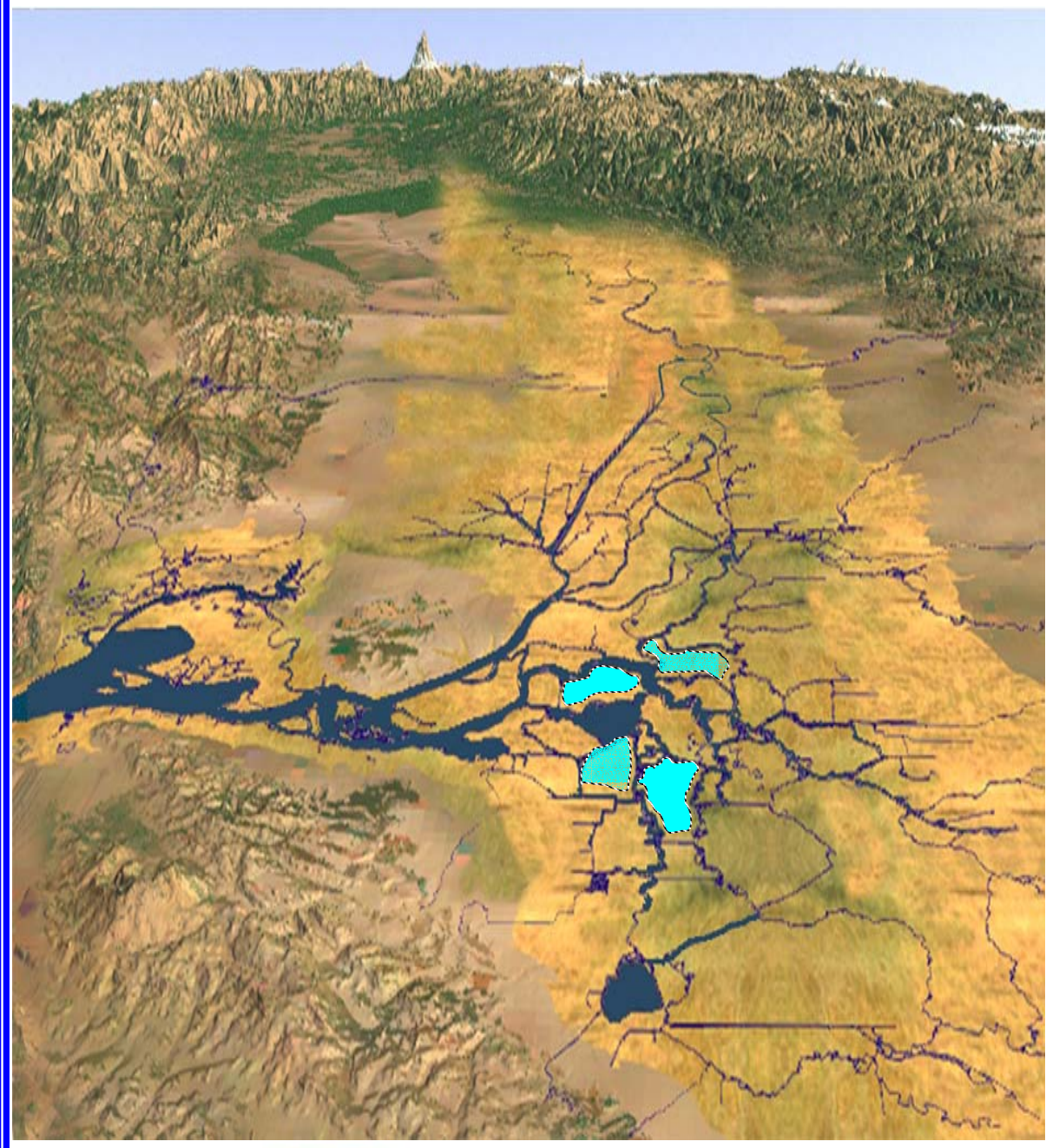
INTEGRATED STORAGE INVESTIGATIONS

IN-DELTA STORAGE PROGRAM
PLANNING STUDY REPORT ON ENVIRONMENTAL EVALUATIONS



CALFED BAY-DELTA PROGRAM

May 2002

ORGANIZATION

State of California
Gray Davis, Governor

The Resources Agency
Mary D. Nichols, Secretary for Resources

CALFED

Patrick Wright
Director

Department of Water Resources

Thomas M. Hannigan, Director
Steven Macaulay, Chief Deputy Director
Jonas Minton, Deputy Director
Raymond D. Hart, Deputy Director
L. Lucinda Chipponeri, Deputy Director
Peggy Bernardy, Chief Counsel
Naser Bateni, Chief
Div. of Planning and Local Assistance
Mark Cowin, Deputy Chief
Div. of Planning and Local Assistance

U.S. Bureau of Reclamation[1]
Mid-Pacific Region
Kirk Rodgers,
Regional Director
Susan Ramos,
Assistant Regional Director
Susan Hoffman,
Regional Planning Officer

This report was prepared under the direction of

Division of Planning and Local Assistance
Stephen S. Roberts, Chief
Surface Storage Investigations Branch
Tirath Pal Sandhu, Project Manager
In-Delta Storage Program

By
Environmental Investigations Team, In-Delta Storage Program

Department of Water Resources
Sarah Allred, Associate Environmental Planner, Environmental Services Office
Derrick Adachi, Senior Environmental Scientist, Division of Planning and Local Assistance
Robert DuVall, Environmental Scientist, Division of Planning and Local Assistance
James Gleim, Environmental Scientist, Division of Planning and Local Assistance
Janis Offermann, Senior Environmental Planner, Environmental Services Office
Laura Patterson, Environmental Scientist, Environmental Services Office
Roy Peterson, Environmental Scientist, Environmental Services Office
Leslie Pierce, Senior Environmental Scientist, Division of Planning and Local Assistance
Jerry Ripperda, Senior Environmental Scientist, Environmental Services Office
John Robles, Environmental Scientist, Division of Planning and Local Assistance
Harry Spanglet, Environmental Scientist, Environmental Services Office
Russ Stein, Senior Environmental Scientist, Environmental Services Office
Hans Walter, Environmental Scientist, Environmental Services Office
Heidi West, Environmental Scientist, Division of Planning and Local Assistance

[1] Participation limited to technical assistance.

ORGANIZATION

CH2M HILL
Dick Daniel, Senior Project Manager
Darryl Hayes, Water Resources Engineer

With major contributions from

Department of Water Resources
Anirban Bhattacharyya, Engineer Water Resources, Division of Planning and Local Assistance
Amarjot Bindra, Engineer Water Resources, Division of Planning and Local Assistance
Adrienne Carter, Engineer Water Resources, Division of Planning and Local Assistance
Cathy Crothers, Legal Counsel, Office of Chief Counsel
Nick Kontos, Senior Engineer, Division of Planning and Local Assistance
Hiren Majumdar, Engineer Water Resources, Division of Planning and Local Assistance
Tanya Veldhuizen, Environmental Scientist, Environmental Services Office

Additional technical assistance provided by

U.S. Bureau of Reclamation
Allan Oto, Supervisory Project Manager
Project Management Group
David Lewis, Project Manager
Project Management Group

CALFED
Jeremy Arrich, Engineer WR
Loren Bottorff, Consultant

Review assistance provided by

Douglas Kleinsmith, U.S. Bureau of Reclamation
Ken Lentz, U.S. Bureau of Reclamation
Kent Nelson, Department of Water Resources
Curt Schmutte, Department of Water Resources
Jim Starr, Department of Fish and Game
Jim West, U.S. Bureau of Reclamation

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

LIST OF TABLES

Table **Page**

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF FIGURES

Figure **Page**

ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
AFRP	Anadromous Fish Restoration Program
BA	Biological Assessment
BCDC	San Francisco Bay Conservation and Development Commission
BDAC	Bay-Delta Advisory Council
BMPs	best management practices
°C	degrees Celsius
CC	Clifton Court
CCC	Contra Costa Canal
CCCGP	Contra Costa County General Plan
CCF	Clifton Court Forebay
CCWD	Contra Costa Water District
CDC	California Department of Conservation
CDF	California Department of Forestry and Fire Protection
CDFA	California Department of Food and Agriculture
CEPA	California Environmental Protection Agency
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
CUWA	California Urban Water Agency
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWHRS	California Wildlife Habitat Relationships System
D-	Water Rights Decision
DBCP	dibromochloropropane
DBPs	disinfection by-products
DBW	Department of Boating and Waterways
DCC	Delta Cross Channel
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
Delta	Sacramento-San Joaquin Delta
DFG	Department of Fish and Game
DO	dissolved oxygen
DOC	dissolved organic carbon
DPC	Delta Protection Commission
DSOD	Division of Safety of Dams
DW	Delta Wetlands
DW Properties	Delta Wetlands Properties
DWR	Department of Water Resources
ESA	Endangered Species Act
Estuary	Sacramento-San Joaquin Estuary
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EWA	Environmental Water Account
°F	degrees Fahrenheit
FE	Federal Endangered

ABBREVIATIONS

FMWT	Fall Midwater Trawl Index
FOC	Final Operations Criteria
fps	feet per second
FSC	Federal Species of Concern
FT	Federal Threatened
GIS	geographic information system
HEP	Habitat Evaluation Procedures
HMAC	Habitat Management Advisory Committee
HMP	Habitat Management Plan
HPMP	Historic Property Management Plan
HSI	Habitat Suitability Index
HU	Habitat Units
IEP	Interagency Ecological Program
ISDP	Interim South Delta Program
JSA	Jones and Stokes Associates
MAF	million acre-feet
mg/l	milligrams per liter
mm	millimeter
MOA	memorandum of agreement
MOU	memorandum of understanding
MSL	mean sea level
µg/l	micrograms per liter
µmhos/cm	micromhos per centimeter
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OPR	Governor's Office of Planning and Research
PG&E	Pacific Gas and Electric
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RAB	riverine aquatic bed
Reclamation	U.S. Bureau of Reclamation
ROD	CALFED Record of Decision
RWQCB	Regional Water Quality Control Board
SE	state endangered
SHPO	State Historic Preservation Officer
SJMSCP	San Joaquin County Multi-Species Habitat Conservation and Open Space Plan
SLC	State Lands Commission
SRA	shaded riverine aquatic
SSC	state species of concern
ST	state threatened
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet

ABBREVIATIONS

USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WQCP	water quality control plan

Chapter 1.0 Executive Summary

Environmental studies were conducted to evaluate the Delta Wetlands Project as proposed by Delta Wetlands Properties and two alternative proposals that provide additional operational flexibility to State Water Project and Central Valley Project south of Delta exports, Central Valley Project Improvement Act actions, environmental needs, and other uses. The evaluations assumed public ownership of the Delta Wetlands Project and focused on identifying environmental differences in project design and in the environmental analysis given public ownership. The areas covered in the study included:

- Land use resources,
- Botanical resources,
- Aquatic resources,
- Wildlife resources,
- Cultural resources,
- Hazardous materials, and
- Recreation.

1.1 Delta Wetlands Project

Delta Wetlands Properties proposed a water storage and wetland project utilizing four islands in the Sacramento-San Joaquin Delta. The project would divert and store water on two of the islands, Webb Tract and Bacon Island (reservoir islands). Delta Wetlands Properties would create or enhance wildlife habitat and wetlands on Holland Tract and Bouldin Island (habitat islands).

The information contained in the document has, unless otherwise noted, been extracted from the draft, revised, and final Environmental Impact Reports/Environmental Impact Statements prepared for the Delta Wetlands Project (JSA 1995, 2000, 2001a, 2001b), the California Endangered Species Act Incidental Take Permit (DFG 2001), the U.S. Fish and Wildlife Service and National Marine Fisheries Service biological opinions, and State Water Resources Control Board Decision 1643. Updated information was provided where possible.

Land Use

Land use information for the Delta Wetlands Project islands was updated using Department of Water Resources Land Use Survey Data from 1995 and 1996.

Delta Wetlands Properties owns all the project islands except for 1,120 acres on Holland Tract. Approximately 18,000 of 20,000 acres are in agricultural use. Webb Tract and Bouldin Island produced mainly corn and grain crops. Holland Tract produced mainly grain, safflower and corn. Crops grown on Bacon Island included corn, sunflowers, grain, and potatoes.

The Delta Wetlands Project will result in two significant adverse impacts to agricultural land. The project will convert prime agricultural land to nonagricultural uses and conflict with land use plans. Approximately 15,000 acres of prime agricultural land would be converted to non-agricultural uses under the Delta Wetlands Project. The Delta Protection Commission has designated agricultural production as the primary land use of the Delta.

The Delta Wetlands Project did not propose mitigation to minimize impacts to agricultural land. The State Water Resources Control Board issued a Statement of Overriding Considerations in D-1643 and considered the project's value to water supply to outweigh the importance of maintaining agriculture on the islands.

The CALFED Record of Decision requires that all projects minimize impacts to agricultural land. If the Delta Wetlands Project becomes a public project, it should be evaluated for consistency with the Farmland Protection Policy Act and modified to minimize impacts from the loss of agricultural land as

necessary. It may be possible to obtain agricultural easements on lands surrounding the project as possible mitigation.

Botanical Resources

The Delta Wetlands Project will impact several sensitive botanical resources. One rare plant community, coastal and valley freshwater marsh, was identified in close proximity to Delta Wetlands Project islands. Approximately 763 acres of habitat on the Delta Wetland Project islands were delineated as jurisdictional wetlands under Section 404 of the Clean Water Act. The jurisdictional wetland verifications have expired, but Delta Wetlands Properties is currently working to update the delineation to reflect current conditions on the project islands. Based on extensive investigation, 14 special-status plants have been identified as potentially occurring in the area of the Delta Wetlands Project.

The environmental evaluation identified three main issues with respect to Delta Wetlands Project impacts on botanical resources. The issues are 1) the age of the botanical and wetland data used to determine project impacts, 2) a lack of surveys for the rare natural community coastal and valley freshwater marsh, and 3) a lack of thorough guidelines for weed management in the Habitat Management Plan developed for the Delta Wetlands Project. The majority of the botanical data used to assess the impacts of the Delta Wetlands Project are from 1988 and 1994. Impacts to jurisdictional wetlands were addressed in the Habitat Management Plan and would be mitigated on the habitat islands. The Habitat Management Plan should be revised to include protocols for botanical surveys, mitigation goals, and invasive weed control. At this point, the Incidental Take Permit requires pre-construction botanical surveys and plans describing avoidance, mitigation, and monitoring information. The Habitat Management Plan does not outline specific mitigation or monitoring goals and guidelines for rare plant community impacts on the Delta Wetlands Project islands. However, Condition 12 of the DFG Incidental Take Permit addresses listed plants in the event that they are found prior to the implementation of the Delta Wetlands Project or become established during implementation of the Habitat Management Plan (DFG 2001a). If impacts to listed plant species are unavoidable, a mitigation and monitoring program will be implemented (DFG 2001a).

Aquatic Resources

Nine listed or sensitive fish species occur in the Delta Wetlands Project area and are likely to be affected by the project. The species include chinook salmon, delta smelt, splittail and Central Valley steelhead. The California Endangered Species Act Incidental Take Permit issued by the Department of Fish and Game, U.S. Fish and Wildlife Service and National Marine Fisheries Service biological opinions, and the State Water Resources Control Board Decision 1643 state that the Delta Wetlands Project has the potential to directly and indirectly impact listed fish species. In general, the impacts to fisheries could include:

- Increases in channel water temperature,
- Reductions in channel water dissolved oxygen concentrations,
- Changes in outflow and flow patterns,
- Reduction in transport flows,
- Increased entrainment of eggs and larvae, and
- Increases in total mercury or methyl mercury concentrations in water and biota due to reservoir and habitat island operations.

The Final Operations Criteria were developed to ensure that project operations do not jeopardize the continued existence of delta smelt, splittail, chinook salmon and Central Valley steelhead. Other species are also expected to benefit from the Final Operations Criteria. As long as the Delta Wetlands Project operates to meet the Final Operations Criteria, impacts to listed fish species are considered less than significant.

However, the 1997 DW Project fish screen design does not meet DFG 2000 Fish Screening Criteria. Therefore, the proposed design requires modification to meet current criteria. The information available on the Delta Wetlands proposed fish screens indicate the following potential problems:

- The fish screens proposed by Delta Wetlands will not meet regulatory agency cleaning requirements,
- The screen mesh size proposed by Delta Wetlands in 1997 does not meet current requirements, and
- The proposed screen area does not meet the requirements for manually cleaned screens.

A redesign of the Delta Wetlands fish screens or intake facilities will be necessary to ensure that project operations meet the restrictions in the Final Operations Criteria, biological opinions, and incidental take permit.

In addition, the delta smelt diversion criteria may result in a reduction of project yield. Diversion criteria should be incorporated into model runs to fully assess the impacts to project operations.

Wildlife Resources

Diverse assemblages of wildlife species typical of the Sacramento-San Joaquin River Delta utilize the Delta Wetlands Project islands for foraging, roosting and breeding. The islands provide habitat to several special status species including the state threatened greater sandhill crane and Swainson's hawk. The project could impact over 180 species of birds, 30 species of mammals, and 10 species of reptiles and amphibians.

Delta Wetlands proposed to mitigate project impacts by developing and protecting 9,000 acres of wildlife habitat on two habitat islands, Holland Tract and Bouldin Island. A Habitat Management Plan was prepared to compensate for the loss of Swainson's hawk and greater sandhill crane foraging habitat, jurisdictional wetlands and wintering waterfowl habitat. The habitats that would be developed on the habitat islands include: agricultural crops, seasonal managed wetlands, pasture, emergent marsh, riparian, etc. Island management would not be optimized for agricultural production. Approximately 4000 acres of crops would be planted and 49% would be harvested.

If the Delta Wetlands Project becomes a public project, several issues should be addressed including incomplete ground surveys and lack of a bat habitat evaluation on the project islands. In addition, the recreation proposed by Delta Wetlands will require continuous monitoring to ensure that it is compatible with species goals and objectives identified in the Habitat Management Plan.

Cultural Resources

A substantial amount of previous cultural resource compliance work has been conducted for the Delta Wetlands Project. The previous cultural resource studies were conducted from 1988 -1993 and were conducted in accordance with the requirements of Section 106 of the National Historic Preservation Act. In addition, Department of Water Resources and U.S. Bureau of Reclamation staff conducted a field review of the project area in October 2001.

Delta Wetlands Properties identified sensitive cultural resources on all the project islands. Significant archaeological sites exist on Bouldin Island, Bacon Island, and Holland Tract. Areas of sensitive soils potentially containing prehistoric human remains exist on Webb Tract and Holland Tract.

To ensure compliance with National Historic Preservation Act and California Environmental Quality Act, additional steps should be taken to minimize and mitigate impacts to cultural resources. The steps include re-initiating Section 106 consultations, updating the Programmatic Agreement, re-surveying piper soils, and conducting data recovery excavations.

Hazardous Materials

The Department of Water Resources performed a modified Phase I Environmental Site Assessment of the Delta Wetlands Project islands. The modified assessments indicate that environmental conditions on

Bouldin Island, Holland Tract, Webb Tract, and Bacon Island will require remediation before the islands can be used for either reservoir storage or habitat mitigation.

Site Assessment staff observed six general areas of concern that should be addressed prior to the acquisition and/or use of the project islands: chemical containers, stained soil, pesticide use, wells, structures and debris.

A Phase II Environmental Site Assessment should be completed for all islands prior to purchase to determine the extent of the remediation. The Phase II Environmental Site Assessment will also establish state and federal liability for future cleanup and remediation.

Recreation

Delta Protection Commission and Department of Boating and Waterways reported that recreation opportunities in the Delta are limited because facilities are insufficient, access is limited, and the demand for parking, boat launch ramps, camp sites, and picnic areas exceeds supply. As part of the Delta Wetlands Project, Delta Wetlands Properties has proposed private recreation facilities on all four islands. The recreation facilities consist of living quarters, floating docks on interior and exterior of the islands, and a parking lot.

On the reservoir islands, private waterfowl and upland bird hunting is proposed during both shallow-water wetland conditions and water storage conditions. Spaced-blind and free-roam hunting zones would be designated on the habitat islands.

If the Delta Wetlands Project becomes a public project, the proposed recreational facilities may not be appropriate for a publicly owned and operated project. The recreation plan should be modified to provide recreational benefits to the general public through a range of recreation opportunities. In addition, the recreational facilities proposed by Delta Wetlands do not meet the unmet recreational needs of the Delta such as fishing piers, bicycle and hiking trails, and public access points.

1.2 Re-engineered Delta Wetlands Project

Under the Re-engineered Delta Wetlands Project, federal and state entities would acquire the Delta Wetlands Project and redesign it to meet all federal and state design standards. It would involve the same four islands, the reservoir and habitat islands, as described in the Delta Wetlands Project. Diversion and discharge facilities would be consolidated into two structures per island and all diversions would occur through self-cleaning flat-plate fish screens. In this alternative, the agencies are also considering flattening the water-side levee slopes to 4:1.

The section provides information on existing resources and impacts on the Delta Wetlands Project islands in the areas of botanical resources, fishery resources, wildlife resources, and recreation that may change under Re-engineered Delta Wetlands Project. The existing resources and impacts in land use, cultural resources and hazardous materials assessments will not differ from those discussed for the Delta Wetlands Project.

To address the impacts to agricultural land from the Delta Wetlands Project, staff evaluated keeping Bouldin Island in agricultural production and placing all mitigation on Holland Tract. Through the analysis it became apparent that there is not enough land on Holland Tract to provide all the required mitigation. Because of the shortfall, staff proposed the addition of Sherman or Twitchell islands in lieu of Bouldin Island at the recommendation of the Delta Protection Commission.

Land Resources

The Re-engineered Delta Wetlands Project will result in the same significant adverse impacts to agricultural land if Bacon Island and Webb Tract are converted to reservoir islands and Holland Tract and

Bouldin Island are used for mitigation. The project would convert prime agricultural land to nonagricultural uses.

Several possible solutions to minimize the impacts to agricultural land were investigated. In the first option, Bouldin Island was designated for only agricultural production. All mitigation would occur on Holland Tract. Approximately 9,000 acres of prime agricultural land would be converted rather than 15,000 acres. Unfortunately, this option would create a 5271-acre shortage in land for wildlife and wetland mitigation. Consequently, this option is not feasible.

The second option designates Bouldin Island for only agricultural production and Sherman or Twitchell island would be used for wildlife and wetland mitigation in its place. Agricultural easements could also be included in this option to further minimize impacts to agricultural land as necessary. The use of Sherman or Twitchell island should be investigated further to determine if it is feasible to incorporate either island into the project.

Botanical Resources

The Re-engineered Delta Wetlands Project will impact similar botanical resources as in the Delta Wetlands Project. The impact of the integrated facilities and the potential flattening of water-side levee slopes on special-status plant populations and high-quality native wetland vegetation is unknown. No impacts to in-channel islands due to flow and stage changes from the diversions proposed in the Delta Wetlands Project were expected. Consequently, any impacts under the Re-engineered Delta Wetlands Project could be additional impacts that would be evaluated in future environmental documents and mitigation would be proposed.

Aquatic Resources

The Re-engineered Delta Wetlands Project would impact the same fish species as in the Delta Wetlands Project. One difference between the Delta Wetlands Project and the Re-engineered Delta Wetlands Project are the proposed fish screens and intake/discharge facilities. Consolidated facilities with self-cleaning flat plate screen technologies appear to be a possible solution to the inadequacies in the Delta Wetlands Project screens. The differences between consolidated facilities and diversions that are spread out over a larger distance have not been evaluated. Impacts of consolidated facilities on channel flow and stages should be evaluated using DSM2 runs.

Impacts to shallow water habitat from proposed changes in the slough-side of the levee slopes will occur. Projects that remove or alter areas within the tidal fluctuation zone can be required to mitigate at a 3:1 ratio by USFWS and DFG. Consultation with DFG and USFWS will be needed to address this issue.

As mentioned in the land use section, Sherman or Twitchell islands have been proposed for wildlife and wetland mitigation in lieu of Bouldin Island. No impacts to fisheries are expected with the option.

Several stakeholders requested we evaluate using Sherman Island for reservoir storage. Using Sherman Island for reservoir storage may have significant adverse impacts on fishery resources in the central Delta but it could benefit fisheries in the western Delta and Suisun Bay. To fully assess the impacts to fish, evaluations of model runs would be necessary. However, there are other issues that make using Sherman Island as a storage island an infeasible option. Please see the In-Delta Storage Program Draft Summary Report for more information.

Wildlife Resources

The Re-engineered Delta Wetlands Project will impact the same wildlife resources as in the Delta Wetlands Project. The emergent marsh habitat on the in-channel islands has the potential to provide habitat for sensitive wildlife species, such as, the giant garter snake, California black rail, tricolored blackbirds, and western pond turtles. The impacts to wildlife from construction and operation of the integrated facilities are unknown. An impact analysis should be done to quantify the direct and

cumulative impacts to wildlife species and habitats that would be associated with the integrated facilities and the possible changes in the water-side levee slopes.

Recreation

In the Re-engineered Delta Wetlands Project, staff proposed changes to the recreation plan to provide recreational opportunities to the general public and a greater range of experiences. The Delta Protection Commission and Department of Boating and Waterways identified shortages in recreation in the Delta including: public restrooms, swimming beaches, fishing piers, other fishing access, bicycle trails, hiking trails, and hunting areas.

The habitat islands lend themselves to a wide variety of recreational uses. Hiking and biking trails are proposed for the levees and less-sensitive wildlife areas. Wildlife observation or birdwatching could be easily incorporated into the design. Additional facilities could include informational signage, photography blinds, restroom facilities, and an interpretative center. Interpretative center topics could include wildlife and Delta ecology, Delta cultural resources, Delta history, and water projects.

Shoreside fishing access could be accommodated on the habitat islands as well. Short-term boat docking for shoreline access could be included in the general design.

Public hunting is compatible with the habitat islands and could be managed to avoid conflict with non-consumptive recreation. The hunting program would be modeled after that used on existing State Wildlife Management Areas.

Water project operations substantially limit the habitat and attraction for wildlife on the reservoir islands. It is more likely the reservoir islands lend themselves to levee-bank fishing access and short-term boat docking facilities on the exterior sides of the levees.

1.3 Bacon Island and Victoria Island storage and connection to Clifton Court

To provide operational flexibility, the In-Delta Storage Program staff propose replacing Webb Tract storage with Victoria Island storage and Victoria Island be connected to Clifton Court Forebay. Therefore, Bacon Island and Victoria Island would be the reservoir islands. Webb Tract, Holland Tract, and Bouldin Island may be considered for habitat development and agricultural mitigation. Intake and discharge facilities would be the same as proposed in the Re-engineered Delta Wetlands Project alternative.

No on site evaluations of Victoria Island were conducted since landowners and the Victoria Island Reclamation District did not grant access to the island. The impacts of converting Victoria Island will likely be similar to impacts discussed in the previous sections. Based on available information, staff concluded the following:

- All of Victoria Island is in agricultural production and approximately 5,000 acres are designated as prime agricultural land. Approximately 20,000 acres of prime farmland would be converted to nonagricultural uses under this alternative. This is a significant adverse impact on agricultural land.
- As in the Re-engineered Delta Wetlands Project, the impact of the integrated facilities on special-status plant populations and high-quality native wetland vegetation on in-channel islands is unknown.
- Converting Victoria Island to reservoir storage will negatively impact Swainson’s hawk foraging habitat. Approximately 4,948 acres of land on Victoria Island is considered suitable Swainson’s hawk foraging habitat. In addition, alfalfa, a crop with high foraging value to Swainson's hawks, is grown on Victoria Island and not Webb Tract. The Swainson’s hawk mitigation needed for this alternative would increase over levels needed for the Delta Wetlands Project.
- U.S. Bureau of Reclamation surveyed a portion of Victoria Island in 1994 and no cultural resources were identified during that survey effort. No sensitive areas, such as piper soils, exist on the island.

1.4 Mitigation Measures and Solutions

It is estimated that the initial environmental mitigation, monitoring and recreation costs for the Delta Wetlands Project will be over $600 million. The estimate includes the costs for developing and constructing the habitat islands, providing construction monitoring, completing initial fisheries mitigation, completing cultural resources mitigation, constructing the recreation facilities proposed by Delta Wetlands, and completing a Phase II environmental site assessment.

The ongoing costs for environmental mitigation, monitoring, and weed control for the life of the Delta Wetlands Project are estimated at greater than $7.1 million per year. The annual costs do not include operations and maintenance costs for recreational facilities.

The mitigation, monitoring, aquatic weed control and recreation costs for the Re-engineered Delta Wetlands Project and the Victoria and Bacon Island storage alternative are difficult to estimate. The costs for agricultural easements, flat-plate screen operations and maintenance, and fisheries mitigation and monitoring are unknown under both these alternatives. However, it is likely that the environmental and recreation costs for these alternatives would be significantly less (~$500 million less) since state and federal agencies would not construct the DW proposed recreation facilities.

The environmental permitting required for the Re-engineered Delta Wetlands Project could range from a subsequent Environmental Impact Report/Environmental Impact Statement to a new Environmental Impact Report/Environmental Impact Statement depending on the islands included in the alternative. Reconsultation with DFG, NMFS and USFWS will be necessary.

The Environmental Investigations Team developed 7 preliminary mitigation strategies that could be pursued in greater depth if the agencies decide to pursue the Victoria Island option. The options range from continued agricultural production on Webb Tract with all mitigation occurring on Holland Tract and Bouldin Island to levee setbacks on Webb Tract with internal marsh habitat, some mitigation on Holland Tract, and only agricultural production on Bouldin Island. Extensive coordination with other agencies would be required to implement this alternative.

The environmental permitting and documentation required to implement the Bacon Island and Victoria Island reservoir alternative include preparing a new Environmental Impact Report/Environmental Impact Statement, completing Section 7 consultation, obtaining Clean Water Act Section 404 Permit and California Endangered Species Act Incidental Take Permits, and filing a Change of Petitions with the State Water Resources Control Board.

Chapter 2.0 Introduction

CALFED Bay-Delta Program was established in 1995 to develop a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The Integrated Storage Investigations Program was initiated by CALFED agencies in 1999 to support efforts towards meeting the goals defined under CALFED's comprehensive water management strategy. The plan entitled *"California's Water Future: A Framework for Action"* dated June 2000 states that one of CALFED agencies' primary goals is to improve the reliability of California's water supply and development of new storage is an important component of the overall strategy to meet the competing environmental and other water supply needs.

The CALFED Record of Decision (ROD) (2000a) identified in-Delta storage as one of five surface storage projects (Enlarged Shasta, Los Vaqueros, Sites Reservoir, 250-700 TAF of additional storage in the upper San Joaquin watershed, and in-Delta storage) to be pursued with a project specific study early in Stage 1 of the Bay-Delta Program implementation. The purpose of new storage in the Delta is to increase operational flexibility for the Central Valley Project (CVP) and the State Water Project (SWP) and provide ecosystem benefits in the Delta. The ROD included an option to explore the lease or purchase of the Delta Wetlands (DW) Project, a private proposal by DW Properties, Inc. or to initiate a new project, in the event that DW Project proves cost prohibitive or technically infeasible.

A joint reconnaissance level study by the U.S. Bureau of Reclamation (Reclamation) and California Department of Water Resources (DWR) for the DW Project and other potential alternatives, completed in September 2000, concluded that the In-Delta Storage Project would meet the goals of operational flexibility and provide other beneficial uses in the Delta (CALFED 2000b).

The participating agencies initiated a study of the In-Delta Storage Project in January 2001. The study included investigations related to operational flexibility, water quality, engineering, environmental, economic, and policy and legal evaluations. This report presents information on environmental evaluations undertaken to assess the DW Project as proposed and to evaluate two alternative proposals that provide additional operational flexibility to Central Valley Project Improvement Act (CVPIA) actions, environmental needs, and other uses. These alternatives would be designed to meet DWR and Reclamation design standards.

The areas covered in the environmental evaluation included:

- Land use resources,
- Botanical resources,
- Aquatic resources,
- Wildlife resources,
- Cultural resources,
- Hazardous materials, and
- Recreation.

2.1 Project Alternatives

There are three main project alternatives evaluated in the report. The alternatives are

- the DW Project as proposed by DW Properties (Alternative 1),
- a re-engineered DW Project (Alternative 2), and
- an option for storage using Victoria and Bacon islands as reservoirs with a connection to Clifton Court (Alternative 3).

Within Alternatives 2 and 3 there are several sub alternatives due to variations in how mitigation for the project could be implemented. Table 2-1 provides a summary of the island usage under each alternative.

Table 2-1. Expected use of each island under each alternative.

Alternative	Island or Tract	Expected Use
Alternative 1 (DW Project)	Webb Tract	reservoir
	Bacon Island	reservoir
	Bouldin Island	wildlife habitat
	Holland Tract	wildlife habitat
Alternative 2(a1) (Re-engineered DW Project)	Webb Tract	reservoir
	Bacon Island	reservoir
	Bouldin Island	agriculture[a]
	Holland Tract	wildlife habitat
Alternative 2(a2) (Re-engineered DW Project)	Webb Tract	reservoir
	Bacon Island	reservoir
	Bouldin Island	agriculture
	Holland Tract	wildlife habitat
	Sherman or Twitchell islands	wildlife habitat
Alternative 2(b) (Re-engineered DW Project)	Webb Tract	reservoir
	Bacon Island	reservoir
	Bouldin Island	wildlife habitat
	Holland Tract	wildlife habitat
Alternative 3(a) (Bacon and Victoria Islands as Storage with Connection to CC)	Webb Tract	agriculture & wildlife habitat
	Bacon Island	reservoir
	Bouldin Island	wildlife habitat
	Holland Tract	wildlife habitat
	Victoria Island	reservoir
Alternative 3(b) (Bacon and Victoria Islands as Storage with Connection to CC)	Webb Tract	wildlife habitat
	Bacon Island	reservoir
	Bouldin Island	agriculture only
	Holland Tract	wildlife habitat
	Victoria Island	reservoir

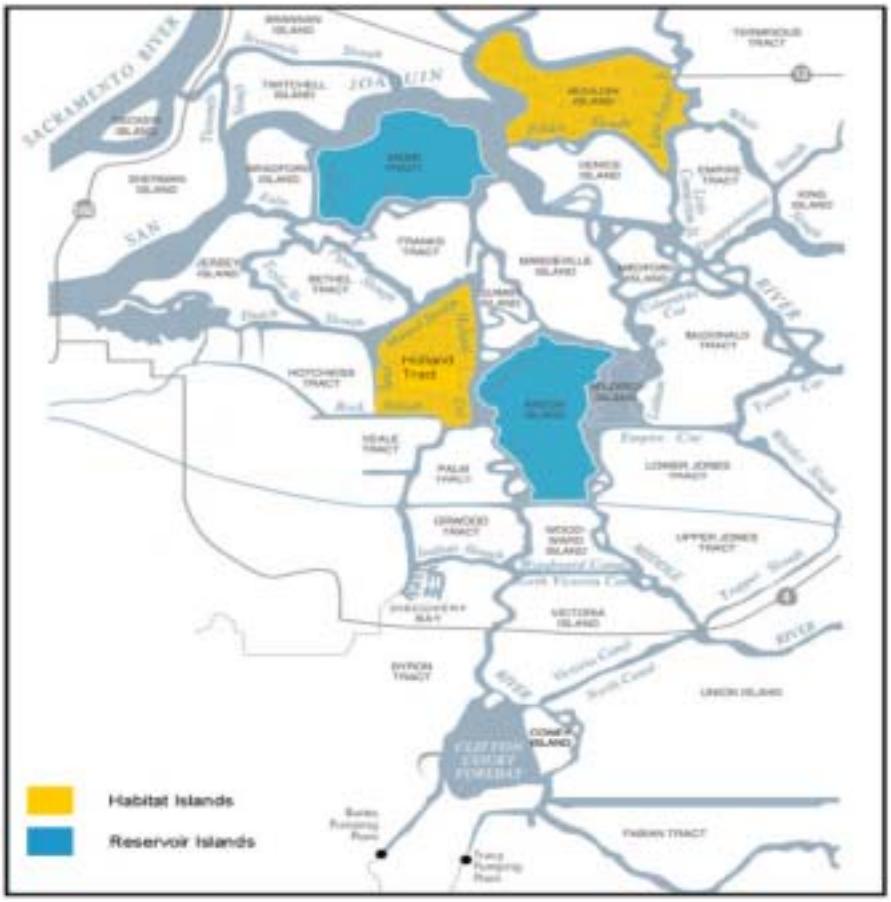
[a]The DFG Incidental Take Permit requires DW to sign conservation easements for Bouldin Island and Holland Tract. As of December 2001, the conservation easements had not been signed. If the conservation easements are signed, federal and state agencies may have to modify the easements.

2.1.1 Alternative 1 – Delta Wetlands Project

Under Alternative 1, federal and state entities would either lease or acquire the DW Project from DW Properties and would operate it in accordance with the terms and conditions of the Permit issued by the State Water Resources Control Board (SWRCB) and all other permits, agreements, and limitations imposed on the project. The following is a brief discussion of the DW Project. For a more detailed discussion see the In-Delta Storage Program Draft Report on Engineering Investigations.

DW Properties proposed a water storage and wetland project utilizing four islands in the Sacramento-San Joaquin Delta (Delta). The DW project would divert and store water on two of the islands, Webb Tract and Bacon Island (reservoir islands) (Figure 2-1). DW Properties would create or enhance wildlife habitat and wetlands on Holland Tract and Bouldin Island (habitat islands). Water would be seasonally diverted onto the habitat islands to use for wildlife habitat and wetlands creation, enhancement and management.

Figure 2-1. Proposed island usage under Alternative 1 – DW Project and Alternative 2 – Re-engineered DW Project



The project would primarily consist of:

- Improving and strengthening the levees of Webb Tract and Bacon Island to meet or exceed the criteria outlined in DWR Bulletin 192-82. Levee improvements would address erosion caused by wind and water waves action through placement of rock revetment on the slopes of the levees. The maximum water level in the storage reservoirs would not exceed +4 above mean sea level (MSL) providing a storage capacity of about 217 thousand acre-feet (TAF).

- Installing two new Intake Siphon Stations along the perimeter of each reservoir island. Each Station would incorporate 16 new siphon pipes 36-inch in diameter. The rate of diversions would vary with pool elevation and water availability. The maximum rate of diversion onto either Webb Tract or Bacon Island would be 2,750 cubic feet per second (cfs) and the combined maximum daily rate of diversion onto all four islands (including diversions to habitat islands) would not exceed 6,000 cfs. The combined maximum monthly average rate of diversion would be 4,000 cfs (Figures 2-2 and 2-3). Booster pumps will be used to top off the reservoirs.

- Installing drum-style fish screens (similar to those used in agricultural diversions) around the intake of each of the 64 new and 57 existing siphon pipes on both the reservoir and habitat islands.

- Installing two new discharge pump stations on the reservoir islands including one Discharge Pump Station with 32 pumps on Webb Tract and another Discharge Pump Station with 40 pumps on Bacon Island. All discharge pipes would be 36-inch-diameter. The installed pumps would be an assortment

of axial-flow and mixed-flow pumps to accommodate a variety of head conditions and flow rates throughout draw down. Discharges would be pumped at a combined maximum daily average rate of 6,000 cfs (including discharge from the habitat islands). The combined monthly average discharge rate would not exceed 4,000 cfs.

The diversion of water onto the habitat islands is restricted to the existing water rights held by DW Properties and it is limited to 200 cfs (19 TAF annually). The 200 cfs amount is included in the maximum daily and monthly average rates of diversion listed above.

The habitat islands would be created and managed as proposed in the DW Project (JSA 1995a). Section 3.2.2 provides a detailed description of DW Habitat Management Plan (HMP).

2.1.2 Alternative 2 – Re-Engineered Delta Wetlands Project

Under Alternative 2, federal and state entities would acquire the DW Project and redesign it to meet all federal and state design standards. Alternative 2 would involve the same four islands, the reservoir and habitat islands, as described in Alternative 1 and as shown in Figure 2-1.

Figure 2-2. Siphon and pump stations on Webb Tract in Alternative 1 – DW Project

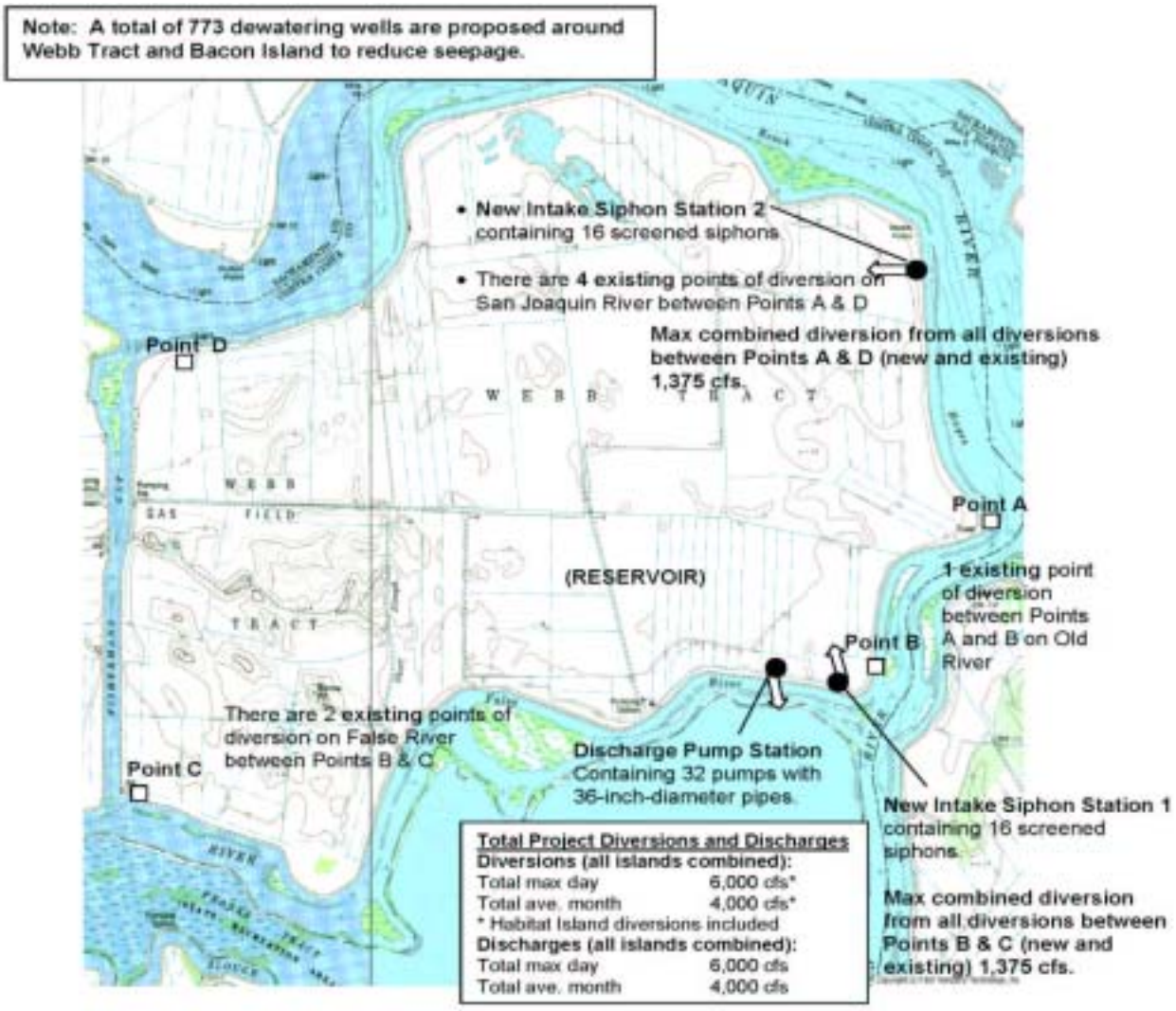
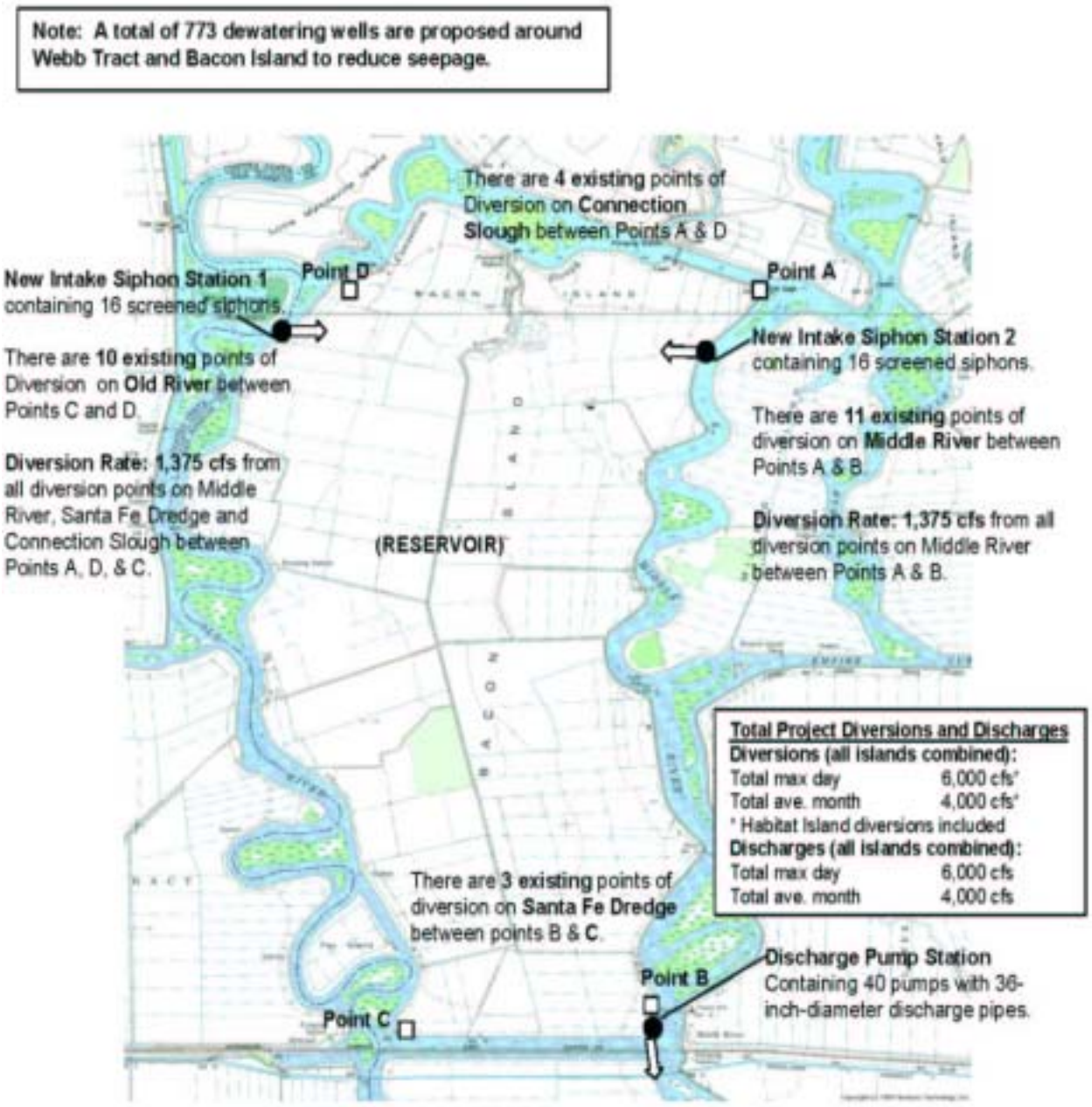


Figure 2-3. Siphon and pump stations on Bacon Island in Alternative 1 – DW Project



The reliability, design life, and functionality of the facilities designed and built under Alternative 2 would be similar to those used in federal and state water resources infrastructure projects. The project would consist of:

- Redesigning and improving the levees of Webb Tract and Bacon Island. The improved levee design would be based on the Federal Public Law 84-99 urban standard. The design would have a 3-foot freeboard over the 100-yr flood elevation, a 35-foot wide crest, and a landside slope varying according to the depth of the peat soil at that location. The interior levee slopes would be revetted with a layer of riprap 2.5 feet thick over a 1-foot thick bedding layer, placed from the top of the levee to 5 feet below elevation + 4 feet to protect the levee from wind driven waves. The maximum water level in the storage reservoirs would not exceed +4 MSL (217 TAF). This

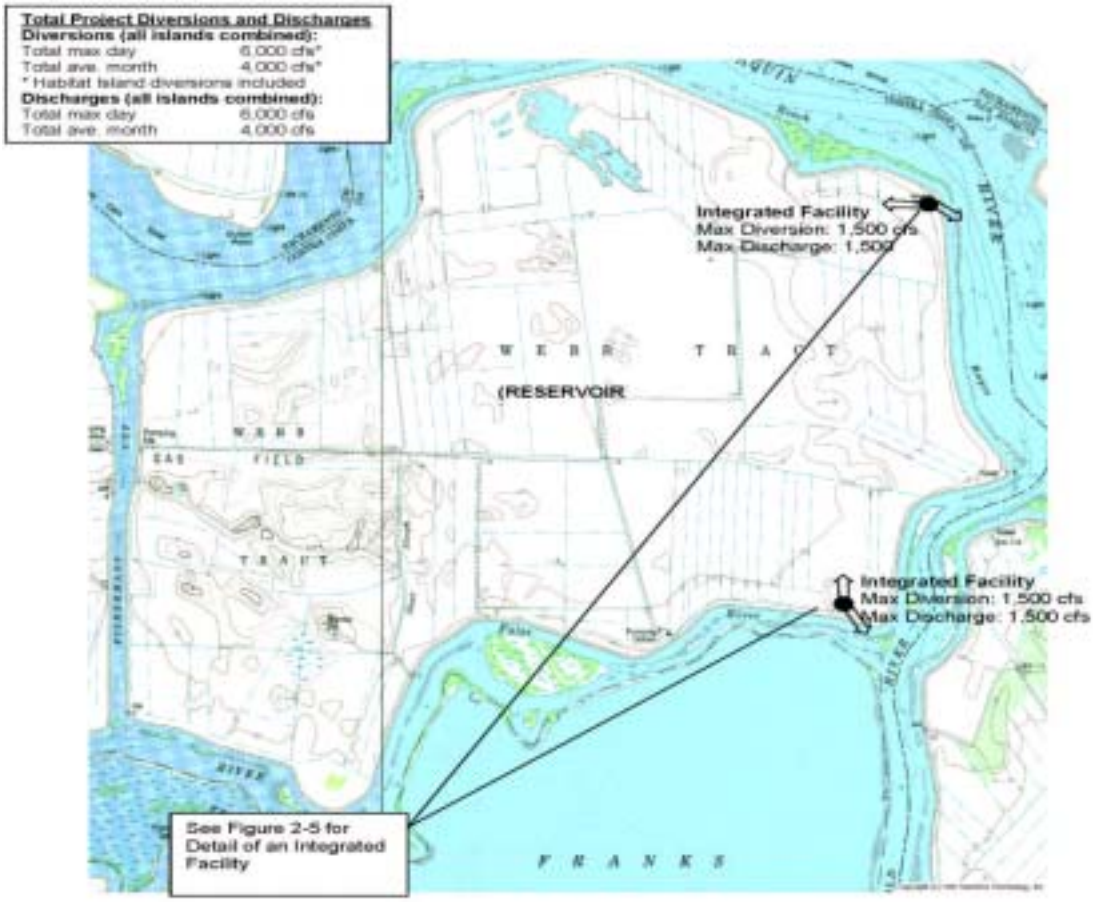
alternative also includes an option to flatten the existing slough-side slopes on Webb Tract and Bacon Island to 4:1 from the existing average slope of 2.5:1.

- Building a total of four new gated siphon/pumping stations on the reservoir islands (two in each reservoir island) (Figure 2-4 through 2-6). Each station would be an integrated facility that could divert water from the adjacent river onto the reservoir island and release it back into the river[2]. The pump stations would utilize fewer pumps and their capacities would range from 500 cfs to 1,000 cfs. The maximum rate of diversion onto either Webb Tract or Bacon Island would be 3,000 cfs and the combined maximum daily rate of diversion for all four islands (including diversions to habitat islands) would not exceed 6,000 cfs. The combined maximum monthly average rate of diversion would be 4,000 cfs.

- Installing four flat-plate fish screens continuously cleaned meeting the criteria of the Department of Fish and Game (DFG), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS).

- Discharges would be at a combined maximum daily average rate of 6,000 cfs (including discharge from the habitat islands). The combined monthly average discharge rate would not exceed 4,000 cfs.

Figure 2-4. Integrated facilities on Webb Tract in Alternative 2 – Re-engineered Delta Wetlands Project



[2] The existing siphons on Webb Tract and Bacon Island would be removed. This alternative essentially combines all the diversions proposed by DW Properties into 2 larger facilities per island. Under this alternative, all water diversions and discharges would occur through the integrated facilities.

Under Alternative 2, the Environmental Investigations Team evaluated minimizing project impacts to agricultural land by keeping Bouldin Island in agricultural production (Alternative 2(a1)). The Team developed Alternative 2(a2) as an additional solution when it became apparent that placing all the wildlife and wetland mitigation on Holland Tract was not possible. Under Alternative 2(a2), the Team proposes to use Sherman or Twitchell islands for wildlife and wetland mitigation instead of Bouldin Island.

In addition to Alternative 2(a1) and 2(a2), the Team also evaluated implementation of the mitigation proposed in the DW Project with slight modifications to cover the engineering changes proposed in the re-engineered design. The mitigation proposed in the DW Project with changes due to re-engineering is discussed under Alternative 2(b).

Figure 2-5. Detail of integrated facility proposed for the Re-engineered Delta Wetlands Project and for Bacon Island and Victoria Island storage

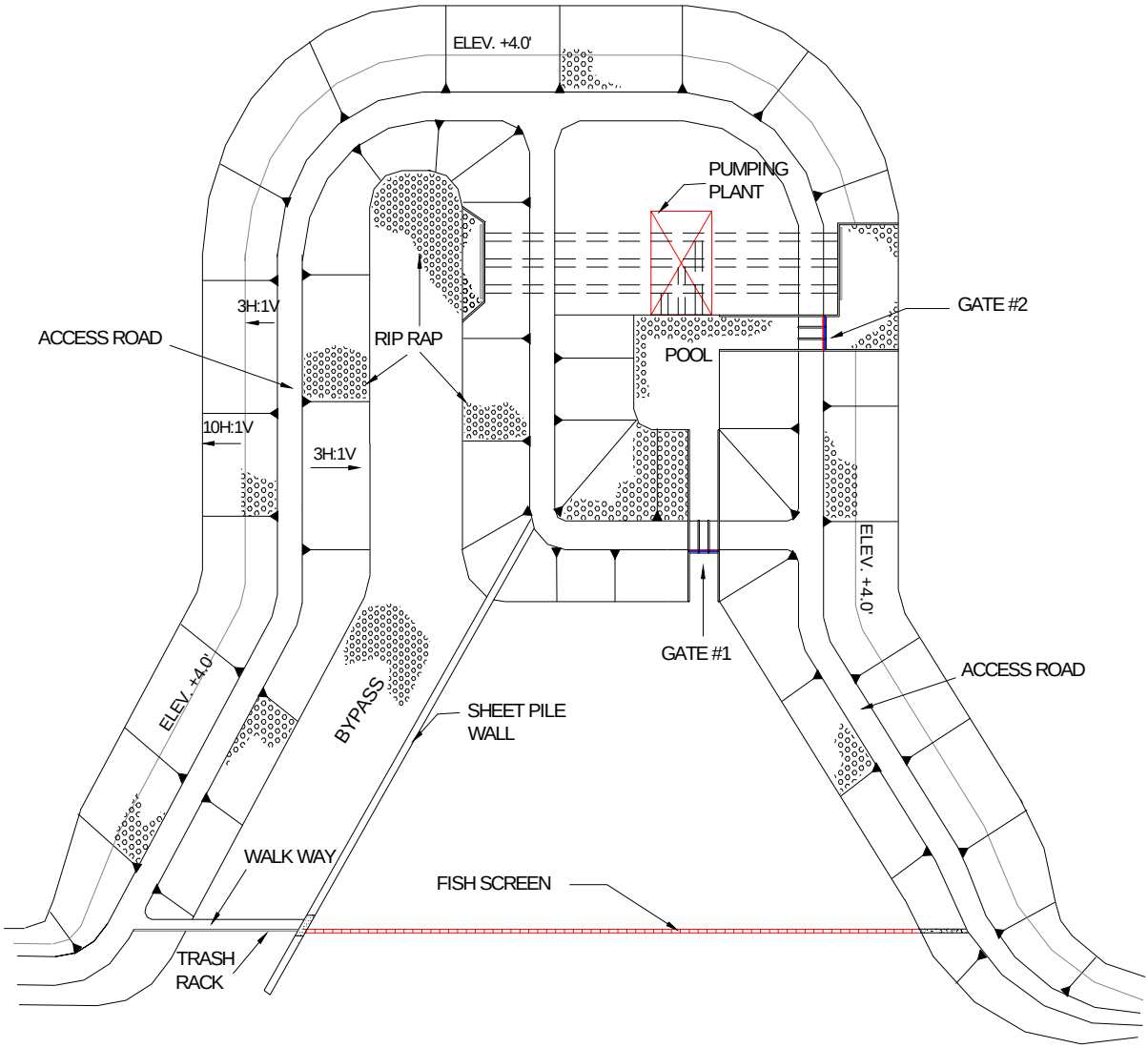
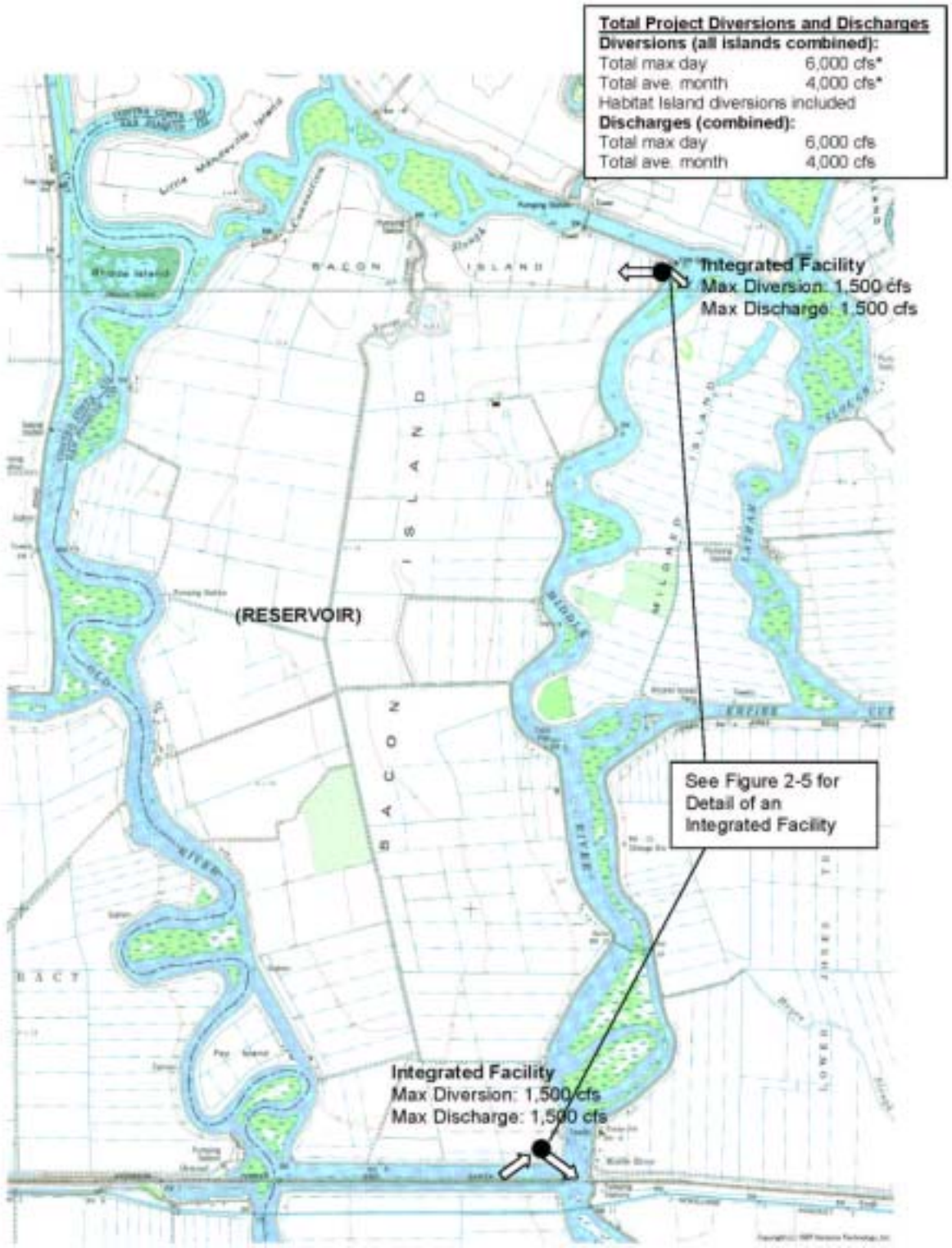


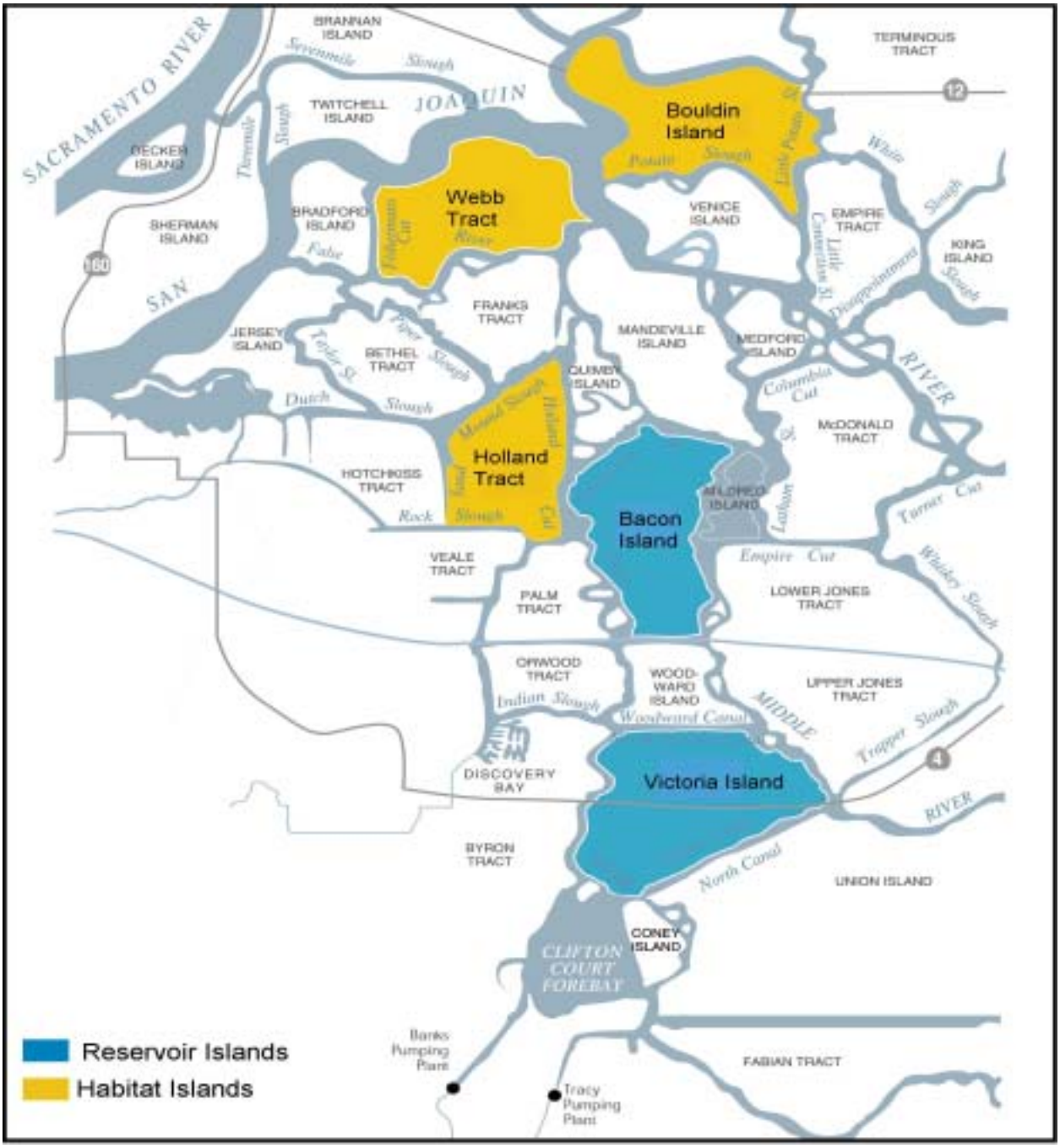
Figure 2-6. Integrated facilities on Bacon Island in Alternative 2 – Re-engineered Delta Wetlands Project



2.1.3 Alternative 3 – Bacon Island and Victoria Island storage and connection to Clifton Court

To provide operational flexibility, the In-Delta Storage Program staff propose replacing Webb Tract storage with Victoria Island storage and Victoria Island be connected to Clifton Court (Figure 2-7). Therefore, Bacon Island and Victoria Island would be the reservoir islands. Webb Tract, Holland Tract, and Bouldin Island may be considered for habitat development and agricultural mitigation.

Figure 2-7. Proposed island usage under Alternative 3 – Bacon Island and Victoria Island storage and connection to Clifton Court



Stored water in Bacon Island would be released in the Delta channels whereas stored water in Victoria Island would either be released into the Delta channels or conveyed directly into Clifton Court or both. The direct connection to Clifton Court could possibly have benefits associated with improved water quality and operational flexibility for south of Delta water supply and Environmental Water Account (EWA). Further, if an intertie between Clifton Court and Tracy Pumping Plant is implemented, both the SWP and CVP could realize the additional flexibility benefits.

The project would consist of:

- Redesigning and improving the levees of Bacon Island and Victoria Island. The improved levee design will be based on the Federal Public Law 84-99 urban standard. The maximum water level in the storage reservoirs will not exceed +4 MSL.

- Installing a total of four siphon/pumping stations (two at Bacon Island and two at Victoria Island). Each station would be an integrated facility that could divert water from the adjacent river onto the reservoir islands and release it back into the river. A separate conveyance facility with capacity 2,000 cfs will deliver stored water from Victoria Island to New Clifton Court Intake by gravity and/or pumping.

- The gated siphon/pumping facilities could be operated as gravity or pumping systems. The facilities would utilize fewer pumps and their capacities will range from 500 cfs to 1,000 cfs. The maximum rate of diversion onto either Bacon Island or Victoria Island is assumed to be 3,000 cfs and the combined maximum daily rate of diversion for all islands (including diversions to habitat islands) would not exceed 6,000 cfs. The combined maximum monthly average rate of diversion would be 3,000 cfs. Releases would be at a combined maximum daily average rate of 6,000 cfs (including discharge from the habitat islands). The combined monthly average discharge rate would not exceed 4,000 cfs (Figures 2-8 and 2-9).

- Stored water in Bacon Island will be released into Delta Channels for Delta use or export from the CVP/SWP facilities. A siphon and pumping combination connection from Victoria Island to Clifton Court Forebay (CCF) will be provided.

- Installing four flat-plate fish screens continuously cleaned (one per integrated facility) meeting the criteria of the DFG, USFWS and NMFS.

Under Alternative 3, the Team also evaluated minimizing project impacts to agricultural land. Alternative 3(a) proposes combining agricultural production with wildlife habitat on Webb Tract and wildlife and wetland habitat on Holland and Bouldin islands (Alternative 3(a)). Alternative 3(b) proposes keeping Bouldin Island in agricultural production and placing all wildlife and wetland mitigation on Holland and Webb tracts.

(Please note that the “In-Delta Storage Program Draft Report on Engineering Investigations” also includes costs estimates for Alternative 4 – Webb Tract and Victoria Island storage and connection to Clifton Court. Environmental evaluations and mitigation development for Alternative 4 will be done in the next phase of the study.)

Figure 2-8. Integrated facilities on Bacon Island in Alternative 3 – Bacon Island and Victoria Island storage and connection to Clifton Court

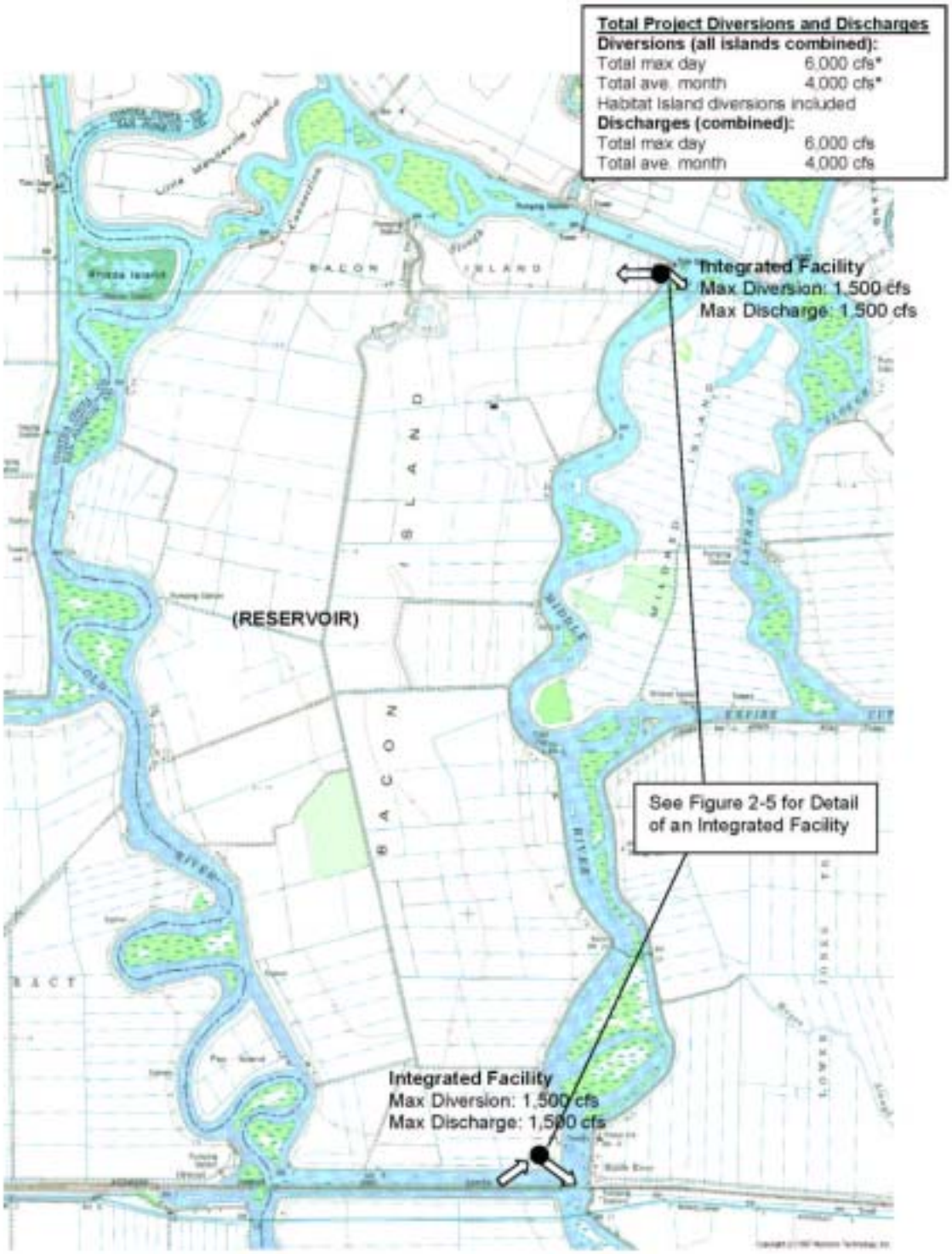
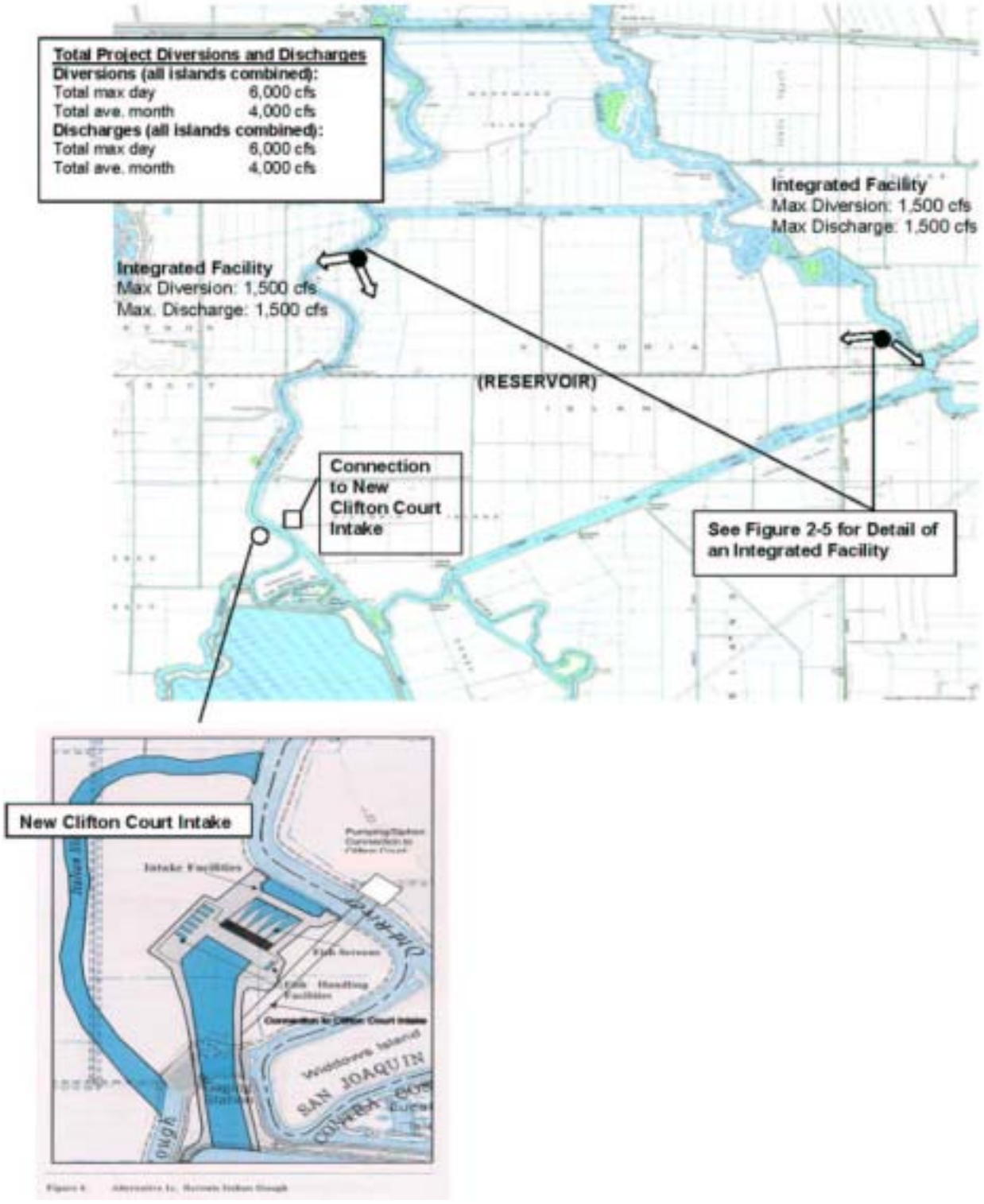


Figure 2-9. Integrated facilities on Victoria Island in Alternative 3 – Bacon Island and Victoria Island storage and connection to Clifton Court



Chapter 3.0 Delta Wetlands Project

This chapter provides a review and summary of the existing conditions on the DW Project islands in the areas of land use, botanical resources, aquatic resources, wildlife resources, cultural resources, hazardous materials, and recreation. Much of the information contained in this chapter, unless otherwise noted, has been extracted from the Draft Environmental Impact Report (DEIR) and Draft Environmental Impact Statement (DEIS) for the DW Project (JSA 1995a), Revised EIR/EIS (JSA 2000), Final EIR (JSA 2001a), Final EIS (JSA 2001b), California Endangered Species Act Incidental Take Permit for the DW Project (DFG 2001a), and NMFS and USFWS biological opinions (NMFS 1997, USFWS 1997). Updated information is provided where possible.

The DW Project proposes to convert two Delta islands (Bacon Island and Webb Tract) into storage reservoirs, and seasonally divert water to create and enhance wetlands and to manage wildlife habitat on two other Delta islands (Bouldin Island and Holland Tract). See Section 2.2.1 for a more detailed project description.

3.1 Resource Evaluations

3.1.1 Land Use

The California Department of Conservation's Farmland Mapping Program designates eight land categories, three of which are commonly used in California Environmental Quality Act (CEQA) evaluations to determine impacts to agricultural land. The categories are prime farmland, farmland of statewide importance, and unique farmland. Prime farmland has the best combination of physical and chemical features and is able to sustain long-term production of agricultural crops. Farmland of statewide importance is similar to prime farmland with minor shortcomings, such as greater slopes. Unique farmland is defined as farmland of lesser quality soils used for the production of the state's leading agricultural crops.

CEQA also identifies Williamson Act lands as a category that can be used to assess impacts to agricultural land. The California Land Conservation Act of 1965, commonly referred to as the Williamson Act, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural, preserving open space, and promoting efficient urban growth patterns. In return, landowners receive property tax assessments which are much lower than normal because they are based upon farming and open space uses as opposed to full market value. Local governments receive an annual subvention of forgone property tax revenues from the state via the Open Space Subvention Act of 1971.

The four DW Project islands are zoned almost entirely for agricultural use and are used primarily for perennial and annual agricultural production, with some hunting and fishing recreational uses. Approximately 90 percent of Bacon and Bouldin islands and 85 percent of Webb Tract are used for agricultural production or grazing. Approximately 69 percent of Holland Tract is used for agricultural production and grazing, with the most land idle or fallow of all the project islands.

3.1.1.1 Webb Tract

The majority of Webb Tract is in agricultural use, producing mainly corn (50%) and grain crops (35%) (Table 3-1). A small number of agricultural structures and equipment complexes are located near the perimeter levees on the western and eastern sides of the island (JSA 2001b). Occupied residences on the island include two trailers located in the southwest corner and a residence (semi permanently occupied) on the southeast corner of the island. A clubhouse is located on high ground on the southeast corner. Webb Tract is entirely owned by DW Properties.

The Contra Costa County zoning designation for 5330 acres of Webb Tract is Agriculture (A-2), with a 139-acre parcel zoned as Agricultural Preserve District (A-4). The A-4-zoned parcel is under a

Williamson Act contract. The Contra Costa County A-2 zoning (5-acre minimum parcel size) allows a variety of agricultural uses, as well as incidental sheds, warehouses, production facilities, produce stands, one single-family detached unit, and other uses allowable by code or use permit, including commercial recreational facilities. Refuse disposal sites are also allowed in areas zoned A-2 by use permit only. Land uses under A-4 zoning include commercial agricultural production and other uses specifically agreed on by the county and the landowner at the time the zoning was established. Uses allowed by permit include agriculture-related structures, fruit and vegetable stands, owner or lessee residences, oil and gas drilling, and a variety of other agriculture- and livestock-related practices.

Table 3-1. Land use on Webb Tract

Land Use Category	Acres
Grain & hay crops	1921
Corn (field & sweet)	2742
Idle (but cropped within last 3 years)	88
Field crops but currently fallow	29
Water surface (lakes, canals, etc.)	91
Marshes, tules & sedges	129
Native vegetation	502
Farmsteads	6
source: DWR 1995	

The majority of Webb Tract falls under the Contra Costa County General Plan (CCCGP) designation of Delta Recreation and Resources and a small portion under Open Space (CCC 1996). The CCCGP identifies agriculture and wildlife habitat as the most appropriate uses in this area. The Delta Recreation and Resources designation allows for a residential density of one unit permitted per 20 acres, and marinas, shooting ranges, duck and other hunting clubs, campgrounds, and other outdoor recreation complexes are allowed through issuance of a land use permit. All recreational uses should be accessible by a publicly maintained road. Under the Open Space designation, areas involving resources management, such as maintaining endangered habitats and low intensity, private recreation are appropriate.

Webb Tract currently has one parcel under a Williamson Act contract, a 139-acre parcel located along the southern portion of Webb Tract. The Department of Conservation's Farmland Mapping and Monitoring Program classifies soils on Webb Tract in the following categories:

- 4,725 acres are prime farmland,
- 130 acres are farmland of statewide importance,
- 294 acres are unique farmland (DPC 2001; JSA 2001b).

3.1.1.2 Bouldin Island

Approximately 90% of Bouldin Island is used for agriculture and produces mainly corn (59%), grain and hay (30%)(Table 3-2). Scattered agricultural structures and equipment complexes are located in the northern, central, and southern portions of the island (JSA 2001b). Several residences and associated farmstead structures are located north of State Highway 12. Two residences, one of which is currently occupied, are located south of State Highway 12 on the eastern side of the island. An airstrip used by crop-dusting operators is located west of these residences. An oil-drilling pad is also located in this area. The island also has an old duck club that is unoccupied and is currently used for decoy storage and other similar uses. Bouldin Island is entirely owned by DW Properties.

The San Joaquin County zoning designation for Bouldin Island is AG-40 (SJC 2001a, 2001b). Uses allowed under this zoning include single-family dwellings, crop production, packing sheds, farm employee housing, livestock grazing, and other limited agriculture- and livestock-related activities (SJC 2000). Site approval is required for outdoor sports clubs, resorts, and nurseries. Use permits are required for marinas, parks, and campgrounds.

Table 3-2. Land use on Bouldin Island

Land Use Category	Acres
Grain & hay crops	1833
Corn (field & sweet)	3519
Marshes, tules & sedges	26
Water surface (lakes, canals, etc.)	9
Native vegetation	607
Residential	2
Farmsteads	6
source: DWR 1996a	

Bouldin Island falls under the San Joaquin County General Plan (SJCGP) Resource Conservation and the General Agriculture designations (SJC 2001a). The General Agriculture designation provides for crop production, feed and grain storage and sales, crop spraying, and animal raising and sales. The Resource Conservation designation requires areas to remain open space.

All of Bouldin Island's 5985 acres are under Williamson Act contracts and are owned by DW Properties. The Department of Conservation's Farmland Mapping and Monitoring Program classifies soils on Bouldin Island in the following categories:

- 5,711 acres are prime farmland, and
- 50 acres are farmland of statewide importance (DPC 2001; JSA 2001b).

3.1.1.3 Holland Tract

Approximately 69% of Holland Tract is used for agriculture and produces mainly grain (30%), safflower (23%) and corn (12%)(Table 3-3). Agricultural structures and equipment complexes are scattered along the southern and western perimeter levees. Onsite residences include a temporary trailer located in the northeast portion of the island near the levee bordering Holland Cut and two residences on the Beaulieu Foundation property in the western portion of the island (JSA 2001b). An abandoned hog feeding area is located east of the Beaulieu Foundation residences. This area includes several structures ancillary to hog farming and untilled open space.

Two marinas are located at the southern boundary of Holland Tract on Rock Slough. The Lindquist Landing Marina on the southern boundary features boat docks and other structures ancillary to marina uses. The Holland Riverside Marina, at the southeastern corner of the island, is a large facility with numerous boat docks, covered slips, and ancillary marina uses.

Table 3-3. Land use on Holland Tract[a]

Land Use Category	Acres
Grain & hay crops	1253
Corn (field & sweet)	514
Safflower	991
Field crops but currently fallow	23
Idle (but cropped within last 3 years)	9
Water surface (lakes, canals, etc.)	12
Marshes, tules & sedges	70
Native vegetation	218
Riparian vegetation	19
source: DWR 1995 [a]1,120 acres excluded from the project area are not included in totals.	

DW Properties owns the majority of Holland Tract parcels. DW Properties does not own the Beaulieu Foundation parcel (860 acres) in the southwestern corner of the site, several small parcels adjacent to the Beaulieu parcel in the southwestern corner of the island, and the marina parcels along the southeastern

perimeter of the island. The marina parcels, the Beaulieu Foundation parcel, and other small parcels total about 1,120 acres. The 1,120 acres would not be purchased as part of the project and are therefore excluded from the environmental evaluations in subsequent sections.

The Contra Costa County zoning designations for Holland Tract are General Agricultural District (A-2) and Heavy Agricultural District (A-3). Uses allowed under A-2 zoning were discussed above for Webb Tract. The A-3 zone allows uses that are similar to the uses allowed in A-2 zones, with the exception that parcels must consist of at least 10 acres. This designation specifically allows only owners or lessees to reside on the site.

The CCCGP designation for all of Holland Tract is Delta Recreation and Resources. Uses allowed under the Delta Recreation and Resources designation are the same as discussed under Webb Tract.

Holland Tract has no parcels under Williamson Act contracts. The Department of Conservation's Farmland Mapping and Monitoring Program classifies soils on Holland Tract in the following categories:

- 1,575 acres are prime farmland,
- 2,031 acres are farmland of statewide importance, and
- 426 acres are unique farmland (DPC 2001; JSA 2001b).

3.1.1.4 Bacon Island

DW Properties owns all of Bacon Island. Crops grown on the island include corn, grain, potato, sunflower, and asparagus (Table 3-4). JSA (2001b) reports that approximately 20 farmsteads or rural residences are located on the island near the perimeter levees. An additional five or six barracks for migrant farm workers are also occupied seasonally. Agricultural structures and equipment complexes are located in the northern, central, and southern portions of the island. An airstrip for crop dusting flights is located on the eastern portion of the island.

The San Joaquin County zoning designation for Bacon Island is General Agriculture with an 80-acre parcel minimum (AG-80) (SJC 2001a, 2001b). Uses allowed under this zoning include single-family dwellings, crop production, packing sheds, farm employee housing, livestock grazing, and other limited agriculture- and livestock-related activities (SJC 2000). Site approval is required for outdoor sports clubs, resorts, and nurseries. Use permits are required for marinas, parks, and campgrounds.

Table 3-4. Land use on Bacon Island

Land Use Category	Acres
Grain & hay crops	851
Corn (field & sweet)	2206
Sunflowers	888
Asparagus	290
Potatoes	830
Grain sorghum	71
Melons, squash, & cucumbers	3
Idle (but cropped within last 3 years)	13
Water surface (lakes, canals, etc.)	4
Native vegetation	416
Airport runways	6
Barren	13
Canneries & food processing	5
Farmsteads	10
Storage & distribution	4
Farmsteads & canneries	13
source: DWR 1996a	

Bacon Island falls under the SJCGP General Agriculture designations (SJC 2001a). The General Agriculture designation provides for crop production, feed and grain storage and sales, crop spraying, and animal raising and sales.

Approximately 4,662 acres of Bacon Island are currently under Williamson Act contracts (JSA 1995a). Two parcels on Bacon Island are not under Williamson Act contracts. The Department of Conservation's Farmland Mapping and Monitoring Program classifies soils on Bacon Island in the following categories:

- 5,278 acres are prime farmland, and
- 125 acres are farmland of statewide importance (DPC 2001; JSA 2001b).

Pacific Gas and Electric (PG&E) owns two subsurface high-pressure gas transmission pipelines which cross Bacon Island (SWRCB 2001). One line connects PG&E's interstate and intrastate gas transmission and distribution system to the natural gas storage facility under McDonald Island. The other line is not in use but may be used again at some point in the future.

3.1.1.5 Resource Issues and Impacts

CEQA provides the following guidance for determining the significance of impacts to land use, including agricultural lands. Project impacts may be considered significant if:

- the project converts prime farmland, unique farmland, or farmland of statewide importance;
- the project conflicts with existing agricultural zoning or Williamson Act contracts;
- the project causes other impacts on or conversions of farmland;
- the project displaces a substantial number of existing housing units or people; and
- the project conflicts with land use plans, policies, or regulations.

Overall, JSA (2001b) determined that implementation of the DW Project would result in two significant and unavoidable land use and agricultural impacts. Approximately 15,029 acres of prime agricultural land on Webb Tract, Bouldin Island, Holland Tract and Bacon Island would be converted to water storage and habitat. The conversion of prime farmland is a significant adverse impact of the DW Project. The conversion would also be inconsistent with Contra Costa County's and the Delta Protection Commission's (DPC) land use goals to preserve prime agricultural lands for agricultural production. San Joaquin County's preliminary determination is that the proposed uses do not conflict with existing plans or zoning. However, recent information indicates San Joaquin County may require permits for flooding Bacon and Bouldin islands for storage and wetland habitat, respectively (Cooper 2001).

CALFED agencies have proposed conversion of 166,000 acres of Delta farmland to other uses (CALFED 2000c). The DW Project's 15,000 acres are included in the CALFED total. San Joaquin County (2000) estimated that 630,000 acres and Contra Costa County (1996) estimated that 215,840 acres of important farmland remain in their counties. DW Project islands make up 2% and 5% of that remaining important farmland in San Joaquin and Contra Costa counties, respectively. JSA (2001b) determined that the conversion of prime farmland and conflicts with land use policies were significant, unavoidable impacts to agriculture which could not be mitigated.

Webb Tract Issues and Impacts

JSA (2001b) identified three significant adverse impacts from the use of Webb Tract as a reservoir island: the conversion of prime farmland, conflicts with land use plans, and conflicts with adjacent land uses. The project would convert 4,725 acres of prime farmland on Webb Tract to nonagricultural use. Although this would result in significant adverse impact under strict interpretation of CEQA guidelines, there is disagreement among soil scientists on whether peat soils fit the criteria of prime farmland given their oxidation qualities (JSA 2001b). However, as of 2002, portions of Webb Tract are classified prime farmland and must be evaluated for impacts as prime farmland. In addition, resolving disagreements among scientists on prime farmland classification is beyond the scope of the study and the mission of DWR and Reclamation. Therefore, the conversion of prime farmland is considered a significant adverse impact.

The use of Webb Tract as a reservoir island is consistent with CCCGP's policies for lands designated as Delta Recreation and Resources and Open Space (JSA 2001b). It is also consistent with the Delta Protection Act which allows for water reservoir and habitat development that is compatible with other uses (PRC 1992). However, the conversion of Webb Tract from agriculture to water storage conflicts with the county's policy to encourage and enhance agriculture. It also conflicts with the DPC's policies that designate agriculture as the primary land use in the Delta (DPC 1995).

The use of Webb Tract as a reservoir island could result in conflicts with adjacent land uses. These conflicts include increased seepage and trespassing on neighboring islands. The increase in trespassing may result from increased recreational use in the area. The potential conflicts with adjacent land uses are addressed in the Draft Report on Engineering Investigations and in Section 3.1.7 of this report.

JSA (2001b) reported that Contra Costa County made a preliminary determination that the use of Webb Tract for water storage is consistent with the current Williamson Act contract and therefore, would not be a significant impact. Three trailers, a residence and a clubhouse owned by DW Properties would be removed from the island. This would be a less than significant impact because DW Properties are willing sellers and would be compensated for their property if federal and state entities were to lease or buy the project.

Bouldin Island Issues and Impacts

JSA (2001b) identified two significant adverse impacts from the use of Bouldin Island as wildlife habitat: the conversion of prime farmland and conflicts with land use plans. Approximately 3,864 acres of a total of 5,711 acres prime farmland would be lost to nonagricultural uses under the DW Project. Approximately 1,800 acres on Bouldin Island would be used for corn, wheat, small grains, pasture and hay production under the HMP (JSA 1995b). An estimated 1,195 acres would be harvested for sale. JSA (2001b) concluded that the sale of grain crops planted for wildlife habitat would partially offset the loss of agricultural production but the overall reduction on the island would still be significant.

The use of Bouldin Island as wildlife habitat conflicts with DPC policies that designate agriculture as the priority land use for prime Delta farmland (DPC 1995).. The primary land use on Bouldin Island would become wildlife habitat rather than agricultural production with the implementation of the DW Project. JSA (2001b) reported that San Joaquin County determined the use of Bouldin Island for wildlife habitat as consistent with its zoning and General Plan designations for the island. However, Cooper (2001) reported that San Joaquin County may require permits for flooding Bouldin Island for wetland habitat.

JSA (2001b) also reported that San Joaquin County made a preliminary determination that the use of Bouldin Island for wildlife habitat is consistent with the goals of the Williamson Act and therefore, would not be a significant impact. The structures located on Bouldin Island are owned by DW Properties and may or may not be removed from the island. Regardless of the ultimate fate of those structures, any impacts would be a less than significant impact because DW Properties are willing sellers and would be compensated for their property if federal and state entities were to lease or buy the project.

JSA (2001b) did not identify any significant adverse impacts to adjacent land uses around Bouldin Island from the DW Project. However, several stakeholders raised concerns that increased recreational use of Bouldin Island could increase trespassing on adjacent islands. The impacts to adjacent land uses from increased recreation are addressed in Section 3.1.7 of this report.

Holland Tract Issues and Impacts

JSA (2001b) identified two significant adverse impacts from the use of Holland Tract as wildlife habitat: the conversion of prime farmland and conflicts with land use plans and policies. The implementation of the DW Project would remove agricultural land in Contra Costa County from production. This would be inconsistent with the county's agriculture policy to encourage and enhance agriculture. It also conflicts with the DPC's policies that designate agriculture as the primary land use in the Delta (DPC 1995).

The use of Holland Tract as wildlife habitat may not conflict with the CCCGP designation of Delta Recreation and Resources (JSA 2001b). Further review by county staff will be required to make a final determination.

Approximately 1,162 acres prime farmland, 357 acres of farmland of statewide importance and 214 acres of unique farmland would be converted to nonagricultural uses under the DW Project. An estimated 1,179 acres on Holland Tract would be used for corn, wheat, barley, and pasture under the HMP (JSA 1995b). An estimated 741 acres would be harvested for sale. JSA (2001b) concluded that the sale of grain crops planted for wildlife habitat would partially offset the loss of agricultural production but the overall reduction on the island would still be significant. Therefore, the DW Project results in a significant adverse impact to prime, unique and farmland of statewide importance.

JSA (2001b) did not identify any significant adverse impacts to adjacent land uses around Holland Tract from the DW Project. However, several stakeholders raised concerns that the increased recreational use of Holland Tract could increase trespassing on adjacent islands and properties on Holland Tract that are outside of the project area. The impacts to adjacent land uses from increased recreation are addressed in Section 3.1.7 of this report.

The structures located on Holland Tract within the project area are owned by DW Properties and may or may not be removed from the island. Regardless of the ultimate fate of those structures, any impacts would be a less than significant impact because DW Properties are willing sellers and would be compensated for their property if federal and state entities were to lease or buy the project.

Bacon Island Issues and Impacts

JSA (2001b) identified two significant adverse impacts from the use of Bacon Island for water storage: the conversion of prime farmland and conflicts with land use plans. Approximately 5,278 acres of prime farmland would be lost to nonagricultural uses under the DW Project.

The use of Bacon Island for water storage conflicts with DPC' policies but does not conflict with San Joaquin County policies. The DPC (1995) has designated agriculture as the primary land use in the Delta. Agriculture would no longer be the primary land use on Bacon Island with the implementation of the DW Project. JSA (2001b) reported that San Joaquin County preliminary determination is that the use of Bacon Island for water storage is consistent with the open space and conservation policies of the general plan. However, Cooper (2001) reported that San Joaquin County may require permits for flooding Bacon Island because the county is in the process of developing permit regulations for flooding agricultural lands.

JSA (2001b) also reported that San Joaquin County made a preliminary determination that the use of Bacon Island for water storage is consistent with the goals of the Williamson Act and therefore, would not be a significant impact. The structures located on Bacon Island are owned by DW Properties and would be removed from the island. Any impacts from removing the structures and relocating the residents would be a less than significant impact. DW Properties are willing sellers and would be compensated for their property if state and federal entities were to lease or buy the project.

The use of Bacon Island as a reservoir island could result in conflicts with PG&E's gas pipelines on the island and adjacent land uses. Adjacent land use conflicts include increased seepage and trespassing on neighboring islands. The increase in trespassing may result from increased recreational use in the area. The potential conflicts with adjacent land uses and PG&E's gas pipelines are addressed in the Draft Report on Engineering Investigations, Chapter 7- Policy and Legal Issues in the In-Delta Storage Draft Summary Report, and in Section 3.1.7 of this report.

3.1.2 Botanical Resources

3.1.2.1 Methodology and Sources for Existing Botanical Resources

Habitat Types on the DW Project Islands – Methodology and Sources

Habitat types on the DW Project islands were identified and mapped in 1988, using December 1987 photos (color, 1:24,000). Habitat types were mapped to a minimum polygon size of approximately one acre. Field verification of the habitat types was performed from January through June of 1988 by vehicle and foot surveys, and low-altitude flights (JSA 1995a).

Nineteen habitat types in seven major habitat groups were designated in a classification scheme designed specifically for the DW Project islands. The habitat type classification scheme was developed in consultation with DFG and USFWS (JSA 1995a). The major habitat groups include riparian, marsh, open water, herbaceous upland, agriculture, woody non-native, and developed land (Tables 3-5 and 3-6). More current data about land use on the DW Project islands is presented in Section 3.1. Habitat groups and types, however, are not directly comparable with the land use categories. Therefore, the land use acreage values (Table 3.1 through 3.4) cannot be used to update the 1988 habitat acreage (Table 3-6).

The riparian, freshwater marsh, and open water habitats often were associated with island blowout ponds formed from levee breaks where water from seepage and pooling remained in the scour scars after an island has been reclaimed. Riparian habitat also was found in strips along the inside toe of perimeter levees and in association with inland seepage areas. Both freshwater and exotic marsh grew in low-lying seepage areas, dominated by herbaceous species growing in soil inundated for long periods. Exotic marsh consisted of former agricultural fields that were abandoned or left fallow for more than two years and subsequently had been invaded by dense stands of exotic herbaceous weeds. Exotic marsh also occupied small, untilled sites in actively farmed fields. Tidal marsh occurred outside of DW Project islands, along the margins of perimeter levees and on in-channel islands. The status of invasive aquatic plant species in marshes and open water habitat like blowout ponds, ditches, and canals was not evaluated.

From 1998 to 2000, data about plant habitat on and adjacent to perimeter levees of Delta islands were collected for DFG habitat assessment. Data were available for Webb Tract, Bouldin Island, Holland Tract, and Bacon Island. The presence of riparian, freshwater marsh, exotic and shaded riverine aquatic (SRA) habitats, and riverine aquatic bed (RAB) was recorded for these islands. Much of the riparian and marsh habitats catalogued in the assessment was less than one acre each, but many patches grew along the island levees.

Annual grassland typically occurred on broad, gentle interior slopes of perimeter levees and was primarily dominated by exotic annual grasses. Perennial grassland had moisture conditions ranging between those of annual grassland and exotic marsh. Soil moisture was adequate year-round to support the growth of native and exotic perennial grasses, but in the dry season was not sufficient to support typical wetland vegetation (JSA 1995a).

There are five agricultural habitat types and of these, livestock pasture and fallow fields could have some value for native plants. Typically, pastureland is dominated by exotic grasses and forbs because of trampling and grazing by livestock. Depending upon soil, disturbance, and hydrological factors, fallow fields supported weedy species such as exotic grasses and forbs. Agricultural fields and other weedy sites abandoned for more than two years are included in the marsh or herbaceous upland group, depending upon their hydrology, soils, and plant species composition (JSA 1995a).

Habitat Types on In-Channel Islands – Methodology and Sources

The characteristics of in-channel islands were not described in detail (JSA 1995a). In-channel islands are landmasses and submerged shoals that are remnants of the original wetlands associated with the Sacramento and San Joaquin rivers (Kjeldsen and others 1997). In-channel islands arise from different

origins. The islands can be described as (a) remnant stands of emergent vegetation that are off-shore of reclaimed islands (e.g., Webb Tract), (b) abandoned levees that encircle flooded islands (e.g., Franks Tract), or (c) areas that originally comprised the perimeter of reclaimed islands, but were subsequently separated from them by dredging.

Depending on tidal influence, typical plant species on in-channel islands include bulrush (*Scirpus* spp.), cattail (*Typha* spp.), common reed (*Phragmites australis*) and pondweed (*Potamogeton* spp.). In some cases woody terrestrial species, such as willow (*Salix* spp.), blackberry (*Rubus* spp.), and button bush (*Cephalanthus occidentalis*) grow on the interior of in-channel islands. Elderberry (*Sambucus* spp.), habitat for the valley elderberry longhorn beetle, also occurs on some islands (Kjeldsen and others 1997). Adjacent to the islands, submerged plants grow in RAB. The substrate of in-channel islands is typically fibrous organic peat (Kjeldsen and others 1997).

The DW Project will pay $111 per year to DFG for each additional boat berth added beyond pre-project recreational conditions (DFG 2001a). This fee will supplement the Aquatic Habitat Restoration Fund and is adjusted for inflation (Table 3-26). The boat berth payment acts as mitigation for both aquatic and terrestrial resources potentially impacted by boat wake erosion (Starr personal communication; see "Notes"). In-channel islands in the vicinity of the DW Project provide habitat for some of covered species (e.g., Mason's lilaeopsis) listed in the Incidental Take permit (DFG 2001a) and could be impacted by boat wake erosion (Kjeldsen and others 1997).

Rare Plant Communities – Methodology and Sources

The DFG California Natural Diversity Database (CNDDB) (DFG 2001b) indicated that one rare plant community, coastal and valley freshwater marsh, occurred in the vicinity of the DW Project islands. Coastal and valley freshwater marsh is a Holland type vegetation classification (Holland 1986) that is dominated by perennial, emergent monocots that often form closed canopies up to five feet tall. Typical species include sedge (*Carex* spp.), nutsedge (*Cyperus* spp.), spikerush (*Eleocharis* spp.), pennywort (*Hydrocotyle verticillata*), mudwort (*Limosella aquatica*), common reed, bulrush, bur-reed (*Sparganium* spp.), cattail, and vervain (*Verbena bonariensis*). Coastal and valley freshwater marsh generally grows on peat soils in areas permanently, semi-permanently, or seasonally flooded by fresh water and lacking significant current (Holland 1986, Sawyer and Keeler-Wolf 1995). It occasionally occurs in coastal valleys near river margins, rivers, and springs and along the lower reaches of the Colorado River. However, it is more widely distributed in the Sacramento and San Joaquin valleys and in the Delta (Holland 1986).

Wetlands – Methodology and Sources

Delineation of jurisdictional wetlands under Section 404 of the Clean Water Act (CWA) (using the 1987 U.S. Army Corps of Engineers (Corps) Wetland Delineation Manual) was jointly conducted for the DW Project islands by the Natural Resources Conservation Service (NRCS) (formerly the U.S. Soil Conservation Service), Corps, Environmental Protection Agency (EPA), and USFWS in October 1994. In December 1994 and January 1995, the Corps and NRCS, respectively, verified the delineation of waters of the U.S., including wetlands, on the DW Project islands. Results of the delineation were used to identify the extent and types of jurisdictional wetlands on the DW Project islands.

Approximately 763 acres of riparian woodland, riparian scrub, freshwater marsh, exotic marsh, canal and ditch, permanent pond, herbaceous upland, and seed and grain crop habitats were delineated by NRCS, the Corps, EPA, and USFWS as jurisdictional wetlands under Section 404 of the CWA (JSA 2001b). Hydric Soils of the U.S. included organic mucks and mucky clays that often contained coarse sand and decomposed peat layers (JSA 1995a). The project island wetland hydrology generally was characterized as shallow ponded water or saturated soil within one to two feet of the soil surface.

Table 3-5. Habitat group classifications for the Delta Wetlands Project islands[a]

Habitat Group[b]	Habitat Type[b]	Description	Dominant and Typical Plant Species
Riparian	Great Valley willow scrub	willow shrubs and trees	red willow, yellow willow, sandbar willow, Goodding's willow
	cottonwood-willow woodland	cottonwood, willow trees and shrubs	Fremont cottonwood, red willow, yellow willow
Marsh	tidal marsh	outside of island levees	common tule, common reed, bulrush, common rush
	non-tidal freshwater marsh	inside of island levees	cattail, bulrush, yellow nutsedge, pondweed, buttonbush
	exotic marsh	dense upland and wetland weeds (sometimes dry in summer)	annual smartweed, peppergrass, amaranth, wild radish, nettle, cocklebur, watergrass
Open water	canals and drainage ditches	permanent water	dallis grass, knot grass, Himalayan blackberry, smartweed
	permanently ponded water	still water	water hyacinth, water primrose, azolla
	tidal mudflats	tidal influence, open bare mud	none
Herbaceous upland	annual grassland	true uplands, including sand hills and levee slopes	wild oats, barley, rip-gut brome, Italian rye grass
	perennial grassland	mixed exotic weeds in fields and on levee slopes	Bermuda grass, perennial ryegrass, Johnson grass
Agriculture	crops	annual and perennial crops	corn, wheat, sunflowers, potatoes asparagus, grapes (vineyards)
	livestock pasture	permanently grazed	tall fescue, orchard grass, canary grass, ryegrass, legumes
	fallow fields	short term fallow fields	yellow star thistle, Russian thistle, milk thistle, houseweed, lamb's quarter, telegraph weed
Woody, non-native	mature trees	trees used for shade and for windbreaks (typically exotic)	eucalyptus, pine, elm
	mixed ornamental	shrubs and lawns	turf grass, ornamental shrubs
Developed land	structures	buildings and marinas	N/A
	scarified and compacted soil	roads, landfills, unvegetated areas	N/A

[a]Adapted from JSA 1995a.
[b]Habitat groups and types are not directly comparable with the land use categories in Section 3.1.

Table 3-6. Acreage of habitat types on Delta Wetlands Project islands[a]

Habitats		Webb Tract		Bouldin Island		Holland Tract		Bacon Island		Total for All Islands	
Habitat group[b]	habitat types[b]	acres	percent of total	acres	percent of total	acres	percent of total	acres	percent of total	acres	percent of total
Riparian	Great Valley willow scrub	58.0	1.06	9.9	0.16	24.8	0.79	3.4	0.06	96.1	0.48
	cottonwood-willow woodland	47.7	0.87	6.9	0.11	80.3	2.56	0.0	0.00	134.9	0.67
Marsh	tidal marsh	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	non-tidal freshwater marsh	172.0	3.14	21.1	0.35	27.8	0.89	2.7	0.05	223.5	1.11
	exotic marsh	783.3	14.32	114.7	1.92	195.5	6.23	30.4	0.55	1123.9	5.58
Open water	canals and drainage ditches	49.7	0.91	118.1	1.97	39.4	1.26	91.8	1.66	299.0	1.49
	permanently ponded water	105.7	1.93	0.0	0.00	16.6	0.53	1.5	0.03	123.8	0.62
	tidal mudflats	0.0	0.00	9.3	0.16	0.0	0.00	1.2	0.02	10.5	0.05
Herbaceous upland	annual grassland	534.6	9.77	349.1	5.83	369.0	11.77	260.8	4.71	1513.5	7.52
	perennial grassland	304.2	5.56	0.0	0.00	263.8	8.41	267.6	4.83	835.6	4.15
Agriculture	crops	2694.7	49.27	4530.3	75.69	1037.3	33.08	4439.0	80.14	12701.3	63.10
	pasture	61.0	1.12	34.2	0.57	349.8	11.16	0.0	0.00	445.0	2.21
	fallow fields	637.9	11.66	711.6	11.89	689.1	21.98	355.3	6.41	2394.0	11.89
Woody, non-native	mature trees and mixed ornamental	0.0	0.00	5.0	0.09	4.4	0.14	0.0	0.00	9.4	0.05
Developed land	structures and scarified and compacted soil	20.2	0.37	74.8	1.25	37.4	1.20	85.7	1.55	218.1	1.09
Total		5467.0	100.00	5985.0	100.00	3135.2	100.00	5539.4	100.00	20128.6	100.00

[a]Adapted from JSA 1995a.
[b]Habitat groups and types are not directly comparable with the land use categories in Section 3.1.

The Corps and NRCS verifications expired 5 years after they were issued. DW Properties is currently working with the Corps and Jones & Stokes to update the delineation to reflect current conditions on the project islands. The updated delineation will identify waters of the U.S., including wetlands, on the project islands and in channels where project facilities (e.g., pump and siphon stations) would be located. Before issuing a permit under the CWA and Rivers and Harbors Act, the Corps will revise the estimates of wetland impacts based on more detailed investigations (JSA 2001b). At no time were wetland delineations submitted for the in-channel islands.

Special-Status Plants – Methodology and Sources

Sensitive plant information has been obtained from numerous sources. These include the following: the DW Properties regulatory documents (JSA 1995a, 2000, 2001a, 2001b), the Incidental Take Permit (DFG 2001a), the DFG Levee Habitat Assessment Vegetation Survey Log (DFG 1998a, 1998b, 1999a, 1999b), the CNDDB (DFG 2001b), the biannual Special Plants List (DFG 2001c), the California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California (Tibor 2001), and the Jepson Manual (Hickman 1993).

A CNDDB search (1987 and 1993, versions unknown) and consultation with numerous professional sources was completed for the DEIR/EIS (JSA 1995a). JSA used the information to develop a list of special-status plant species that could occur near the DW Project islands. Special-status plant species potentially occurring in the project area were defined as those with known populations in or near the project area, and those known from habitats either identical to or similar to those found in the project area. Based on extensive investigation, JSA identified 14 special-status plants as potentially occurring in the area (JSA 1995a). Based on guidance by DFG, seven other species occurring in the vicinity were not included on the list because potential habitat for these species did not exist in the project area at that time. These seven species include water hemlock (*Cicuta maculata* var. *bolanderi*), palmate-bracted bird's-beak (*Cordylanthus palmatus*), Delta button-celery (*Eryngium racemosum*), Contra Costa goldfields *(Lasthenia conjugens*), Colusa grass (*Neostapfia colusana*), caper-fruited tropidocarpum (*Tropidocarpum capparideum*), and Crampton's tuctoria (*Tuctoria mucronata*). Subsequent regulatory documents incorporated few changes to the botanical information (JSA 2000, 2001a, 2001b).

DWR staff updated information about sensitive plant taxa by performing current searches with the references listed in Table 3-7. Marsh pea (*Lathyrus palustris*) was removed from the original list (JSA 1995a) because it does not occur in the Delta (Hickman 1993, Tibor 2001). Tall woolly-heads (*Psilocarphus brevissimus* var. *globiferu*s) (sic.), correctly known as round woolly marbles (*Psilocarphus tenellus* var. *globiferus*) was recently considered, but rejected for listing by CNPS because it is too common. This taxon was neither state nor federally listed and, therefore, it is not included on the updated list (Table 3-7). Based on a discrepancy in the DEIR/EIS, Delta button-celery was included on the list of potentially occurring species even though apparent consultation with DFG revealed that potential habitat for this species did not occur within the project area (JSA 1995a). Because of this discrepancy between the potential special-status plant list and the list of rejected species, Delta button-celery is included in Table 3-7 until DWR consults with DFG. Lastly, two other taxa were added in the updated species list based on their current listing status; these include Northern California black walnut (*Juglans californica* var. *hindsii*), and marsh skullcap (*Scutellaria galericulata*) (Table 3-7).

Based on the lack of specific location information in the environmental documents (JSA 1995a, 2000, 2001a, 2001b) and the CNDDB (DFG 2001b), it cannot be determined with confidence that sensitive plant occurrences listed in the DEIR/EIS (JSA 1995a) are the same occurrences as in the CNDDB (DFG 2001b). Therefore, Table 3-8 depicts special-status plant occurrences recorded in 1988 and 1994 (JSA 1995a) and Table 3-9 summarizes the number of occurrences from the recent CNDDB (DFG 2001b) search by DWR staff.

During their reconnaissance trips to the DW Project islands in August and October 2001, DWR staff did not survey for sensitive plants.

Table 3-7. Special-status plant species potentially occurring within the proximity of the project area

Scientific Name Common Name (Family)	Status Federal/State CNPS	Distribution in California	Habitat and Flowering Time
Aster lentus Suisun marsh aster (Asteraceae – sunflower family)	FSC/--/ 1B	San Francisco, San Pablo, and Suisun Bays and the Delta. Counties - Contra Costa, Napa, Sacramento, San Joaquin, Solano.	Salt, brackish, and freshwater marshes at or above the zone of tidal fluctuation. Blooms May-Nov.
Cirsium crassicaule slough thistle (Asteraceae – sunflower family)	FSC / -- / 1B	The Delta and San Joaquin Valley. Counties – Kings, Kern, San Joaquin.	Shallow water or saturated soils in various wetland plant communities, including chenopod scrub, marshes, swamps, and riparian scrub. Often found along sloughs, canals, and rivers and and/or in disturbed areas. Blooms May-Aug.
Eryngium racemosum Delta button-celery (Apiaceae - carrot family)	-- / CE / 1B	The Delta and San Joaquin Valley. Counties – Merced, San Joaquin, Stanislaus.	Vernally mesic clay depressions (e.g., vernal pools) in riparian scrub. Blooms June-Aug.
Erysimum capitatum ssp. *angustatum* Contra Costa wall flower (Brassicaceae - mustard family)	FE / CE / 1B	Known only from the Antioch Dunes in the city of Antioch, Contra Costa county.	Interior dunes with sparse herb and shrub cover. Blooms March-July.
Hibiscus lasiocarpus rose-mallow (Malvaceae - mallow family)	-- / -- / 2	Counties – Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, Yolo, and elsewhere.	Freshwater marsh, often in riparian areas with slow moving water. Canals, sloughs, ponds, and oxbow lakes. Blooms June-Sept.
Juglans californica var. *hindsii* Northern California black walnut (Juglandaceae - walnut family)	FSC / -- / 1B	Inner side of the northern Coast Ranges, southern Sacramento Valley, northern San Joaquin Valley, San Francisco Bay region. Counties – Contra Costa, Napa, Sacramento, Solano, Yolo.	Canyons and valleys in riparian scrub and woodland. Blooms April-May.
Lathyrus jepsonii var. *jepsonii* Delta tule pea (Fabaceae - pea family)	FSC / -- / 1B	The Delta and Central Valley. Counties - Alameda, Contra Costa, Napa, Sacramento, Santa Clara, San Joaquin, Solano.	River and canal banks in association with freshwater and brackish marshes and riparian woodlands at or above the zone of tidal influence. Blooms May-Sept.
Lilaeopsis masonii Mason's lilaeopsis (Apiaceae - carrot family)	FSC / CR / 1B	The Suisun Bay and Delta within areas influenced by tidal fluctuations. Counties - Alameda, Contra Costa, Napa, Sacramento, San Joaquin, Solano.	Often growing on clay-peat deposits and rotting wood located in marsh vegetation along the edges of waterways within the tidal zone. Sometimes found lodged on levee riprap. Blooms April-Nov.
Limosella subulata delta mudwort (Scrophulariaceae - figwort family)	-- / -- / 2	The Delta. Counties – Contra Costa, Sacramento, San Joaquin, Solano, and elsewhere.	Edges of riverbanks and slough banks in marsh vegetation rooted within zone of tidal fluctuation. Blooms May-Aug.
Oenothera deltoides ssp. *howellii* Antioch Dunes evening primrose (Onagraceae - primrose family)	FE / CE / 1B	Known only from the Antioch Dunes in the city of Antioch and from Brannan Island. Counties – Contra Costa, Sacramento.	Interior bluffs and dunes with sparse herb and shrub cover. Blooms March-Sept.
Potamogeton zosteriformis eel-grass pondweed (Potamogetonaceae - pondweed family)	-- / -- / 2	Clear Lake, the Great Valley, Modoc Plateau. Counties - Contra Costa, Lake, Lassen, Modoc, Shasta, and elsewhere. Expected in the Central Valley, but more information is needed.	Freshwater marshes, ponds, canals, and ditches. Blooms June-July.

Table 3-7. Special-status plant species potentially occurring within the proximity of the project area (continued)

Scientific Name Common Name (Family)	Status Federal/State CNPS	Distribution in California	Habitat and Flowering Time
Sagittaria sanfordii Sanford's arrowhead (Alismataceae - arrowhead family)	FSC / -- / 1B	Widespread, but infrequent in the Central Valley, north Coast Ranges, and northern south coast. Counties – Butte, Del Norte, Fresno, Kern, Merced, Orange, Sacramento, Shasta, San Joaquin, Tehama, Ventura.	Shallow freshwater marshes, ponds, sloughs, streams and ditches. Prefers silty or muddy substrate. Blooms May-Oct.
Scutellaria galericulata marsh skullcap (Lamiaceae - mint family)	-- / -- / 2	Counties – El Dorado, Lassen, Modoc, Nevada, Placer, Plumas, Shasta, San Joaquin, Siskiyou (?), and elsewhere.	Lower montane coniferous forest, mesic areas, meadows, marshes, seeps. Occurrences in the Delta (San Joaquin Co.) need further study. Blooms June-Sept.
Scutellaria lateriflora blue skullcap (Lamiaceae - mint family)	-- / -- / 2	Counties – Inyo, San Joaquin, and elsewhere.	Mesic meadows, seeps, and freshwater marshes. Blooms July-Sept.

Listing status code definitions used by the California Native Plant Society (CNPS), the State of California (i.e., DFG), and the Federal Government (i.e., USFWS) to describe the degree of endangerment and the legal status of sensitive plant taxa:

CNPS LISTS

List 1A: Plants presumed extinct in California

List 1B: Plants rare, threatened, or endangered in California and elsewhere

List 2: Plants rare, threatened, or endangered in California, but more common elsewhere

STATE LISTING CODES

CE State listed, endangered

CT State listed, threatened

CR State listed, rare

FEDERAL LISTING CODES

FE Federal, endangered

FT Federal, threatened

PE Federal, proposed endangered

PT Federal, proposed threatened

FSC Federal species of concern (replaces old "candidate" categories C1, C2, C3c)

C Federal candidate for listing

Table 3-8. Occurrences of special-status plant taxa on DW islands listed in the 1995 DEIR/EIS[a]

Species	Webb Tract	Bouldin Island	Holland Tract	Bacon Island
Aster lentus Suisun Marsh aster	3	8	19	6
Hibiscus lasiocarpus rose-mallow	1	1	1	10
Lathyrus jepsonii var. *j* Delta tule pea	1	1	0	0
Lilaeopsis masonii Mason's lilaeopsis	3	5	0	18

[a]These data do not include the CNDDB 2001 update by DWR staff.
Note: All plant occurrences listed were observed on the exterior levee slopes along Delta Channels
Source: Dains 1988. Table reproduced from JSA 1995a.

Invasive Plants – Methodology and Sources

Invasive plant taxa are exotic species that, via their reproduction and spread, can create low-diversity monocultures or alter the environment in ways that are detrimental to native plants and animals. Of particular concern is the impact of exotic invasives on native habitat, special-status species, and operations and maintenance of the In-Delta Storage project. Current information about exotics on the project islands has been developed from the DEIR/EIS (JSA 1995a), the HMP (JSA 1995b), and reconnaissance trips by DWR staff (DWR 2001a). Specific infestations of exotic species on project islands were not mapped or otherwise documented (JSA 1995a, 1995b) and DWR staff were unable to map invasive populations on reconnaissance trips in 2001.

Habitats where invasive species typically occurred include agricultural and fallow fields, pastures, exotic marsh, the margins of open water, and annual and exotic perennial grassland. A chronic agricultural management problem on Delta islands was field infestation by weeds, especially perennial peppergrass (*Lepidium latifolium*), canary grass (*Phalaris canariensis*), smartweed (*Polygonum* spp.), milk thistle (*Silybum marianum*), bull thistle (*Cirsium vulgare*), Johnson grass (*Sorghum halepense*) and other moisture-dependent exotic weeds. Because weeds become established readily on Delta islands, farm management emphasizes clean farming practices that include annual disking of fallow fields and periodic clearing of riparian trees and shrubs (JSA 1995a).

Both exotic marsh and exotic perennial grassland are ruderal plant communities that colonize previously disturbed sites, such as abandoned fields (e.g., fallow fields), mowed levees, or flooded corners of active croplands. If left undisturbed for several years, they tend to be replaced by freshwater marsh or woody riparian species. The abandoned agricultural fields near the blowout ponds on Holland and Webb Tracts demonstrate this gradient of vegetation development. In addition, annual grassland often colonizes drier upland areas, such as some interior levee slopes (JSA 1995a).

While the margins of open water provide habitat for development of vegetation like exotic and freshwater marshes and riparian woodland (JSA 1995a), the open water also is habitat for numerous aquatic invasive taxa (DWR 2001a). Aquatic weeds observed in 2001 in Delta channels near the project islands include Brazilian elodea (*Egeria densa*), water hyacinth (*Eichhornia crassipes*), and watermilfoil (*Myriophyllum* spp.). Because these species spread rapidly, they have the potential to overtake open water habitat used by native species and clog waterways, reservoirs, and water transport systems. The status of exotic aquatic species on the DW Project and in-channel islands is currently unknown.

3.1.2.2 Webb Tract - Existing Botanical Resources

Habitat Types on Webb Tract

On Webb Tract, riparian forests and marsh had grown up around two blowout ponds (i.e., open water habitat) sculpted by in-rushing floodwater from the 1950 and 1980 levee breaks. Based on a reconnaissance field visit in August 2001, DWR staff tentatively identified the riparian forests surrounding both scour ponds as Great Valley willow scrub and cottonwood (*Populus fremontii* ssp. *fremontii*)-willow riparian woodland, and the pond marshes as freshwater marsh (DWR 2001a). The southern tip of Webb Tract was an area that sustained regular water seepage. One area in particular was dominated by a dense stand of willows. Based on a reconnaissance field visit in August 2001, DWR staff tentatively identified this vegetation as willow scrub.

Relatively sparse tidal marsh occurred intermittently along the shores of Webb Tract levees (JSA 1995a). However, DFG Levee Habitat Assessment Vegetation Survey data (DFG 1998b) indicated the presence of many strips of wetland vegetation occurring on both the land and watersides of Webb Tract's levees. These strips were generally less than one acre in size (e.g., the largest was approximately 0.50 acres) and for the most part, were dominated by bulrush and cattail. In some cases, the vegetation met DFG standards for freshwater marsh and therefore, may fit the criteria for the rare community, coastal and valley freshwater marsh. Records of willows, Himalayan blackberry (*Rubus discolor*), walnut (*Juglans* spp.), cottonwood, and alder (*Alnus rhombifolia*) indicated the presence of patches of riparian vegetation.

As of 1987, 15.33% of Webb Tract was herbaceous upland, the second highest proportion behind Holland Tract (Table 3-6). Patches are scattered throughout Webb Tract and along parts of the east, west, and northeast sections of the inland side of the peripheral levee. Some of the inland patches are consistent with locations of remnant sand hills, which are known to be difficult to farm because of topographic and hydrological constraints.

Fallow cropland (11.66%) was scattered throughout the island, with most occurring on the southwest, central south, north, and east sides of the island (Table 3-6). Exotic plant taxa colonized these fields some of which included Johnson grass, several thistle species, and Himalayan blackberry (DWR 2001a).

Rare Plant Communities

A current CNDDB search (DFG 2001b) showed that coastal and valley freshwater marsh, a sensitive and rare community type, occurred around the margins of Webb Tract. The DEIR/EIS (JSA 1995a) did not thoroughly address the occurrence of coastal and valley freshwater marsh around the perimeter of Webb Tract. However, the DWR In Delta Storage Investigation Pre-Feasibility Study Draft Report (2000) maps the extent of coastal and valley freshwater marsh around the island.

Wetlands

Wetlands on Webb Tract generally consisted of the habitat, soil, and hydrological conditions described above in the text. In total, 369.6 acres of wetlands occurred on Webb Tract when the first delineation was done (JSA 1995b). Most notable are the two blowout ponds and their associated riparian and marsh wetland habitats.

Special-Status Plants

DW Properties performed a field survey for sensitive plants on Webb Tract in 1988, but surveys for one area of the island could not be completed until 1994. Eight special-status plant occurrences were observed on the Webb Tract's exterior levee slopes (Table 3-8). An updated search was done in 2001 by DWR staff using the CNDDB (DFG 2001b). This search revealed one sensitive plant occurrence on Webb Tract at the scour ponds (Table 3-9).

No sensitive plant taxa were noted in the Webb Tract DFG Levee Habitat Assessment Vegetation Survey

Log. The walnut found during the levee survey should be re-examined to determine if it is Northern California black walnut.

Table 3-9. Occurrences of special-status plant taxa on DW islands and adjacent in-channel islands (CNDDB 2001)[a]

Species	Webb Tract	Bouldin Island	Holland Tract[b]	Bacon Island[b]
Aster lentus Suisun Marsh aster	3	2	1	1
Hibiscus lasiocarpus rose-mallow	2	2	15	8
Lathyrus jepsonii var. *j* Delta tule pea	2	4	0	1
Lilaeopsis masonii Mason's lilaeopsis	3	5	12	9
Limosella subulata delta mudwort	5	3	1	1
Scutellaria galericulata marsh skullcap	0	1	0	0
Scutellaria lateriflora blue skullcap	0	2	0	0

[a] These data do not include data from the 1995 DEIR/EIS (JSA 1995a).
[b] Nine occurrences are on in-channel islands between Holland Tract and Bacon Island. These occurrences were recorded for both project islands and include Suisun Marsh aster (1 occurrence), rose-mallow (4), and Mason's lilaeopsis (1).

Invasive Plants

Fallow fields commonly occurred throughout the island (JSA 1995a) and infestations of herbaceous species most probably grew in those areas. During reconnaissance visits in August 2001, DWR staff spent most of their time on levee roads. At that time, levee slopes and upland habitat were dense with introduced invasives such as perennial rhizomatous grasses (e.g., Bermuda grass, *Cynodon dactylon* and dallis grass, *Paspalum dilatatum*), bull thistle, milk thistle, and mustard species (*Brassica* sp., *Raphanus* sp.). In some areas on the waterside of levee slopes, giant reed (*Arundo donax*) grew in small clumps. In the eastern interior of the island, much of the farmland was flooded for weed control and waterfowl forage (DWR 2001a). However, invasive exotics like sorghum (*Sorghum* spp.), barnyard grass (*Echinochloa crus-galli*), and smartweed grew on the borders of flooded fields and ditches, while annual grasses (*Bromus* spp.) covered drier, flat areas adjacent to the flooded farm fields. Smartweed also occurred in thick patches bordering stands of willow scrub.

DWR staff observed aquatics species in the channels around Webb Tract and in association with some in-channel islands (DWR 2001a). Water hyacinth mats grew between bulrush on in-channel islands on the north side of Webb Tract, while small clumps of it floated by Webb levees on the south, east, and north sides of the island. Small pieces of Brazilian elodea also floated by Webb levees.

3.1.2.3 Bouldin Island

Habitat Types on Bouldin Island

As a result of clean farming practices, little riparian and marsh habitat existed on Bouldin Island. In 1987, 0.27% of Bouldin Island was riparian vegetation, while 2.27% was marsh habitat (Table 3-6). Most marsh

habitat was exotic. Of all four DW Project islands, only Bacon Island had lesser proportions of riparian and marsh habitats (Table 3-6). Records from the DFG Levee Habitat Assessment Vegetation Survey for Bouldin Island levees (DFG 1999b) indicated the presence of strips of freshwater marsh occurring on both the land and water sides of the island's levees. These strips were generally less than one acre in size, but the largest was 1.30 acres. In addition, DFG recorded riparian habitat, including a small stand of mature cottonwood (0.32 acres) and a willow scrub patch (0.30 acres). Other species found on levees were common and giant reeds. During a one-day reconnaissance trip to the southern and northwest sides of Bouldin Island, DWR staff only noted one thicket of willow scrub on the southwest side of the island (DWR 2001a).

Bouldin Island possessed the second highest percent area of open water habitat (2.13%) of the four DW Project islands, most of which was dedicated to agricultural drainage ditches and canals (Table 3-6). Some tidal marsh also existed around the outside edge of the island (JSA 1995a).

Bouldin Island had the smallest proportion of herbaceous upland (5.83%), compared to the other project islands, as a result of clean farming practices and the lack of topographic relief (i.e., sand hills).

A thin ribbon of pasture existed on the west side of the island just south of Highway 12 (JSA 1995a). Subsequently, DWR staff noted sheep grazing near the interior levee toe in this area (DWR 2001a). This pasture may contain native habitat.

Rare Plant Communities

Coastal and valley freshwater marsh was not recorded on Bouldin Island (DFG 2001b). However, the DFG Levee Habitat Assessment Vegetation Survey information indicated the distribution of freshwater marsh around Bouldin Island (DFG 1999b). To determine the similarity between the DFG freshwater marsh classification used in its levee survey, and coastal and valley freshwater marsh, field comparisons are necessary.

Wetlands

Bouldin Island wetlands consisted of the habitat, soil, and hydrological conditions described above in the text. In total, 225.0 acres of wetlands occurred on Bouldin Island (JSA 1995b).

Special-Status Plants

The CNDDB search (1987 and 1993, versions unknown) and 1988 field survey for sensitive plants on Bouldin Island (JSA 1995a) revealed 15 occurrences (Table 3-8). All plants listed were observed on the exterior levee slopes. An updated CNDDB search (DFG 2001b) revealed eight sensitive plant occurrences on Bouldin Island (Table 3-9).

One occurrence of rose-mallow (*Hibiscus lasiocarpus*) was recorded on the water side of the Bouldin Island levee during the DFG Levee Habitat Assessment Vegetation Survey (DFG 1999b).

Invasive Plants

Bouldin Island levees and roads were well maintained, as were the agricultural fields and ditches (JSA 1995a). During a reconnaissance trip to the island, DWR staff noted the occurrence of exotics similar to those found on other project islands, but in smaller proportions (DWR 2001a).

The channels around Bouldin Island contained floating mats and fragments of aquatic weeds such as water hyacinth, Brazilian elodea, and watermilfoil (DWR 2001a).

3.1.2.4 Holland Tract

Habitat Types on Holland Tract

Holland Tract was similar to Webb Tract in that it had extensive riparian, marsh, and open water habitat. One place that these habitats were well represented was at the blowout pond created in 1980 by a levee breach on the northeastern side of the island. Riparian woodland and marsh occurred in the highest proportions of any island at 3.35% and 7.12% (Table 3-6). DFG noted the presence of riparian habitat, including stands and single individuals of willow, Oregon ash (*Fraxinus latifolia*), Fremont cottonwood, black walnut, and introduced and ornamental trees (e.g., English walnut, *Juglans regia*). In addition, strips of emergent wetland vegetation grew primarily on the land and waterside of the island's levees. These strips, composed of cattail and bulrush species, were generally less than one acre in size (0.90 acres). Other common species on the waterside of the levees were common and giant reeds. Exotic marsh vegetation grew in low-lying areas on the eastern side of the island, where ditches contain intermittent patches of Himalayan blackberry, cattails, bulrush, and were bordered by various herbaceous upland species (DWR 2001a). Open water habitat included pooled water in the 1980 blowout pond, water in ditches throughout the island, and a pond on the southwest parcel that is under different ownership (JSA 1995a).

Of all four project islands, Holland Tract contained the highest proportion of herbaceous upland at 20.18% (Table 3-6). Most likely, herbaceous upland typified Holland Tract because agricultural management was not intensive, thus allowing annual and perennial grasslands to colonize agricultural land. In addition, annual grassland colonized remnant sand hills on the interior and western side of the island.

Rare Plant Communities

A current CNDDB search (DFG 2001b) yielded no occurrences of coastal and valley freshwater marsh on the project island or surrounding in-channel islands. DFG Levee Habitat Assessment Vegetation Survey data indicated that freshwater marsh occurred around Holland Tract (DFG 1998a). Thus, this freshwater marsh should be evaluated for the coastal and valley freshwater marsh characteristics, as described above within the text.

Wetlands

Holland Tract wetlands generally consisted of the habitat, soil, and hydrological conditions described above within the text. A total of 144.1 acres of wetlands occurred on Holland Tract when the first delineation was done (JSA 1995b). The blowout pond on the northeastern side of the island and fallow fields provided the best areas for wetland vegetation, like riparian and marsh habitat, to develop.

Special-Status Plants

JSA performed a CNDDB search (1987 and 1993, versions unknown) and field survey for sensitive plants on Holland Tract (JSA 1995a). In all, 20 occurrences of two species were recorded from the exterior levee slopes on the island (Table 3-8). In addition, one large elderberry cluster was found on the eastern levee of the project island along Old River (JSA 1995a).

According to the updated CNDDB search (DFG 2001b), 29 occurrences were in the vicinity of Holland Tract (Table 3-9). Most occurrences were distributed on in-channel islands all around Holland Tract, but several records did not specify whether plants grew on in-channel islands or Holland Tract. In addition, the CNDDB contained several records that described multiple colonies (i.e., multiple locations) per record. Consequently, the 29 CNDDB occurrences could have been a conservative count.

The DFG Levee Habitat Assessment Vegetation Survey indicated that several stands and single individuals of black walnut grew on levees (DFG 1998a). Reevaluation of these specimens may reveal that they are Northern California black walnut.

Invasive Plants

Holland Tract was not as intensely managed as Bouldin and Bacon islands. DWR staff observed overgrown ditches, numerous patches of Himalayan blackberry along the eastern levee landside toe, and weedy fallow fields (DWR 2001a).

The channels surrounding Holland Tract on the south, east, and west sides, contained the same aquatic species as around the perimeter of Webb Tract and Bouldin Island (DWR 2001a). Invasive aquatic species included water hyacinth, Brazilian elodea, and watermilfoil. DWR staff also observed larger mats of water hyacinth growing among in-channel island emergent vegetation east of Holland Tract.

3.1.2.5 Bacon Island

Habitat Types on Bacon Island

In 1987, open water habitat and stands of native vegetation were virtually absent from Bacon Island due to clean farming practices (Table 3-6). Most open water (1.71%) occurred in a north-south drainage ditch and other small canals and ponds throughout the island (JSA 1995a). According to the DFG Vegetation Survey (DFG 1999a), emergent freshwater marsh dominated by bulrush and shrub scrub dominated by willow were the two main native habitat types found on Bacon Island. While these habitat types generally were patchy and less than one acre in size, the largest strip of freshwater marsh was 1.46 acres. Typically, the emergent marsh and shrub scrub grew on the waterside of Bacon Island levees. DFG recorded the presence of other native riparian and wetland species, including small stands and single individuals of common reed, button bush, Fremont cottonwood, and walnut. Further information is needed to definitively classify the walnut trees to see if they are the special-status species, Northern California black walnut.

Bacon Island is relatively flat, so the main areas where herbaceous upland vegetation grows is on disturbed levee slopes (DWR 2001a). As of 1987, no pasture occurred on Bacon Island, but fallow land was scattered throughout the island (JSA 1995a). The value of pasture and fallow fields on Bacon Island should be re-evaluated for native habitat and sensitive plant occurrences.

Rare Plant Communities

A recent CNDDB search (DFG 2001b) yielded no occurrences of coastal and valley freshwater marsh on Bouldin Bacon Island. However, based on information from the DFG Levee Habitat Assessment Vegetation Survey (DFG 1999a) on freshwater marsh, the presence of coastal and valley freshwater marsh should be re-evaluated on the outside edges of Bacon Island.

Wetlands

Bacon Island wetlands are associated with a few riparian, marsh, and open water habitats that have the soil and hydrological conditions described above within the text. Only 24.0 acres of wetlands occurred on Bacon Island (JSA 1995b). Bacon Island was subject to clean farming practices; its ditches and canals were well maintained, it was relatively level, had few unmanaged seepage areas exist, and there were no blowout ponds

Special-Status Plants

DW Properties performed a CNDDB search (1987 and 1993, versions unknown) and field survey for sensitive plants on Bacon Island (JSA 1995a). A total of 34 occurrences of special-status plant species were found and were observed on the exterior levee slopes of Bacon Island (Table 3-8).

According to a recent CNDDB search (DFG 2001b), two occurrences grew on Bacon Island (Table 3-9).

The DFG Levee Habitat Assessment Survey recorded four occurrences of rose-mallow on Bacon Island levees (DFG 1999a). Species identification of the walnut trees recorded in the survey should be done to determine if they are Northern California black walnut.

Invasive Plants

Clean farming techniques on Bacon Island keep the levees, roads, agricultural fields, and ditches well-maintained (JSA 1995a). Similar terrestrial and aquatic weeds occurred on and around Bacon Island as were found on the other islands. The terrestrial species grew in significantly lower proportions compared to populations on other islands (DWR 2001a). In addition, the DFG Vegetation Survey noted introduced species like giant reed, gum tree (*Eucalyptus* spp.), oleander (*Nerium oleander*), and Himalayan blackberry on the land and watersides of Bacon Island levees.

3.1.2.6 In-Channel Islands

In-Channel Islands in the Vicinity of Webb Tract

The in-channel islands around Webb Tract were most prominent on the south, east, and north sides of the island, in False, Old, and San Joaquin rivers and Fishermans Cut (DWR 2001a). Franks Tract abandoned levees had significant amounts of land above tidal influence and ran along the south and southeast sides of Webb Tract. One dominant species on these islands was blackberry. Between the Franks Tract levee islands and Webb Tract were a series of islands entirely within tidal influence and dominated by bulrush. Remnant islands and ones isolated by dredging also occurred intermittently around the east and north sides of Webb Tract.

A current CNDDB search (DFG 2001b) showed that coastal and valley freshwater marsh occurred in patches of habitat on small in-channel islands, old levee berms and along old dredge cuts.

An updated search was done in 2001 by DWR staff using the CNDDB (DFG 2001b). This search revealed 14 occurrences of sensitive species on the in-channel islands and northern levee of Franks Tract (Table 3-9).

In-Channel Islands in the Vicinity of Bouldin Island

Most in-channel islands surrounding Bouldin Island occurred adjacent to its north, east, and south sides, in the South Mokelumne River, Little Potato Slough, and Potato Slough. Between high and low tide, small islands approximately 20 to 100 feet long were completely submerged (between low and high tide) except for emergent vegetation like bulrush. Although a clear view of large in-channel islands was not possible from the levee roads, the edges were easily observed. The edges were tidally influenced and dominated by partially submerged bulrush. Common reed grew on dry ground immediately inland of the bulrush and sparse trees grew farther into the interior (DWR 2001a).

Coastal and valley freshwater marsh was not present on the in-channel islands surrounding Bouldin Island according to an updated CNDDB search (DFG 2001b).

An updated CNDDB search (DFG 2001b) revealed 11 sensitive plant occurrences on in-channel islands adjacent to Bouldin Island in Little Potato Slough and the South Fork of the Mokelumne River (Table 3-9).

In-Channel Islands in the Vicinity of Holland Tract

The number, type, and diversity of size of the in-channel islands in the vicinity of Holland Tract are unique among the four DW Project islands. Holland Tract is located just to the south of Franks Tract and is surrounded by Sandmound Slough, Roosevelt Cut, Sheep Slough, Holland Cut, Rock Slough, and Old River. All these water bodies contain in-channel islands, with the largest islands occurring on Holland Tract's northwestern and eastern sides. A narrow chain of small islands runs along the southern side. Bulrush, common reed, and sparse willows characterized the vegetation on many in-channel islands on

the east side of Holland Tract (DWR 2001a). The elevation and amount of tidal influence of Franks Tract abandoned southern levees is currently unknown. Depending on elevation and tidal influence, the levee remnants may support emergent (e.g., bulrush) or woody vegetation (e.g., willow, blackberry).

A current CNDDB search (DFG 2001b) yielded no occurrences of coastal and valley freshwater marsh on in-channel islands surrounding Holland Tract.

According to the updated CNDDB search (DFG 2001b), 29 occurrences were in the vicinity of Holland Tract (see text within Section 3.1.2.4.) (Table 3-9). The major water bodies with in-channel islands where special-status species grew were Franks Tract, Old River, Sandmound Slough, Roosevelt Cut, Holland Cut, Sheep Slough, and Rock Slough.

In-Channel Islands in the Vicinity of Bacon Island

Many large in-channel islands surround Bacon Island, most of which are in Old and Middle rivers and Connection Slough. On the upper half of its west side, Bacon Island shares in-channel islands with the lower eastern edge of Holland Tract. The in-channels islands around Bacon Island were under tidal influence, but some woody riparian vegetation was distinguishable on island interiors (DWR 2001a). Species were similar to those mentioned on the other three islands.

A current CNDDB search (DFG 2001b) yielded two occurrences of coastal and valley freshwater marsh that included multiple islands in Middle River east of Bacon Island and one area in Old River near the confluence with Connection Slough.

According to a recent CNDDB search (DFG 2001b), 18 occurrences grew on in-channel islands all around Bacon Island (Table 3-9). Nine were recorded for in-channel islands in Old River south of Rock Slough, Middle River, at the mouth of Empire Cut, and in Connection Slough. In addition, nine were in Old River north of Rock Slough; occurrences on in-channel islands along this reach were also counted for Holland Tract.

Several issues affected how the number of special-status species locations was tabulated for Bacon Island. Several records did not specify whether plants grew on in-channel islands or on Bacon Island. Secondly, the CNDDB contained records that describe multiple colonies (i.e., locations) per record; sometimes these were on separate but adjacent in-channel islands. Consolidating multiple locations onto one record created a conservative count of in-channel islands supporting sensitive taxa. Lastly, nine occurrences were counted for both Holland Tract and Bacon Island because they grew on in-channel islands directly between these two project islands (Table 3-9). Thus, the total number of species occurrences tabulated for the whole project was higher than the actual number by nine occurrences.

3.1.2.7 Resource Issues and Impacts

Impact Zone

An impact zone outside the project island levees was not defined in the regulatory documents (JSA 1995a, 2000, 2001a, 2001b). How channel stage and velocity from the independently distributed pumps and siphons will affect in-channel islands has been assessed. The hydrodynamic simulation results under maximum DW siphoning rates indicated that maximum channel flows and velocities would be within the range of conditions normally encountered during tidal fluctuations in the Delta channels surrounding the DW Project islands (JSA 1995a). An impact zone for recreational boating and boat wakes on in-channel islands has not been assessed. Wave action from boating is known to impact the habitat and stability of in-channel islands (Kjeldsen and others 1997). However, in recognition that boat wake erosion will occur, DW will pay $111 per year to DFG for each additional boat berth added beyond pre-project recreational conditions (DFG 2001a) (Table 3-26).

Botanical Surveys

Habitat Types

In order to avoid or mitigate project impacts, accurate information, such as current habitat acreage information, is necessary. Because of vegetation succession, habitat delineation done with 1987 aerial photos (JSA 1995a) may be outdated now and should be re-evaluated. Different successional changes in riparian habitat represent different habitat types. Since 1987, areas delineated as marsh could have succeeded to willow scrub and willow scrub could have succeeded to cottonwood-willow riparian. In addition, substrate erosion and deposition by natural river processes could have altered the amount of marsh and tidal mudflats outside of the project islands.

Because of vegetation changes on and around the perimeter of the project islands, updated floristics and habitat surveys should be done.

Rare Plant Communities

Coastal and valley freshwater marsh occurred on in-channel islands in the vicinity of the several project islands (DFG 2001b). Since coastal and valley freshwater marsh is known to occur around the project islands, areas outside of project island levees (i.e., along the outside of the project islands) should be surveyed for this rare plant community. Avoidance and mitigation measures should be used to minimize impacts during project implementation.

Wetlands

The Corps has not issued a Section 404 permit to DW Properties (JSA 1995a, 2000, 2001a, 2001b). Between 1987 and 1990, preliminary interpretation and mapping of vegetation types was performed on the project islands, probable wetlands were identified, and general field surveys were conducted. However, the Corps (JSA 1995a) never verified a formal jurisdictional wetland delineation.

The Corps is currently evaluating the DW Properties Section 404 permit application for the project islands. Wetland surveys were not done for in-channel islands surrounding the project islands, so delineation for those islands will not be included in the permit.

Pending the issuance of the Section 404 permit, two outstanding issues exist for delineation on the project islands. The preliminary wetland identifications done between 1987 and 1990 are outdated. Secondly, the Corps has not determined whether wetlands created by operation of reservoir islands or established on habitat islands (except those dedicated as mitigation for jurisdictional wetlands) would be jurisdictional or non- jurisdictional under Section 404. The Corps will make this determination in consultation with DW Properties before the project is implemented (JSA 1995a). This information is critical to determining the amount of wetland mitigation that will be necessary when existing habitat is destroyed.

Special-Status Plant Surveys

Several issues exist in regard to special-status plant surveys done for the DEIR/EIS (JSA 1995a). Project island surveys may be incomplete because of factors such as drought effects, lack of surveys over the whole flowering season of each special-status species, and not using updated listing status of species from CNPS and regulatory agencies. In addition, the surveys completed on project islands in 1988 and 1994 could be considered outdated.

Most special-status plant surveys were done in 1988 during the drought cycle of 1987-1992. Some sensitive species may have been impacted by the drought, such that populations may not have grown and bloomed as they would have in years with normal precipitation. A drought year most likely would have an impact on special-status plant populations above the high tide mark or on the interior of the

project islands where plants encounter drought stress when they do not come into direct contact with water.

Most surveys were done from January through June 1988 (JSA 1995a). Several special-status taxa, like Suisun Marsh aster (*Aster lentus*), rose-mallow, and Mason's lilaeopsis (*Lilaeopsis masonii*), flower through late summer and autumn months (DFG 2001a, 2001b; Tibor 2001) (Table 3-7). If a plant was not flowering until after June when surveys ended (JSA 1995a), occurrences may have been overlooked by the survey crew.

Since 1988 when the surveys were done, changes have been made to the special-status species lists (DFG 2001b, 2001c; Tibor 2001). For example, Northern California black walnut was not listed by CNPS in 1988, but has been listed since then (Table 3-7). CNPS also de-listed round woolly marbles. Thus, removing it from the current potential special-status species list is appropriate. Additionally, it is unclear whether fieldwork included searches for Delta button-celery because of a discrepancy in the DEIR/EIS (JSA 1995a). During consultation, DFG biologists indicated that potential habitat for button-celery did not occur on the project islands, yet JSA included it on the potential special-status plant lists in the regulatory documents (JSA 1995a, 2000, 2001a, 2001b).

Twelve years have passed since most surveys were done on the project islands. Since then, special-status plant species and elderberry shrubs could have colonized new areas. Project proponents need to know if occurrences exist so that they can evaluate impacts, and develop avoidance and mitigation measures prior to construction and operation. Of particular concern is how levee re-enforcement, and construction and placement of pump, siphon, and recreational facilities would affect new populations on the project islands. Foot traffic around recreational facilities could cause trampling and damage to sensitive species.

In-channel islands were not surveyed, but the CNDDB (DFG 2001b) search for special-status taxa revealed multiple occurrences on in-channels islands around all project islands. Recreational boating may increase wave action precipitating the negative consequences of erosion and habitat loss. However, the boat berth payment acts as mitigation for boat wake erosion (Starr personal communication; see "Notes").

Invasive Plants

Management of terrestrial, semi-aquatic, and aquatic exotics is a major issue in the Delta. Aquatic exotic species obstruct navigation and recreation, slow water flows, plug agricultural irrigation pumps, and disrupt the natural ecosystem of the Delta (DBW 2001a). However, little aquatic vegetation is expected to occur inside reservoir islands during full storage according to the DEIR/EIS (JSA 1995a, 1995b). However, aquatic weed growth within reservoir islands should be re-evaluated; the growth and dispersal characteristics of Brazilian elodea can make it a nuisance plant where it is introduced. For example, an estimated 1500 acre feet of storage capacity were lost annually in Lake Marion, South Carolina due to sedimentation caused by Brazilian elodea growth. In New Zealand, electric generating plants were shut down when fragments of Brazilian elodea clogged intake structures on the Waikato River (WAPMS 2001). In addition, Brazilian elodea is one of the aquatic exotics recognized as an aggressive weed in the Delta. Since its introduction 40 years ago, it now infests approximately 3,900 surface acres, or eight percent of the 50,000 surface acres of Delta waterways (DBW 2001a). Furthermore, other semi-aquatic and terrestrial weeds probably will colonize levee slopes, interiors of the project islands (i.e., during low storage years) and interiors of the habitat islands.

If chemical applications are necessary to control invasive aquatic or semi-aquatic weeds, it may be appropriate to obtain a National Pollutant Discharge Elimination System (NPDES) permit pursuant to Section 402 of the CWA. Application of aquatic pesticides directly into a water body, or directly to organisms in the water or on the water surface that are "waters of the United States" requires a NPDES permit from the SWRCB. The SWRCB has issued a Statewide General NPDES Permit for discharges of aquatic pesticides to waters of the United States (General Permit No. CAG990003). The general permit is only applicable for use by public agencies and expires on January 31, 2004.

3.1.3 Aquatic Resources

Identification of protected species in the project area, descriptions of life histories and discussions of potential impacts on fish were compiled mostly from existing literature and data. The primary sources of information were the 2000 In-Delta Storage Investigations Pre-Feasibility Report (CALFED 2000b), and the 1995, 2000 and 2001 DW Project EIRs and EISs (JSA 1995a, 2000, 2001a, 2001b). Additional material was obtained from the Department of Boating and Waterways (DBW) 2001 EIR for the *Egeria densa* Control Program (DBW 2001b). Little or no fieldwork or original data were generated for this analysis.

3.1.3.1 Species in the Project Area

The DW Project, Alternative One of the In-Delta Storage Project study, could have positive and negative effects on protected fish species in the Bay-Delta. According to the CNDDB records (DFG 2001b), and species lists provided by USFWS and DFG, there are seven threatened or endangered fish species, two candidates for listing, and five species of special concern that could be in the In-Delta Storage Project area. A list of these special status fish species is provided in Table 3-10. A specific description of how the In-Delta Storage Project could affect these species and brief descriptions of their life histories species are provided in the following section.

Chinook Salmon

Chinook salmon, *Oncorhynchus tshawytscha*, have the broadest geographic range of any of the Pacific salmon species and are native to Pacific coast rivers and streams from Alaska to California. They are the largest and least abundant of Pacific salmon species and are an important recreational and commercial resource throughout much of their range. They use the Delta as a migration corridor to and from the Pacific Ocean and as rearing habitat as they emigrate to the ocean (Lentz 2001 personal communication; see “Notes”). Chinook salmon have a highly variable life history and many rivers support more than one run, also referred to as race or spawning population. The Sacramento River supports four runs of chinook salmon each of which is distinguished by the timing of upstream migration and spawning. The runs are named for the season during which the adults enter freshwater. All four of these runs, winter-run, spring-run, late fall-run, and fall-run are special status species because populations have declined from historic levels. The San Joaquin River also supports a fall-run, which has declined. Most of the present-day chinook salmon are fall-run.

Chinook salmon is an anadromous species. Adult salmon deposit their eggs in freshwater substrates. The young fish hatch, emerge from the gravel and emigrate through the Delta to the Pacific Ocean where they grow to maturity. As they reach sexual maturity, these salmon return to fresh water, typically to the stream from which they hatched, to spawn and die, thereby completing their life cycle.

The life span of chinook salmon generally ranges from two to seven years. Adults usually migrate to freshwater after spending one and a half to five years in the ocean but most return to freshwater after spending two and a half years in the ocean. Chinook salmon spawn in the upstream reaches of the Sacramento River and some of its tributaries. San Joaquin chinook spawn in the Merced, Tuolumne, and Stanislaus rivers and their tributaries. During spawning, the females usually excavate a nest, or redd, in adequately sized gravel located in the tailings of a pool, immediately upstream of a riffle or in a deep run or glide. The eggs are deposited in a gravel nest to incubate for about three months before the young fish emerge and enter the water column. The juveniles may migrate from upstream natal areas immediately after emerging from the redd, or they may spend a year or more in freshwater. The length of juvenile residence time in freshwater and estuaries varies between salmon runs and depends on a variety of factors including season of emergence, streamflow, turbidity, water temperature and interaction with other organisms. Juveniles become smolts as they undergo physiological changes before entering saltwater.

Table 3-10. Special status species for the In-Delta Storage Project

Common Name	Scientific Name	Federal Status	State Status
Winter-Run Chinook Salmon	*O. tshawytscha*	Endangered	Endangered
Spring-Run Chinook Salmon	*O. tshawytscha*	Threatened	Threatened
Late Fall-Run Chinook Salmon	*O. tshawytscha*	Candidate	Special Concern
Fall-Run Chinook Salmon	*O. tshawytscha*	Candidate	Special Concern
Central CA Coastal Coho Salmon	*O. kisutch*	Threatened	Endangered[a]
Central CA Coastal Steelhead	*O. mykiss*	Threatened	None
Central Valley Steelhead	*O. mykiss*	Threatened	None
Delta Smelt	*H. transpacificus*	Threatened	Threatened
Splittail	*P. macrolepidotus*	Threatened	Special Concern
Longfin Smelt	*S. thaleichthys*	Special Concern	None
Green Sturgeon	*A. medirostris*	Candidate	None
River Lamprey	*L. ayresi*	Special Concern	None
Kern Brook Lamprey	*L. hubbsi*	Special Concern	None
Pacific Lamprey	*L. tridentata*	Special Concern	None
[a]Not included in the DFG Species List for In-Delta Storage			

There are two general types of chinook salmon life histories in California races, stream type and ocean type. Stream type juveniles remain in the river for a year or more before migrating to the ocean. Ocean type juveniles usually migrate to the ocean during their first few months. Most California races follow the ocean pattern and juveniles tend to move rapidly through the Delta and Sacramento-San Joaquin Estuary (Estuary) (USFWS 1995a).

Both fall-run and late fall-run chinook salmon are currently considered federal candidate species and state species of special concern. Fall-run chinook salmon are the most widely distributed salmon race in the Central Valley. Fall-run occur in both the Sacramento and the San Joaquin rivers. Late-fall run are found mainly in the Sacramento River, and most spawning and rearing of juveniles occurs between Red Bluff and Redding (USFWS 1995B). Late fall-run chinook salmon make up about six percent of all hatchery and wild chinook salmon in the Central Valley.

Fall-run adults migrate upstream from June through December, but spawning peaks in October and November. Late fall-run enter the Sacramento River from October through April. The juveniles of these two runs begin their seaward migration within a few weeks after emergence. Emigration of fall-run smolts through the Delta peaks during April, May, and June. Emigration of late fall-run smolts occurs from November through March. Fall-run juveniles are particularly vulnerable to entrainment because their emigration period typically coincides with the beginning of the agricultural irrigation season.

Historically, spring-run chinook may have been the most abundant spawning population in the Sacramento-San Joaquin Basin, but from 1967 through 1991 they made up only an estimated five percent of all hatchery and wild chinook salmon returning to the Sacramento-San Joaquin Basin. Spring-run are listed as both federal and state threatened species. Spring-run chinook historically spawned in the upper reaches of Central Valley rivers and tributaries, which are now blocked by dams.

Spring-run adults generally enter the Sacramento River from March through July and hold over during summer in cool, deep pools near their spawning grounds. Spawning occurs from August through October with peak spawning occurring in September. Juvenile spring-run typically rear for several months in their natal streams, often over-wintering before emigrating to the ocean from October through May. The emigration period for spring-run juveniles is variable, but peaks from November through January.

The abundance of winter-run chinook salmon has decreased substantially from population levels in the mid 1960's. This decline was used in the decision to list the species for protection under the Endangered Species Act (ESA). Winter-run migrate through the Sacramento-San Joaquin Estuary and enter the

Sacramento River from November through July. They spawn from mid-April to mid-August. From July to October, winter-run fry emerge from their nests and rear in the river for up to one year before migrating downstream to the Delta and ocean. Juveniles begin to move out of the upper river as early as July and may not exit the Delta and Bay until June. However, peak emigration is January through April, which corresponds with the time when most of the water for the reservoir islands will be diverted.

According to the incidental take permit written by DFG, and the biological opinion by NMFS, the DW Project may adversely affect chinook salmon in the Delta and tributaries. Chinook salmon may be impacted directly or indirectly by the project and these impacts include increased water temperatures, depressed dissolved oxygen concentrations and increased entrainment and predation at fish screens from alterations of river flows. Changes to Delta channel hydraulics are expected to increase the loss of chinook salmon, including winter-run and spring-run, because modification of internal Delta channel hydraulics will increase the diversion of juvenile chinook into the western, central and south Delta where they are exposed to increased entrainment in south Delta diversions including the state and federal export facilities and to increased predation (DFG 1998c). The survival of chinook salmon, including spring-run and winter-run, is expected to be additionally impacted by temperature related mortality and decreased dissolved oxygen concentrations caused by discharge of water form the reservoir islands (DFG 1998c).

Coho Salmon

The Central California Coastal Coho salmon, *Oncoryhnchus kisutch*, was included on the species list for the In-Delta Storage Program. However, the project does not include habitat for Central CA Coastal Coho Salmon and is outside of the species range. See http://www.nwr.noaa.gov/1salmon/salmesa/maps/stlhccc.pdf for a general description of the range. Therefore, coho salmon are not considered in the project study.

Steelhead

The Central Valley steelhead, *Oncoryhnchus mykiss*, is an anadromous form of the rainbow trout and is federally listed as threatened. There are no special status listings for steelhead at the state level. Central Valley steelhead migrate to the ocean as juveniles and return to freshwater to spawn as two to four year old adults. Spawning migration of adults usually occurs from August to March and adults do not usually die after spawning. Surviving adults return to the ocean between April and June and may make several more spawning migrations. Juveniles usually remain in freshwater for the first year before migrating to the ocean from November through May. Like salmon, steelhead are found in the Delta primarily during periods of migration.

Wild populations in the Sacramento River Basin have declined from their historical levels. In the upper Sacramento River, the number of spawning individuals dropped from 19,600 in 1968 to less than 1,000 in 1991 (CALFED 2000b). The status of steelhead population in smaller tributaries of the Sacramento River is unknown, although their numbers are believed to be low. Similar to the aforementioned impacts on chinook salmon, steelhead may also be adversely affected by the DW Project because of increased water temperatures, depressed dissolved oxygen concentrations and increased entrainment and predation at fish screens from alterations of river flows.

The Central California Coastal steelhead, *Oncoryhnchus mykiss*, was included on the species list for the In-Delta Storage Program. However, the project does not include habitat for Central CA Coastal Steelhead and is outside of the species range. See http://www.nwr.noaa.gov/1salmon/salmesa/maps/cohocc.pdf for a general description of the range. Therefore, Central CA Coastal steelhead are not considered in the project study.

Delta Smelt

Historically, delta smelt, *Hypomesus transpacificus*, was among the most abundant fish species in the Sacramento-San Joaquin Estuary, but the population has declined in recent decades. The delta smelt is

listed for protection under both federal and state endangered species legislation. They are endemic to the Sacramento-San Joaquin Estuary and are found as far upstream as Mossdale on the San Joaquin River and the confluence of the Feather and Sacramento rivers (DWR 2000b). Normal downstream distribution appears to be limited to western Suisun Bay. During periods of high Delta outflow, transient populations of delta smelt occur in San Pablo Bay. Delta smelt are small, generally less than 8 cm in length and planktivorous. Introductions of exotic zooplankton, changes in phytoplankton abundance and changes in zooplankton community structure after the invasion of Asian clams, *Potamocorbula and Corbicula*, have likely been significant factors in the decline of delta smelt.

The location of delta smelt spawning varies from year to year. In years of moderate to high Delta outflow, spawning typically occurs from Suisun Marsh to lower portions of the Sacramento and San Joaquin rivers. In years of low Delta outflow, spawning occurs further upstream in the Delta. Specific spawning areas include the Sacramento and San Joaquin rivers and Barker, Beaver, Cache, Georgiana, Hog, Lindsey, Montezuma, Prospect, and Sycamore sloughs. Spawning also occurs in Fisherman's Cut, False River, Napa River and along the remnant levees of Franks Tract. Delta smelt are thought to spawn in fresh or slightly brackish water upstream of the entrapment zone (CALFED 2000b). The entrapment zone is related to the interface between freshwater and saltwater and is characterized by elevated concentrations of plankton and juvenile fish. Maintenance of the entrapment zone in the upper reaches of Suisun Bay may result in more desirable habitat than if the entrapment zone is further upstream in narrow channels of the Delta (DBW 2001b). The spawning season of delta smelt also varies from year to year, ranging from February to June.

There are many factors that may influence the abundance of the delta smelt populations including: Delta outflow, entrapment zone, in-Delta flows, diversions, food abundance, competition, predation, the spawner-recruit relationship, exotic species, pollution, water temperature, and water transparency (CALFED 2000b). Spawning has been reported to occur when water temperatures range from about 45 to 59° F. The eggs sink and attach to solid objects such as submerged vegetation, tree branches and roots, and rocks and gravel. Delta outflow may influence the timing of delta smelt spawning. In low outflow years, spawning usually takes place from late March through mid-may (USFWS 1995a). Few adult delta smelt survive beyond their first spawning season.

The distribution and survival of delta smelt may be strongly affected by in-Delta flow patterns. When Delta inflow is low and exports at the state and federal pumps are high, net flow in the lower San Joaquin, Old, and Middle rivers may be toward the pumps rather than downstream. The flows contain water drawn from the Sacramento River, which may encourage upstream migration of delta smelt adults toward the pumps (CALFED 2000b). These flow changes may also interfere with transport of delta smelt larvae from upstream spawning grounds to their nursery habitat in the western Delta and Suisun Bay. Larvae hatch from demersal eggs in several days or a few weeks and start feeding on phytoplankton and zooplankton while drifting downstream to the freshwater/saltwater interface.

The midwater trawl index is used to estimate delta smelt abundance. This index is a product of the midwater trawl monitoring survey conducted by DFG under the IEP. The index declined in the mid 1980s and generally increased until 1994 when it declined to a 28-year low. The index rebounded again in 1995. DFG reviewed the status of delta smelt in 1990 but could not determine factors responsible for population fluctuations. Delta smelt are vulnerable to entrainment and predation at state diversion facilities and agricultural pump intakes. Agricultural diversions pose a significant risk to delta smelt because the diversions are distributed throughout the range of delta smelt, most diversions are unscreened, and there is no salvage of diverted fish. The DW Project could increase reverse flows in the central and southeastern delta. This condition would negatively affect delta smelt by extending the duration that the smelt are exposed both to water diversions and to predation.

Splittail

Splittail, *Pogonichthys macrolepidotus*, is a federally listed threatened species and a state species of special concern. This species was once found throughout the Central Valley in low elevation lakes and rivers. Today, it is found only in California's Sacramento-San Joaquin Delta and Central Valley rivers.

The splittail represents the only extant species in its genus in North America (USFWS 2001a). This large freshwater minnow has a long lifespan, five to seven years, and a high tolerance for salinity, up to 18 ppt as adults. The salt tolerance of juveniles is unknown. Both juvenile and adults use shallow edgewater habitats with submerged and emergent vegetation. Both male and females reach sexual maturity in their second year. Like most cyprinids, these minnows have high fecundity, with about 5,000 to 100,000 eggs per female. The adhesive eggs are laid in clumps on vegetation or other submerged substrates. Larvae become free-swimming and begin feeding about five days after hatching. Shallow, seasonally flooded vegetation provides splittail spawning habitat. Year class strength is thought to be affected by inundation of floodplains which provide spawning, rearing and foraging habitat.

Young splittail seek shallow vegetated areas where they are protected from strong currents. Splittail move downstream as they grow and tend to be carried with higher spring flows into the estuary and bays where they are regularly captured in the midwater trawl monitoring survey conducted in Suisun Bay near Montezuma Slough and the Pittsburg Power Plant and as far downstream as Carquinez Straight and San Pablo Bay.

Based on DFG trawl surveys from 1967 to 2000 and 1980 to 2000, splittail abundance appears to have a high degree of interannual variability. However, because of concerns that several perturbations caused a decline in splittail abundance of 62% over 15 years, it was federally listed as a threatened species in 1999 (USFWS 1999). Perturbations that were cited as potential problems included: changes in water flows and water quality resulting from export of water from the Delta, periodic prolonged droughts, loss of shallow water habitat, and the effect of agricultural and industrial pollutants. There has been considerable disagreement over whether there are any statistically distinct directional trends (*see San Luis & Delta-Mendota Water Authority* v. *Anne Badgley, et al.,* Case No. CIV-F-99-5658 OWW *and State Water Contractors, et al.* v. *Michael Spear, et al.* Case No. CIV-R-99-5667 OWW). Spawning and abundance may be correlated with Delta flows and floodplain inundation (Baxter 2001). Time can be shown to explain a large portion of the variability in splittail abundance but populations have not been monitored long enough to make a strong argument one way or the other in regard to the presence or direction of temporal trends (USFWS 2001b). Also, CVP and SWP entrainment may not have an important population level effect (DBW 2001b). Regardless of disagreement, the current status of splittail remains as a federally listed threatened species and a state species of special concern.

Longfin Smelt

Longfin smelt, *Spirinchus thaleichthys*, is a small, four to five inch long, planktivorous fish species found in Pacific coast estuaries from San Francisco Bay to Prince William Sound in Alaska. It is native to the Sacramento-San Joaquin Estuary, and along with delta smelt, was historically one of the most abundant species in the Estuary. However, from 1984 to 1992, longfin smelt abundance declined by 90 percent (CALFED 2000b). Longfin smelt are currently listed as a federal species of special concern. The recent decline appears to be related to SWP and CVP diversions during the winter and spring months when longfin smelt are spawning (DBW 2001b). The DW Project might make this problem worse by increasing overall diversions in the Delta. SWP and CVP diversions change the hydraulics of the Bay-Delta and increase the loss of larvae, juveniles and adults by entrainment and predation (DBW 2001b).

Longfin smelt is an open water fish and can tolerate a wide range of salinities. They are found in the Estuary as far upstream as Rio Vista on the Sacramento River, Medford Island on the San Joaquin River and at the CVP and SWP water diversion facilities. While they are most abundant in San Pablo and Suisun bays where conditions are more saline, their distribution is highly influenced by Delta outflow. Longfin smelt usually migrate upstream from January to April and spawn in the upper end of Suisun Bay, in the lower and middle Delta, mostly in the Sacramento River channel and adjacent sloughs. Spawning occurs over sandy-gravel substrates, rocks or vegetation. Longfin smelt eggs are adhesive. After hatching, the smelt larvae are carried downstream by river flow to nursery areas in the lower Delta and Suisun and San Pablo bays where they mature. Adult longfin smelt are usually found in Suisun, San Pablo and San Francisco bays, and further upstream during periods of low Delta outflow.

A considerable number of adult longfin smelt survive into a second year. During this second year, they inhabit San Francisco Bay and occasionally the gulf of the Farallones. Hence, longfin smelt are often considered anadromous. Because longfin smelt seldom occur in freshwater except to spawn, and are widely distributed throughout brackish waters of the estuary, it is thought that their range formerly extended as far upstream as saltwater intruded.

Longfin smelt abundance increases during periods of high flows. There is a correlation between the volume of freshwater flowing out of the Delta during and after spawning and the subsequent abundance of longfin smelt (DBW 2001b). This relationship probably results from rapid transport of early life stages out of the Delta to favorable rearing habitat and from reduced entrainment during high outflows. Outflow disperses larvae and increases the probability that some will find a high quality and quantity of food. Higher outflows of freshwater may also reduce predation on longfin smelt. Resultant lower salinities in Suisun and San Pablo bays keep marine predators further downstream while freshwater predators remain further upstream because of mechanisms that prevent them from being washed out to the sea (DBW 2001b).

Green Sturgeon

Green sturgeon, *Acipenser medirostris*, have been found off the coast of California from Mexico to Oregon but spawning populations are only known to exist in the Sacramento and Klamath rivers (Moyle and others 1995). Green sturgeon is proposed for listing as threatened or endangered under ESA. Habitat requirements and the ecology of the green sturgeon are not well known but are likely similar to those of white sturgeon except that green sturgeon probably require colder, cleaner water (Moyle and others 1995). However, green sturgeon spend less time in the Delta and more time in the ocean than white sturgeon (CALFED 2000b). Green sturgeon presumably spawn in the Sacramento River when temperatures range from about 45 to 57° F (Moyle and others 1995). Factors that are likely affecting the abundance of green sturgeon include: over harvest, modification of spawning habitat, entrainment and toxic substances (USFWS 1995a).

Although highly variable, annual production of young sturgeon is positively associated with increased Delta outflow in the spring spawning and initial nursery periods. Based on the estimated number of juveniles salvaged at the SWP fish screens and captured in the IEP trawl catches, juvenile production appears to be positively affected by increased Delta outflow. Channel modifications and barriers probably degraded or eliminated sturgeon spawning habitats and forced green sturgeon to utilize sub-optimal spawning habitat in the lower Sacramento River (Moyle and others 1995). This may have resulted in decreased reproductive success. In addition, modifications to Delta channels and Suisun Bay have probably reduced nursery areas for both green and white sturgeon.

Pacific Lamprey

Pacific lamprey, *Lampetra tridentata*, is designated by the USFWS as a federal species of special concern. Little is known about the life history of Pacific lamprey in California, but in general larval lampreys, or ammocoetes, live in freshwater or estuary environments with sand or mud substrates. Ammocoetes lie on top of or burrow tail-first into the substrate and suspension feed until they are about five or six years old. At that time, they transform to predatory adults and migrate to the ocean. After one or two years in the ocean, they return to freshwater and spawn in the late winter or early spring. Spawning usually occurs in riffles over sand, gravel, or rocks. The ammocoetes and young adults are the most likely life stages to occur in the project area.

River Lamprey

River lamprey, *Lampetra ayresi*, is an anadromous species that migrates upstream to spawn in river tributaries. It is designated by the USFWS as a federal species of special concern. Like Pacific lamprey, very little is known about the life history of river lamprey in California. In general, the life cycle of lampreys from spawning through the ammocoete stage and metamorphosis varies little from species to species (Moyle and Chech 1988). The habitat locations and requirements of both ammocoete and adult

river lamprey in the Sacramento-San Joaquin Estuary have not been studied (Moyle and others 1995). However, the ammocoetes and young adults are probably the most likely life stages to occur in the project area.

Kern Brook Lamprey

Kern Brook lamprey, *Lampetra hubbsi*, is designated by the USFWS as a federal species of special concern. Like Pacific lamprey and river lamprey, little life history documentation of Kern Brook lamprey exists (Moyle and others 1995). However, unlike Pacific and river lamprey, Kern Brook lamprey are not parasitic. They are found at an elevation of 30 to 327 m in silty backwaters of large rivers in foothill regions (Moyle and others 1995). Thus, it appears unlikely that the project will impose significant impacts to Kern Brook lamprey.

3.1.3.2 Resource Issues and Impacts

In general, potential fisheries impacts from the DW Project include:

- Increases in channel water temperature when water from the reservoir islands is discharged into adjacent channels resulting in a reduction in juvenile chinook salmon survival;
- Reductions in dissolved oxygen concentrations when water from the reservoir islands is discharged into adjacent channels resulting in increased fish mortality;
- Changes in outflow and flow patterns during the out-migration period of winter-run chinook salmon resulting in increased mortality and migration barriers;
- Reduction in transport flows and increased diversions resulting in increased mortality and entrainment of delta smelt, longfin smelt and non-listed aquatic species; and,
- Increases in total mercury or methyl mercury concentrations in water and biota due to reservoir and habitat island operations.

The Delta supports about 90 species of fish. The Delta provides habitat for fish that are permanent residents and provides spawning, migration and nursery habitat for many other marine and freshwater species. There is a gradual change in habitat type from freshwater habitats in the upper reaches of the Delta to brackish, estuary and marine habitats further downstream in Suisun, San Pablo and San Francisco Bays. The legal boundary of the Delta extends westward to Chipps Island, just past Pittsburg. However, the location of habitat transition is a dynamic and complex function of tidal influences and freshwater flows. Fish that use the Delta include: American shad, catfish, chinook salmon, delta smelt, largemouth bass, splittail, steelhead, striped bass, and sturgeon. Several of these species are threatened or endangered due at least in part to the draining of wetlands, damming of rivers, and water diversion in the Central Valley and Delta.

The hydraulic characteristics of the Delta are significantly affected by the CVP and SWP and these characteristics can have dramatic effects on fish. The project pumps move and remove both fish and fish food as they export water. Larger fish that are screened from the pumps may be injured or killed by the screening and handling process. Small fish, larvae, eggs, zooplankton and phytoplankton pass through the screens and are lost from the Delta with exported water. The direction and velocity of water flowing in the Delta channels can also be affected by the pumps which could negatively affect fish production.

Another major perturbation affecting fish in the Delta is the continued disruption of aquatic food webs by the introduction and proliferation of invasive plant and animal species. There are indications that overall phytoplankton productivity in the Delta has declined in recent decades and that introduced mollusks might be responsible (Alpine and Cloern 1992; DBW 2001b). Chinese mitten crab, water hyacinth and *Egeria densa* are also introduced species that have been identified as problems in the Delta. The cumulative

impact of these invasions is a dramatic change in the biological, chemical and physical environment of the Delta.

The CESA Incidental Take Permit issued by DFG, the USFWS and NMFS biological opinions and the SWRCB Decision 1643 state that the proposed DW Project has the potential to directly and indirectly impact listed fish species (SWRCB 2001). These impacts could be both temporary and permanent and include the take of listed species. Final Operations Criteria (FOC) were developed to ensure that the project operations do not jeopardize the continued existence of delta smelt, splittail, winter-run chinook salmon or steelhead. Non-listed species are also expected to benefit from the FOC. Specifically, the proposed project may result in the following impacts to sensitive and listed fish species:

- Direct entrainment of delta smelt larvae onto the project lands due to additional, new diversions of up to 9,000 cfs.

- Indirect entrainment and mortality of delta smelt larvae, juveniles, and adults due to increased diversions and exports in the central and south Delta associated with the discharge of DW Project water.

- Increased loss of juvenile winter-run and spring-run chinook salmon from adverse modifications to internal Delta channel hydraulics. Increased diversion of fish into the western, central, and south Delta exposes them to increased entrainment and predation at other south Delta diversions such as agricultural pumps and the state and federal export facilities.

- Increased erosion of in-channel habitat for delta smelt and winter-run chinook salmon due to increased boating activity facilitated by the DW Project.

- Degradation of spawning and rearing habitat for delta smelt and splittail due to construction.

- Increased losses of adult and juvenile delta smelt, juvenile winter-run and juvenile spring-run chinook salmon due to increased predation losses associated with fish screen structures, siphon and pump stations, and boat docks.

- Temperature-related mortality of winter-run and spring-run chinook salmon and delta smelt from elevated water temperatures caused by reservoir discharge.

- Impacts to aquatic Listed Species habitats from decreased dissolved oxygen (DO) concentrations caused by the discharge of water from the reservoir islands.

- Reduced Delta Outflow and loss of associated biological benefits due to increased project diversions onto the reservoir islands.

- Upstream shifts of X2 due to increased project diversions onto the reservoir islands.

- Reductions in QWEST due to increased project diversions onto the reservoir islands.

Temperature and Dissolved Oxygen Requirements of the Biological Opinions and Incidental Take Permit

Temperature

A preliminary consideration of temperature suggests that the project might be unable to meet the temperature requirements of the biological opinions and Incidental Take Permit, at least occasionally. At this point in the assessment of the DW Project, it is difficult to predict whether the violations will be a rare occurrence or a significant limitation for project operations. Additional discussion of theoretical temperature scenarios for the reservoir islands and Delta channels is presented in the CALFED (2002) Water Temperature and Dissolved Oxygen Studies section of the In-Delta Storage Program Draft Water Quality Investigations Report.

D-1643 requires compliance with temperature criteria listed in the Final Operating Criteria during any reservoir discharges to the adjacent channels, regardless of the purpose of the discharge. The temperature criteria are as follows:

- DW shall not discharge reservoir water if the temperature differential between the discharge and the adjacent channel temperature is greater than or equal to 20°F;
- If the natural receiving water temperature of the adjacent channel is greater than or equal to 55°F and less than 66°F, DW discharges shall not increase the channel temperature by more than 4°F;
- If the natural receiving water temperature of the adjacent channel is greater than or equal to 66°F and less than 77°F, DW discharges shall not cause an increase of more than 2°F; and,
- If the natural receiving water temperature of the adjacent channel is greater than or equal to 77°F, DW discharges shall not cause an increase of more than 1°F.

Two possible conditions that may affect the temperature of water released from the reservoirs exist: mixed and stratified. The CALFED (2002) temperature model assumes complete mixing in the reservoir islands. Assuming complete mixing, temperature differentials are expected to range from 1 to 9° F (CALFED 2002). Discharges from the reservoirs will often occur in June and July. Figures 3-1 through 3-3 show that Delta channel water temperatures near the reservoir islands in June and July are usually in the range of 66 to 77° F and are often greater than 77° F. With these temperatures, D-1643 criteria will limit temperature increases in the channels due to discharge to 2° F or 1° F, respectively (SWRCB 2001).

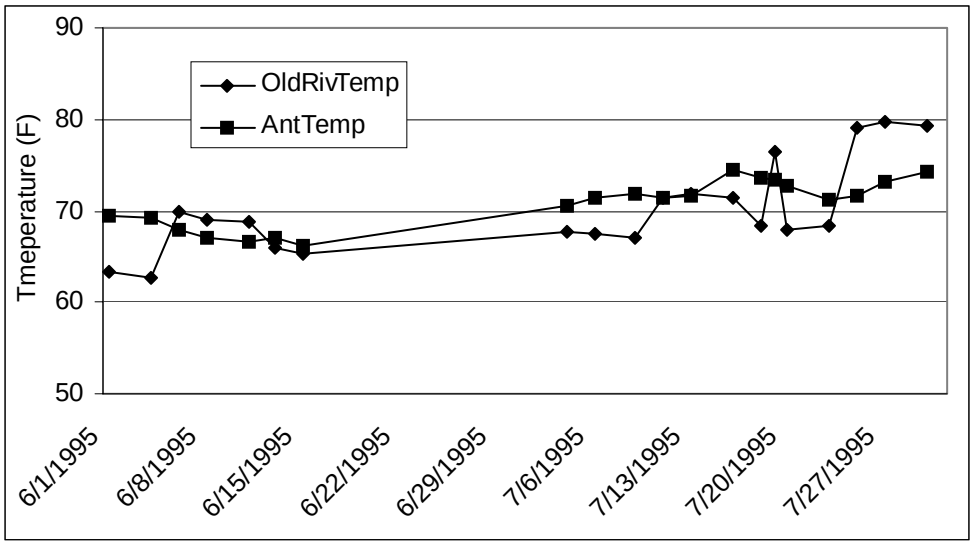


Figure 3-1. June and July channel water temperatures in Old River at Bacon Island and the San Joaquin River at Antioch in 1995

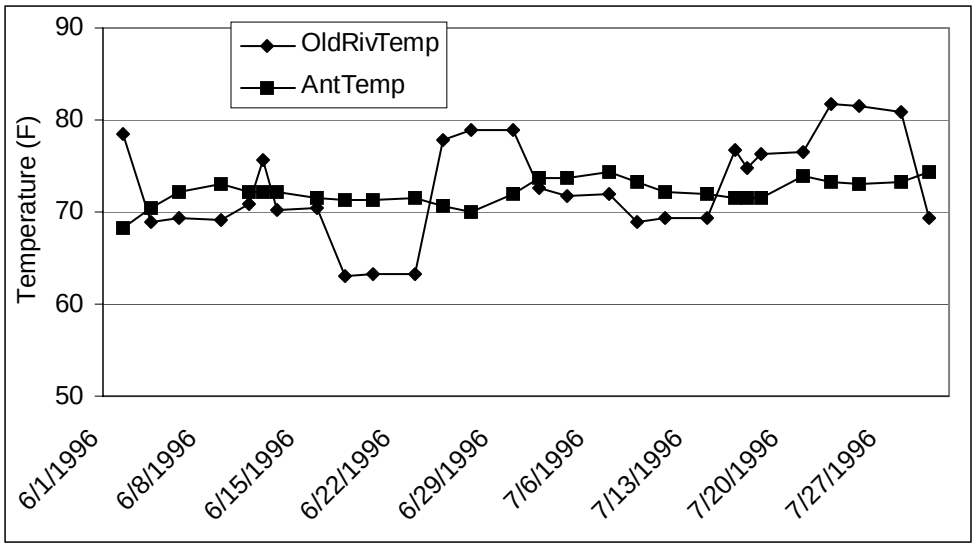


Figure 3-2. June and July channel water temperatures in Old River at Bacon Island and the San Joaquin River at Antioch in 1996

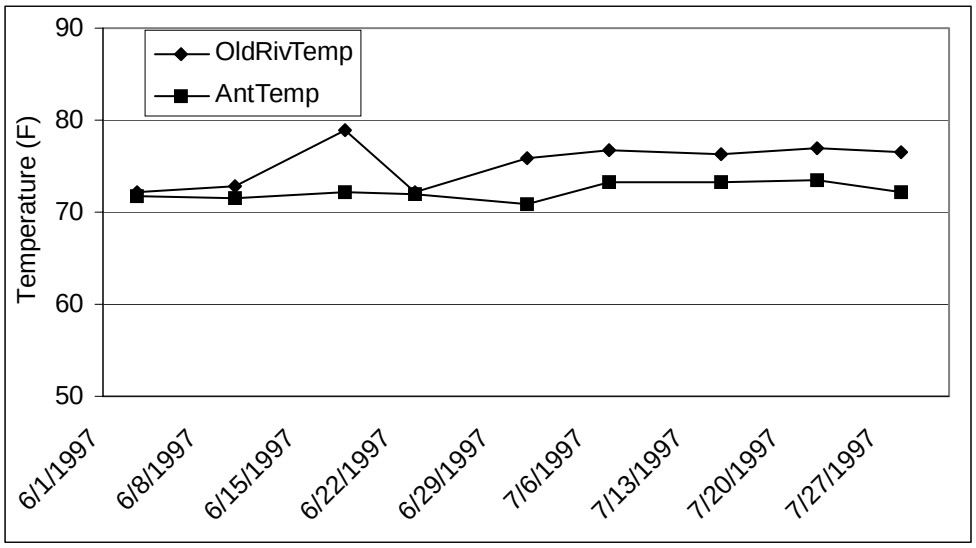


Figure 3-3. June and July channel water temperatures in Old River at Bacon Island and the San Joaquin River at Antioch in 1997

Assuming that the sphere of influence of discharge is a section of the channel 1000 feet long by 1000 feet wide with an average depth of 10 feet, then the volume of this "sphere" is 10,000,000 cubic feet. At a discharge rate of 2000 cfs, this channel volume would be replaced by reservoir water in a little over one hour. Hence, even a small temperature differential between reservoir water and channel water, on the order of 1 or 2° F, might restrict discharge and yield. CALFED (2002) model results suggest that the temperature differential between the reservoir and channel waters might be a high as 9° F. Depending on tidally influenced flow in the channel, these temperature changes might be buffered or diluted. Based on flow data from Old River at Bacon Island where flows ranged from about 1000 to 10,000 cfs (IEP 2001) this dilution might be on the order of 50% to 500%. However, a 9° F differential might still have a significant effect on channel water temperature even at higher tidal flows and would likely have a dramatic effect at lower flows, especially at discharge rates of 3000 cfs.

It is also possible that the reservoirs could be stratified. Ecological Research Associates (ERA 2001), found that theoretically when the reservoir islands are full or nearly full, i.e. depths of 4.5 to 6 meters deep, the reservoirs could stratify. This makes sense empirically considering that the reservoirs will probably be filled rapidly with cold water in the winter and held for the first few months of the year when increasing solar radiation can warm the water. Strong Delta winds may not be present during this initial storage period when the water starts to warm (Figure 3-4). Once the reservoirs stratify, it will take more wind energy to de-stratify them than it would to keep them mixed.

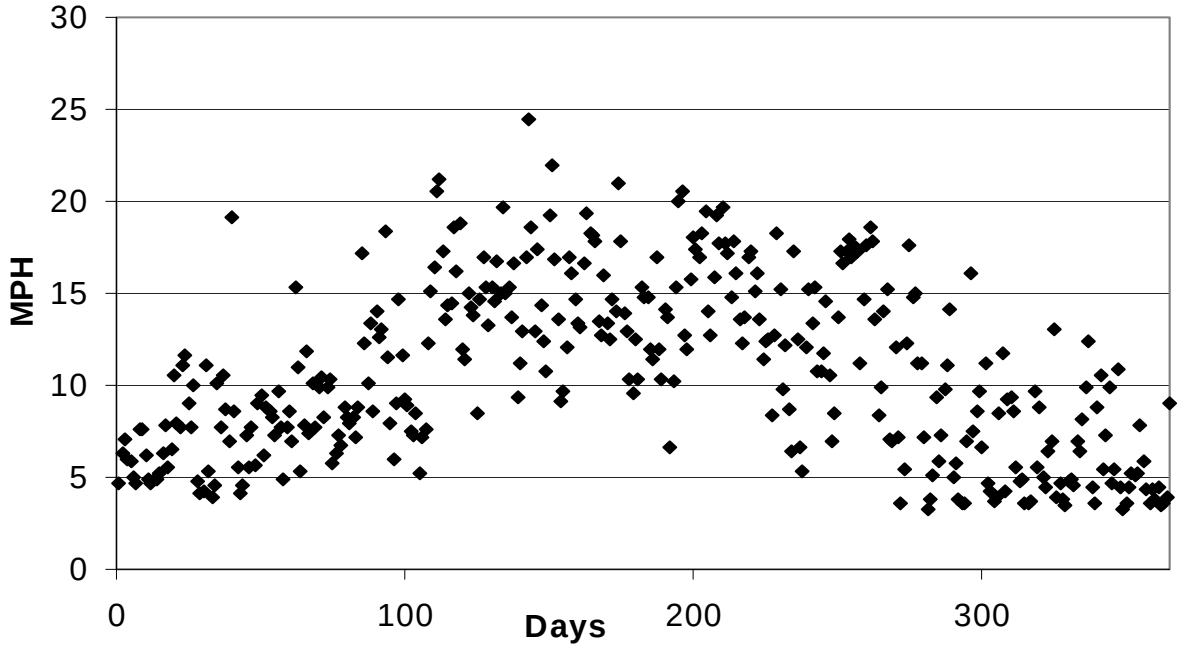


Figure 3-4. Average, N = 24 hours, daily wind speed at Antioch, starting January 1, 1999

Stratification, if it occurs and persists through June and July when discharges are likely to occur, could be a problem. If the discharge pumps draw water from the bottom of a stratified reservoir, the hypolimnion, the discharge water might be more than 20° F cooler than channel water that is likely to be as warm as 80° F in June and July (Figures 3-1 through 3-3). This condition would violate the SWRCB D-1643 water quality criteria that prohibit discharge if there is a temperature differential greater than 20° F. Assuming stratification is maintained during discharge, once the colder hypolimnetic water was gone then discharging the warmer epilimnetic water could become a problem. Regardless of whether the reservoirs are stratified or completely mixed, the temperature criteria may reduce project yield. Additional studies are needed to better estimate the likelihood and magnitude of these potential yield reductions.

Dissolved Oxygen

Additional discussion of theoretical dissolved oxygen scenarios for the reservoir islands and Delta channels is presented in the CALFED (2002) Water Temperature and Dissolved Oxygen Studies section of the In-Delta Storage Program Draft Water Quality Investigations Report. Like the temperature model, the DO model also assumes complete mixing in the reservoir islands. As mentioned above, complete mixing may not be the case. Temperature and DO are correlated in aquatic systems. If the reservoirs stratify, the hypolimnion is likely to become hypoxic or anoxic because of the lack of mixing and heavy organic loading from the peat soils. Even if the reservoirs do not stratify there could be an area of low DO at or near the sediment-water interface.

There are several other potentially important and interacting complex biological, chemical and physical factors that need to be addressed. The CALFED DO model works on one-day time steps and dissolved

oxygen in the water will likely show important hourly fluctuation with lowest DO concentrations occurring in pre-dawn hours and supersaturation of DO occurring in late afternoon. A model operating on daily time steps misses this hourly variability which is a common pattern in many aquatic systems. Thus, it is difficult at this point to predict whether DO violations will be a significant limitation to operations of the project. Additional DO studies are needed.

Flow Requirements in Biological Opinions, Incidental Take Permit and D-1643

This analysis will require the review of the DSM2 and CALSIM model results which should be available soon. The flow requirements are briefly described later in this report in the Fisheries Mitigation section 3.2.3.

Effects of Delta Smelt Diversion and Discharge Criteria on Project Operations and Yield

Without field surveys of delta smelt abundance at the points of diversion and discharge during the times when diversions and discharges are likely it is difficult to know what the total effects of the delta smelt criteria will be on the operations of the project. However, a preliminary analysis of diversion data from the last ten years of CALSIM model runs suggests that delta smelt diversion criteria could substantially reduce project yield. The Fall Midwater Trawl Index (FMWT) for delta smelt was less than 239 about 50% of the time from 1984 to 1993, the last ten years of the model run. The FOC of the incidental take permit prohibits the diversion of water to storage from February 15 through June 30 when the FMWT is less than 239. Additional modeling work should be done to incorporate the delta smelt diversion criteria into CALSIM or DSM2 runs so that effects on project yield are more precisely estimated.

Potential Impacts of Methyl Mercury on Aquatic Resources

Mercury (Hg) was briefly discussed in the 1995 DW EIR. Inorganic mercury and other heavy metals were found to be below their respective detection limits of 10 μg/l or ppb in surface and subsurface soil samples. Thus, JSA concluded that mercury was not and would not be a problem in the operation of the reservoir and habitat islands. However, mercury in organisms, methyl mercury and the methylation potential of island soils were not discussed. Recent research done by the IEP suggests that organic mercury in the delta is a major problem and that the mechanism behind this problem operates at a scale below 10 μg/l or ppb (Slotton and others 2001). The current RWQCB water quality objectives do not specifically address methyl mercury in terms that would likely affect project operations. However, the RWQCB is considering changing California's CWA Section 303(d) by adopting more stringent mercury standards. Current criteria that are being considered include a 0.3 mg/kg methyl mercury in fish tissue to protect human health (USEPA), and a 0.5 mg/kg to protect wildlife (National Academy of Sciences). If adopted, these or other more protective numeric criteria could impact project operations.

Mercury pollution is a major problem that affects aquatic systems on both local and global scales. Mercury can be found in many products that are a part of everyday life, including light bulbs, electronics and medical supplies. In the United States alone, over 500 metric tons of mercury is used annually in manufacturing processes. Unfortunately, some of this mercury ends up as an environmental pollutant. Mercury is a problem because it bioaccumulates and damages neurological tissues in fish, wildlife and humans. Mercury can be released from both natural and anthropogenic sources but atmospheric pollution from human activities is the biggest concern and is the primary reason for the global scale of the problem. Atmospheric deposition of inorganic Hg(0) to aquatic systems means that distant releases can impact remote and pristine systems. In water, Hg(0) is converted to Hg(II) which adsorbs to particulate matter and complexes with anions and dissolved organic carbon (Wetzel 2001). Hg(II) can then move with particulate matter in water or precipitate. In anoxic sediments, bacteria convert the precipitated Hg(II) to methyl mercury (MeHg). This biologically formed MeHg is readily assimilated and concentrated in organisms such as invertebrates and fish.

Mercury can be mobile in aquatic systems as aqueous mercury or when attached to suspended particulate matter. Mercury can also be concentrated and transported in the tissues of plankton and larger animals. For example, Suchanek and others (1999) found mercury concentrations in crayfish from

the Sacramento-San Joaquin Bay-Delta as high as 2 ppm dry weight (d.w.). Another example is the work of Slotton (1991) in a newly flooded reservoir in an area with historical mining activity. Slotton (1991) reported a range of mercury concentrations in zooplankton from 2 to 5 ppm d.w. and in bluegill, Sacramento sucker and largemouth bass, mercury concentrations were two to six time above health standards for edible flesh. Slotton (1991) found high concentrations of mercury in both lower and higher trophic levels soon after flooding of the reservoir. This suggests that methyl mercury can be acutely concentrated directly from the environment in a matter of weeks to months.

Locally, methyl mercury toxicity from accumulation in sediments and biological concentration is a serious problem in the Delta and has been identified as a critical water quality issue by the CALFED Bay-Delta Program. The problem in the Delta results from the combination of intense mining activity in the Coast Range and the Sierra Nevada mountain ranges with a highly productive and vast historical wetland. The mining activity has been a large source of mercury deposition in the Delta for over 150 years. Concentrations of total mercury and methyl mercury in aquatic systems generally increase with the amount of mercury added to the system. There is also a more complex and less understood correlation between methyl mercury production and increasing concentrations of dissolved organic carbon and percentage of highly organic wetland soils.

Flooding the reservoir and habitat islands as described in the DW Project (Alternative 1) might result in an initial pulse of elevated levels of biologically available methyl mercury, called the “new reservoir effect” and also cause long term production of methyl mercury. Heavily vegetated reservoir or habitat islands with highly organic soils might result in enhanced MeHg production, and localized bioaccumulation and export of this MeHg. Intentional flooding of Delta islands to create wetland habitat presents a tangible risk that these activities will increase levels of toxic methyl mercury in the Delta (Suchanek and others 1999). Therefore, mercury should be a consideration for any wetland projects in the Delta (Suchanek and others 1999). Interactions among mercury retention, methylation and mobility are important factors that must be considered. Complex interactions among abiotic and biotic factors in the Delta make it difficult to determine if local conditions such as inorganic mercury concentrations and organic carbon concentrations in the soils will lead to locally elevated levels of mercury bioaccumulation.

The complex dynamics of mercury in the Delta has recently been the subject of interesting and informative research. Early assumptions were that mercury concentrations in biota were uniform throughout the Delta. However, local environmental factors and upstream sources may both be important to mercury dynamics and help to explain why the scientific literature offers conflicting views on the relative role of local versus upstream environmental factors. In 1999, Suchanek and others reported that mercury concentrations in Delta organisms vary by as much as 20 times within taxa and among sites regardless of local conditions. Suchanek and others (1999) concluded that source water or proximity to a key watershed mercury source was most important and caused uniform biotic mercury concentrations within subregions irrespective of habitat type. For example, the Cosumnes River, the Yolo Bypass, the Sierra Range or the Coast Range could all be different key watershed sources. Thus, Suchanek and others (1999) suggested that local soil organic carbon content was relatively unimportant to methylation of mercury and subsequent bioaccumulation of mercury in fish.

In 2000, Slotton and others reported data that seemed to conflict with the conclusions of Suchanek and others (1999). Slotton and others (2000) reported that highly organic wetland sediments increase the potential to convert inorganic mercury to methyl mercury by up to 3000% when compared with more mineral sediment from adjacent channels and flats. Inorganic mercury is also retained more strongly in wetland and highly organic hydrosoils than in upland soils. Once the inorganic mercury is retained, methylation and the mobility of mercury tends to increase when the water warms and flows are low (Wetzel 2001). Nevertheless, Slotton and others (2000) concluded that wetland restoration projects in the Delta may result in localized mercury bioaccumulation at levels similar to, but not necessarily greater than general levels in the surrounding sub-regions.

There are several concerns related to Slotton and others’ (2000) conclusion and the suggestion that newly flooded wetlands might not be a locally significant source of biologically available mercury. Their conclusions were based on observing existing Delta wetlands and did not consider newly created

wetlands or initially flooded wetland soils, i.e. catching the initial pulse of methyl mercury in the first weeks, months and years after initial flooding. A literature search revealed that there are no projects where mercury was specifically monitored before, during and after the construction and flooding of new or "restored" wetlands on peat soils that could be used as a model for the DW Project. However, there are plans to monitor mercury dynamics as a part of the DWR Prospect Island restoration project (Zemitis 2001 personal communication; see "Notes").

Another concern with Suchanek and others' (1999) and Slotton and others' (2000) work is that they seem to discount the fact that extensive tidal mixing in the Delta may overwhelm any ability to resolve the mercury production on a local scale. A mobile organism moving among local habitats may be effectively the same as a sessile organism feeding on suspended particles in water that tidally moves among habitats. Complex biological, chemical and physical, interactions, especially tidal flushing, in the Delta make it difficult to detect local effects.

Recent research suggests that Delta wetlands, with their highly organic sediments, do provide ideal environments for mercury methylating bacteria. These wetland environments produce methyl mercury at enhanced rates relative to other Delta aquatic habitats (Slotton and others 2001). Slotton and others' current research (2001) measured methyl mercury in inflowing and outflowing tidal water from several flooded islands in the Delta. They found an increase in methyl mercury concentrations in water flowing off of highly organic wetland islands when compared to water flowing on the same islands. The increase was apparently not related to suspended solids but attributed to the production of methyl mercury on the islands. This suggests that new flooding could be a source of biologically available mercury in the Delta.

The reservoir and habitat islands might function as sediment/mercury traps retaining mercury in the winter and spring when sediment-laden high flows are used to fill the reservoirs. Then in the summer, these reservoirs might release high levels of mercury with the discharge water if the summer heat warms and stratifies the water and results in an anoxic layer in and above the peat soil. The habitat islands might also increase mercury concentrations in receiving water and organisms on the islands. High concentrations of mercury are released into water and the food chain in newly flooded reservoirs. This phenomenon is known as the "new reservoir effect" or "new flooding phenomenon" and occurs even when mercury concentrations in the soil are relatively low (Slotton 1991; Suchanek and others 1999). In addition to the initial pulse of the new reservoir effect, wetland habitats often produce enhanced mercury methylation on an ongoing basis (Suchanek and others 1999). Highly organic, sulfate-rich wetland soils together with high temperatures and anoxic sediments are conditions that increase the production of biologically available mercury. Unfortunately, these are also conditions that are likely to be present on the project islands. It is important to note that a common agricultural practice in the Delta is the flooding of fields in the fall and winter in order to leach salts, decompose crop residue and control weeds. This practice is somewhat similar to the flooding that will occur on the reservoir and habitat islands and might mean that an initial pulse or "new reservoir effect" will be reduced. Experimentation and additional observational work are necessary to address this uncertainty.

Invasive Aquatic Species

This section provides only a brief overview of invasive species problems in the Delta, how invasive species might impact the DW Project, and how the project might affect invasive species. A complete discussion of invasive species in the Delta is beyond the scope of this report. The species focused on in this section include Chinese Mitten Crabs, Asian clams, and other introduced fishes and animals. Most of the discussion provided here is based on personal communication with Veldhuizen (2001).

Chinese Mitten Crabs

First detected in South San Francisco Bay in 1992, the Chinese mitten crab quickly spread throughout the Bay-Delta. This species is considered a nuisance because of its current and potential impacts, which include impacts to fish salvage operations at the SWP and CVP fish facilities, stealing bait from anglers and altering ecological communities through predation and competition.

Currently, DWR, representatives from academia, state and federal resource agencies, Dept. of Public Health, and reclamation districts are working on the assessment of impacts from the invasion of Chinese mitten crab. They are also in the process of further developing and implementing response plans for minimizing impacts to fish salvage operations arising during the immigration of spawning adults. DWR staff are studying mitten crab habitat use in the Delta. One goal of this study is to identify the habitat types most likely to be impacted by the crab. In addition, effective sampling methods are being developed which can be used in future monitoring and detection programs. DWR staff are also examining the impacts of the mitten crab on the benthic invertebrate community within the Delta and Suisun Bay.

Because current information on the effects of Chinese mitten crab on the Delta is, for the most part limited it is difficult to predict how the crab will affect the DW Project and whether the project will have a significant affect on the crab population in the Delta. Nevertheless, the interaction between the DW Project and Chinese mitten crab needs to be addressed in additional detail if the project moves forward.

Based on reports from Europe and recent investigations in California, some preliminary discussion on the possible effects of Chinese mitten crab can be provided. There are reports from Europe that crab burrows can accelerate bank erosion. Surveys of levees in the Delta showed that crab densities can be up to 5 crabs/m^2 and surveys done in tributaries of the San Francisco Bay showed densities of 2 to 39 burrows/m^2 at an average depth of 20 cm. These burrows formed a complex network of interconnecting tunnels. Densities were highest in tidally influenced areas with steep banks containing a high clay or silt content. Based on preliminary data, damage to levees in the reservoir islands will likely be associated with crab densities, levee structure, and suitability of the bank for burrowing.

There are also reports from Europe of crabs entering water intake pipes or becoming trapped on screens. In California, PG&E reported that the Pittsburg Power Plant, located on the southern shore of Suisun Bay, was affected by high numbers of adult crabs in fall 1997 and 1998, and the Contra Costa Plant, located near Antioch, was affected in fall 1998. Hundreds of crabs entered the cooling water system each fall when migrating downstream, partially blocking the plumbing system and reducing flows. Workers periodically back-flush with hot water to remove the crabs.

To date, the most conspicuous impact of the crab in California is on the fish salvage operations at the SWP and CVP located in the south Delta. These SWP and CVP divert millions of acre-feet of water from the Delta annually to water users in other parts of the state. The fish collection facilities screen all water heading toward the pumping plants and salvage millions of fish. The fish salvage operations at both fish collection facilities were severely hindered in 1998 when nearly 750,000 crabs were entrained into the facilities, clogging the holding tanks and fish transport trucks. There were 5,000 to 40,000 crabs captured per day during the peak fall migratory period. The federal and state fish facilities have since developed mitten crab exclusion devices to prevent crabs from entering the facilities.

The most important potential impacts of Chinese mitten crab on DW Project operations will likely be associated with the fish screens and siphon facilities. Depending on design of the fish screens, crabs could foul the screens or otherwise inhibit their proper operation.

Asian Clams

First detected in 1986, Asian clams quickly spread through the Bay-Delta ecosystem. These clams are now the most abundant benthic organism in many of these areas. Potential impacts include: transfer of elevated concentrations of selenium and methyl mercury to fish through clam bioaccumulation and fish predation on the clams, and disruption of the estuary food web through dramatic increases in benthic suspension feeding and reducing food availability to zooplankton. Like Chinese mitten crab, it is difficult to predict what effect these introduced species will have on the DW Project. The interaction between the DW Project and Asian clams should be addressed in additional detail if the project moves forward.

The most important potential impacts may be indirect and result in changes in water quality or mercury contamination of fish. The effects of phytoplankton and submersed macrophytes on water quality are

discussed in detail in Chapter 4 of the Water Quality Report. Briefly, Asian clams remove phytoplankton through suspension feeding. Therefore, they may reduce TOC loading from phytoplankton while clearing the water and indirectly increasing submersed macrophyte growth, because of increased light transmittance through the water column. This increased submersed macrophyte biomass will, at some point, probably die, decompose and end up increasing TOC concentrations in the discharge water. This can be a Water Quality problem.

Methyl mercury is increasingly being recognized as a serious problem in the Delta and will likely also need to be addressed in relation to the DW Project sooner or later. Methyl mercury is discussed in more detail in the previous section of this report. Briefly, methyl mercury can be absorbed from the water column by phytoplankton. Then this mercury can accumulate in the clams as they feed on the phytoplankton. When fish or wildlife subsequently feed on the clams they ingest relatively high concentrations of mercury with the clam tissue. This mercury is retained, so the more clams they eat the more mercury they accumulate and eventually mercury concentrations become toxic and cause neurological or developmental problems.

Introduced Fishes and Other Animals

A number of introduced fishes, invertebrates and various other animals are now permanent residents of the Delta. Many of these species compete with and prey on native species thereby reducing the chances for recovery of listed species and adversely impacting the continued existence of other native fishes. Introduced species now dominate many of the habitats within the Delta. In particular, introduced species tend to be problematic and flourish in disturbed systems. The variable diversion and discharge cycles expected with the DW Project will probably favor adaptable, opportunistic species, which are usually introduced and invasive. The complex ecological interactions between native and exotic species makes it nearly impossible to predict the effects of all the introduced animals on the DW Project and how the project might in turn effect those species and indirectly effect the rest of the Delta ecosystem. This is especially true considering all the other complex biological chemical and physical factors interacting in the Delta. Nevertheless, future studies should be aimed at better understanding these effects if the project moves forward.

Aquatic weed problems associated with the DW project are discussed in the Botanical Resources section of this report. Additional discussion of aquatic macrophytes and algae as they relate to water quality is provided in Chapter 4 of the Water Quality Report.

Fish Screen Design Proposed by Delta Wetlands

DW Properties, the proponent of DW Project, proposed a plan that makes use of existing pumps and siphons and adding two new pump stations per island for diverting water from the Delta channels into storage reservoirs. The pumps and siphons will be located around the perimeter of the islands and will be equipped with removable drum style fish screens. In this section, we evaluate the merits, impacts, and deficiencies of pump/siphon/fish screens systems as proposed by DW.

Conceptual Design Drawings and Basis for Evaluation

Documented design criteria for the proposed intake and discharge facilities is limited to hydraulic, fish screen criteria, and limited operational criteria. Structural and geotechnical issues including pipe stress, settlement, levee stability, and failure or damage potential are addressed in the In-Delta Storage Program Draft Report on Engineering Investigations.

The conceptual design drawings provided by DW Properties are limited in detail, so comments are directed to the general details available (Figures 3-5 through 3-9). Details of the existing diversions proposed for screening are even less clear, but it is assumed that smaller, yet similar types of screens will be placed on those diversions.

Figure 3-5. Siphon details for Webb Tract under Alternative 1 – DW Project

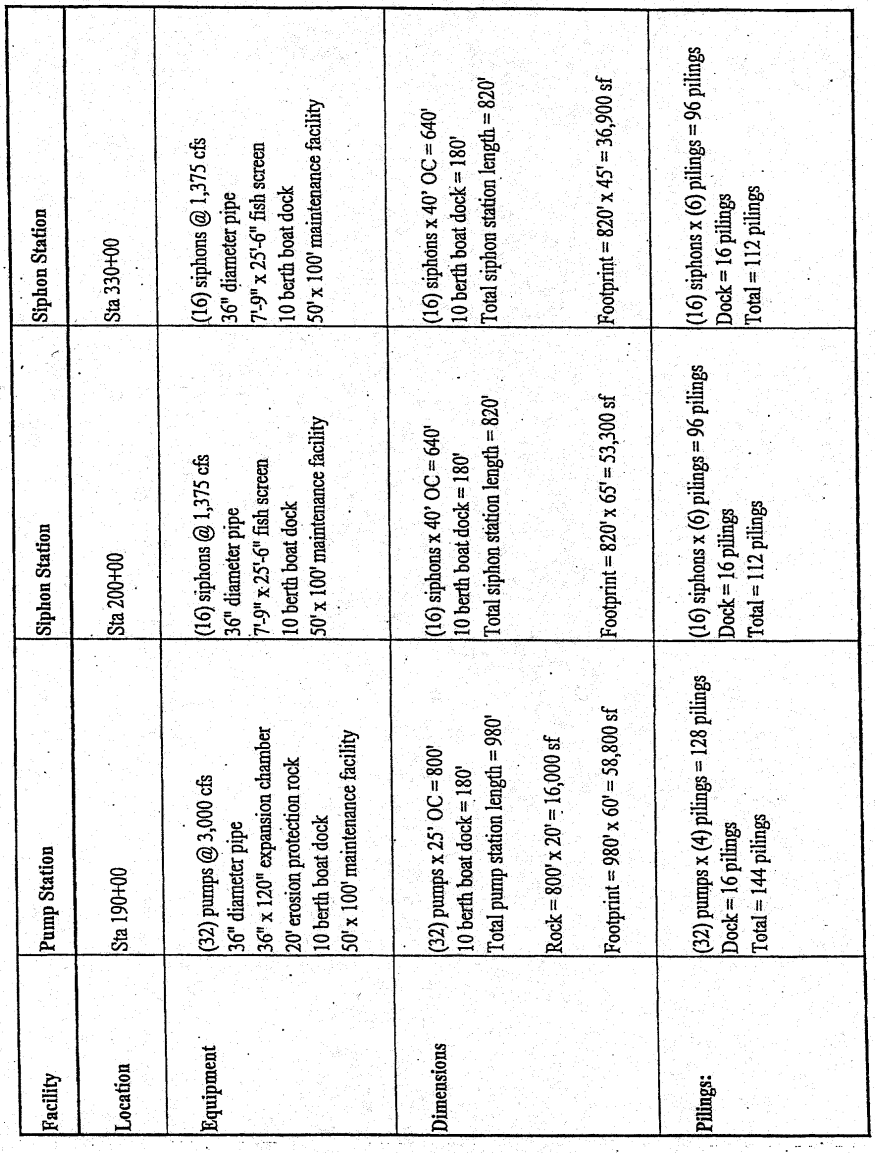


Table 1: Webb Tract Facilities

Facility	Pump Station	Siphon Station	Siphon Station
Location	Sta 190+00	Sta 200+00	Sta 330+00
Equipment	(32) pumps @ 3,000 cfs 36" diameter pipe 36" x 120" expansion chamber 20' erosion protection rock 10 berth boat dock 50' x 100' maintenance facility	(16) siphons @ 1,375 cfs 36" diameter pipe 7'-9" x 25'-6" fish screen 10 berth boat dock 50' x 100' maintenance facility	(16) siphons @ 1,375 cfs 36" diameter pipe 7'-9" x 25'-6" fish screen 10 berth boat dock 50' x 100' maintenance facility
Dimensions	(32) pumps x 25' OC = 800' 10 berth boat dock = 180' Total pump station length = 980' Rock = 800' x 20' = 16,000 sf Footprint = 980' x 60' = 58,800 sf	(16) siphons x 40' OC = 640' 10 berth boat dock = 180' Total siphon station length = 820' Footprint = 820' x 65' = 53,300 sf	(16) siphons x 40' OC = 640' 10 berth boat dock = 180' Total siphon station length = 820' Footprint = 820' x 45' = 36,900 sf
Pilings:	(32) pumps x (4) pilings = 128 pilings Dock = 16 pilings Total = 144 pilings	(16) siphons x (6) pilings = 96 pilings Dock = 16 pilings Total = 112 pilings	(16) siphons x (6) pilings = 96 pilings Dock = 16 pilings Total = 112 pilings

Figure 3-6. Siphon details for Bacon Island in Alternative 1 – DW Project

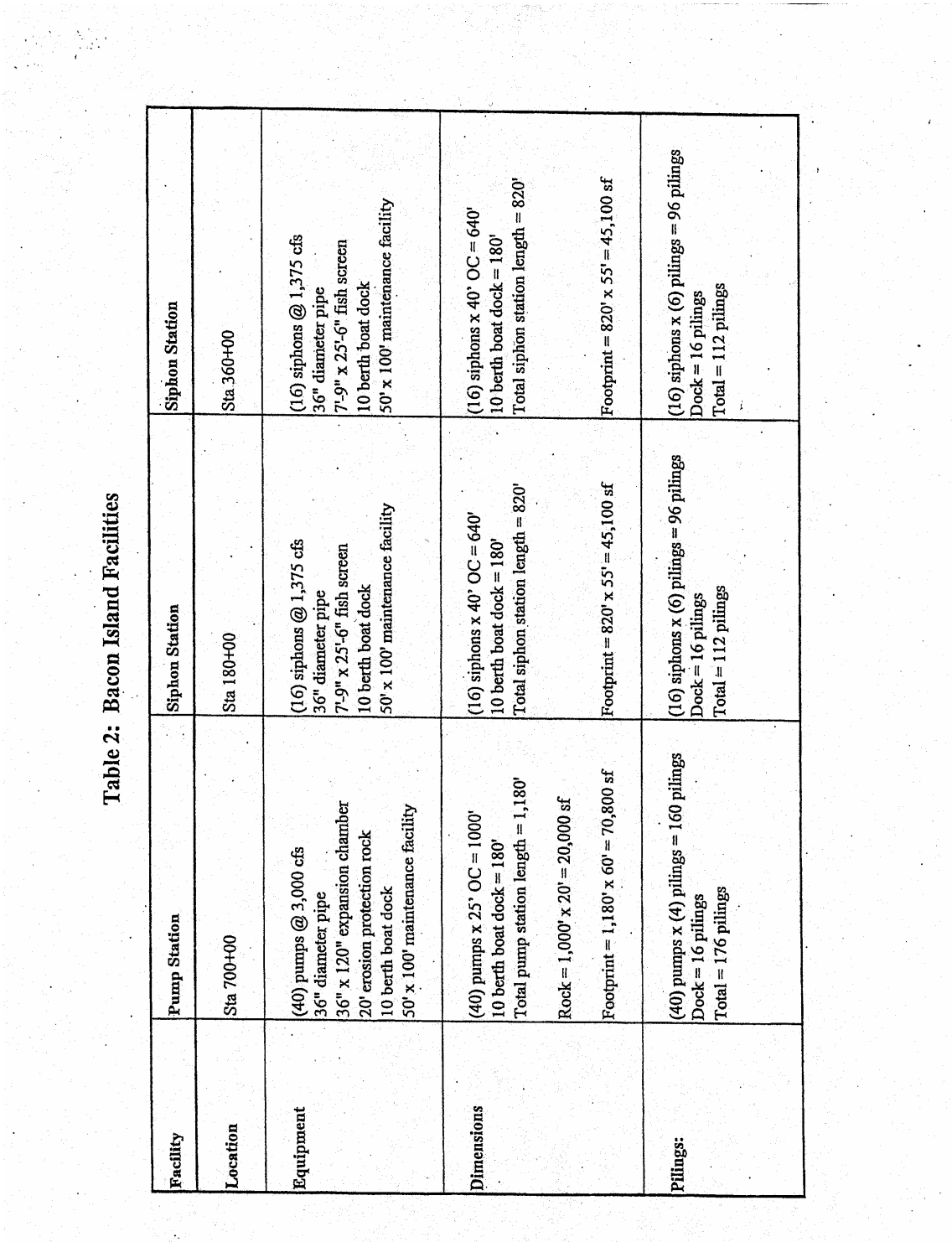


Table 2: Bacon Island Facilities

Facility	Pump Station	Siphon Station	Siphon Station
Location	Sta 700+00	Sta 180+00	Sta 360+00
Equipment	(40) pumps @ 3,000 cfs 36" diameter pipe 36" x 120" expansion chamber 20' erosion protection rock 10 berth boat dock 50' x 100' maintenance facility	(16) siphons @ 1,375 cfs 36" diameter pipe 7'-9" x 25'-6" fish screen 10 berth boat dock 50' x 100' maintenance facility	(16) siphons @ 1,375 cfs 36" diameter pipe 7'-9" x 25'-6" fish screen 10 berth boat dock 50' x 100' maintenance facility
Dimensions	(40) pumps x 25' OC = 1000' 10 berth boat dock = 180' Total pump station length = 1,180' Rock = 1,000' x 20' = 20,000 sf Footprint = 1,180' x 60' = 70,800 sf	(16) siphons x 40' OC = 640' 10 berth boat dock = 180' Total siphon station length = 820' Footprint = 820' x 55' = 45,100 sf	(16) siphons x 40' OC = 640' 10 berth boat dock = 180' Total siphon station length = 820' Footprint = 820' x 55' = 45,100 sf
Pilings:	(40) pumps x (4) pilings = 160 pilings Dock = 16 pilings Total = 176 pilings	(16) siphons x (6) pilings = 96 pilings Dock = 16 pilings Total = 112 pilings	(16) siphons x (6) pilings = 96 pilings Dock = 16 pilings Total = 112 pilings

Figure 3-7. Existing siphons on Webb Tract and Bacon Island in Alternative 1 – DW Project

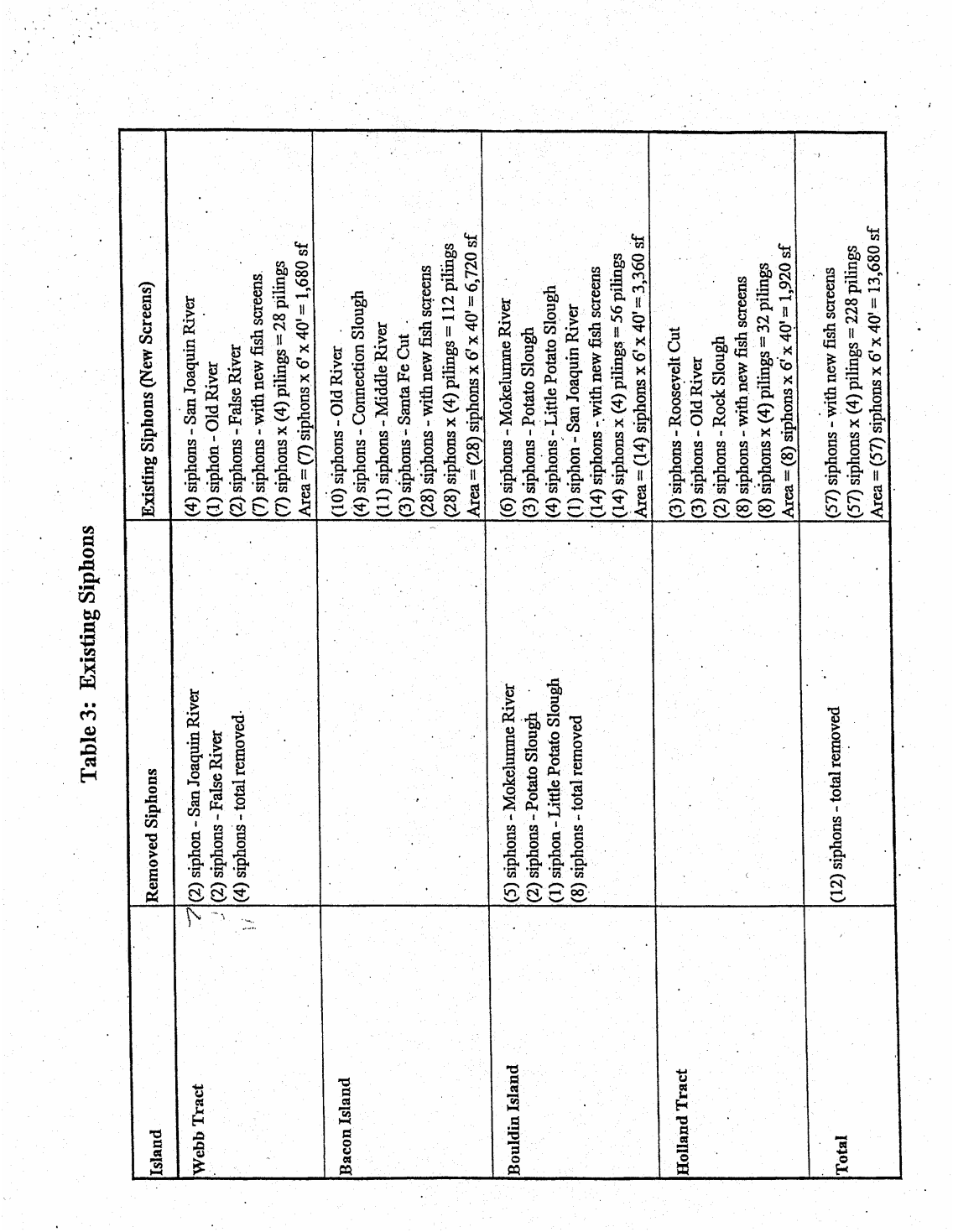


Table 3: Existing Siphons

Island	Removed Siphons	Existing Siphons (New Screens)
Webb Tract	(2) siphon - San Joaquin River (2) siphons - False River (4) siphons - total removed	(4) siphons - San Joaquin River (1) siphon - Old River (2) siphons - False River (7) siphons - with new fish screens (7) siphons x (4) pilings = 28 pilings Area = (7) siphons x 6' x 40' = 1,680 sf
Bacon Island		(10) siphons - Old River (4) siphons - Connection Slough (11) siphons - Middle River (3) siphons - Santa Fe Cut (28) siphons - with new fish screens (28) siphons x (4) pilings = 112 pilings Area = (28) siphons x 6' x 40' = 6,720 sf
Bouldin Island	(5) siphons - Mokelumne River (2) siphons - Potato Slough (1) siphon - Little Potato Slough (8) siphons - total removed	(6) siphons - Mokelumne River (3) siphons - Potato Slough (4) siphons - Little Potato Slough (1) siphon - San Joaquin River (14) siphons - with new fish screens (14) siphons x (4) pilings = 56 pilings Area = (14) siphons x 6' x 40' = 3,360 sf
Holland Tract		(3) siphons - Roosevelt Cut (3) siphons - Old River (2) siphons - Rock Slough (8) siphons - with new fish screens (8) siphons x (4) pilings = 32 pilings Area = (8) siphons x 6' x 40' = 1,920 sf
Total	(12) siphons - total removed	(57) siphons - with new fish screens (57) siphons x (4) pilings = 228 pilings Area = (57) siphons x 6' x 40' = 13,680 sf

Figure 3-8. Intake siphon unit proposed by DW Properties under Alternative 1 – DW Project

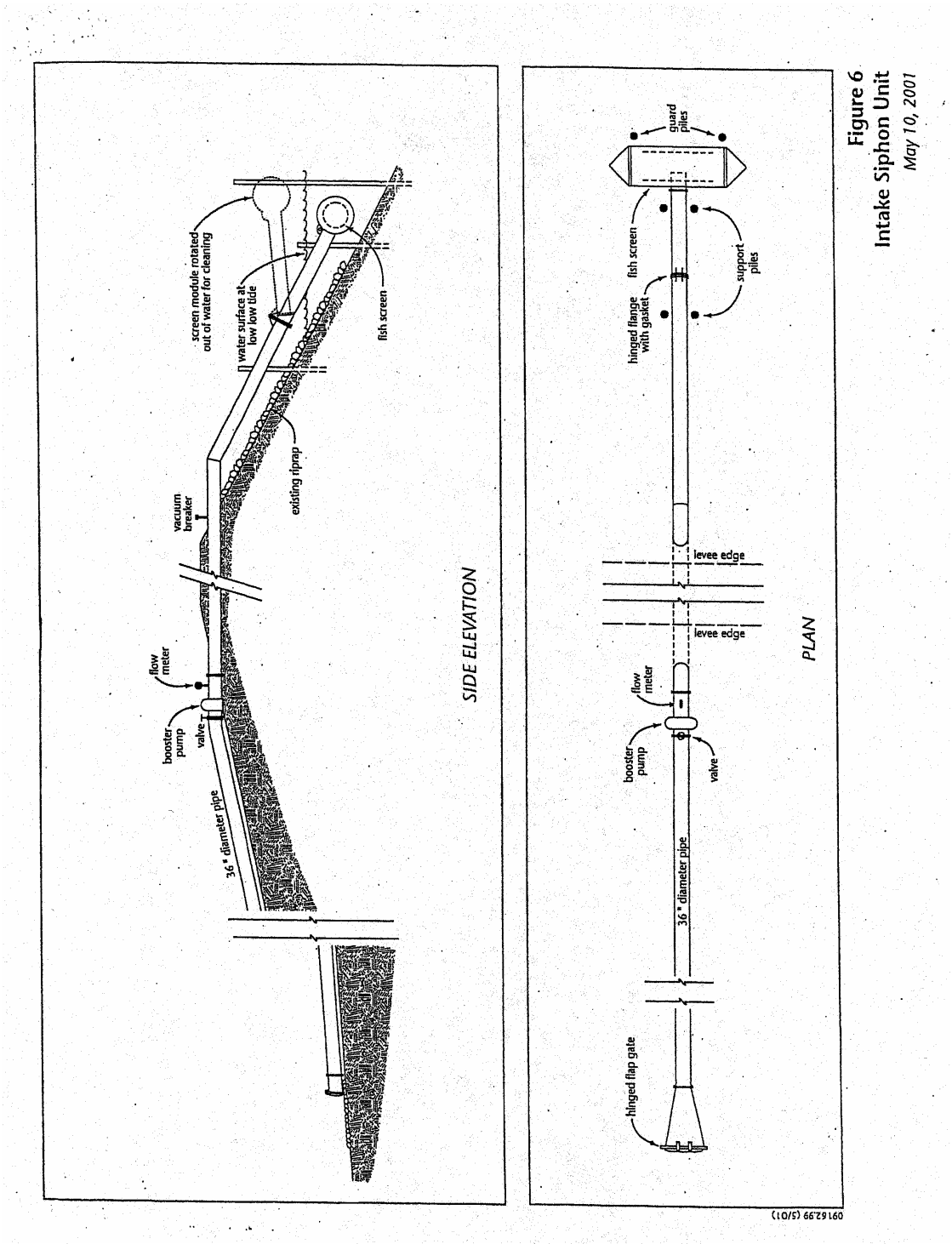
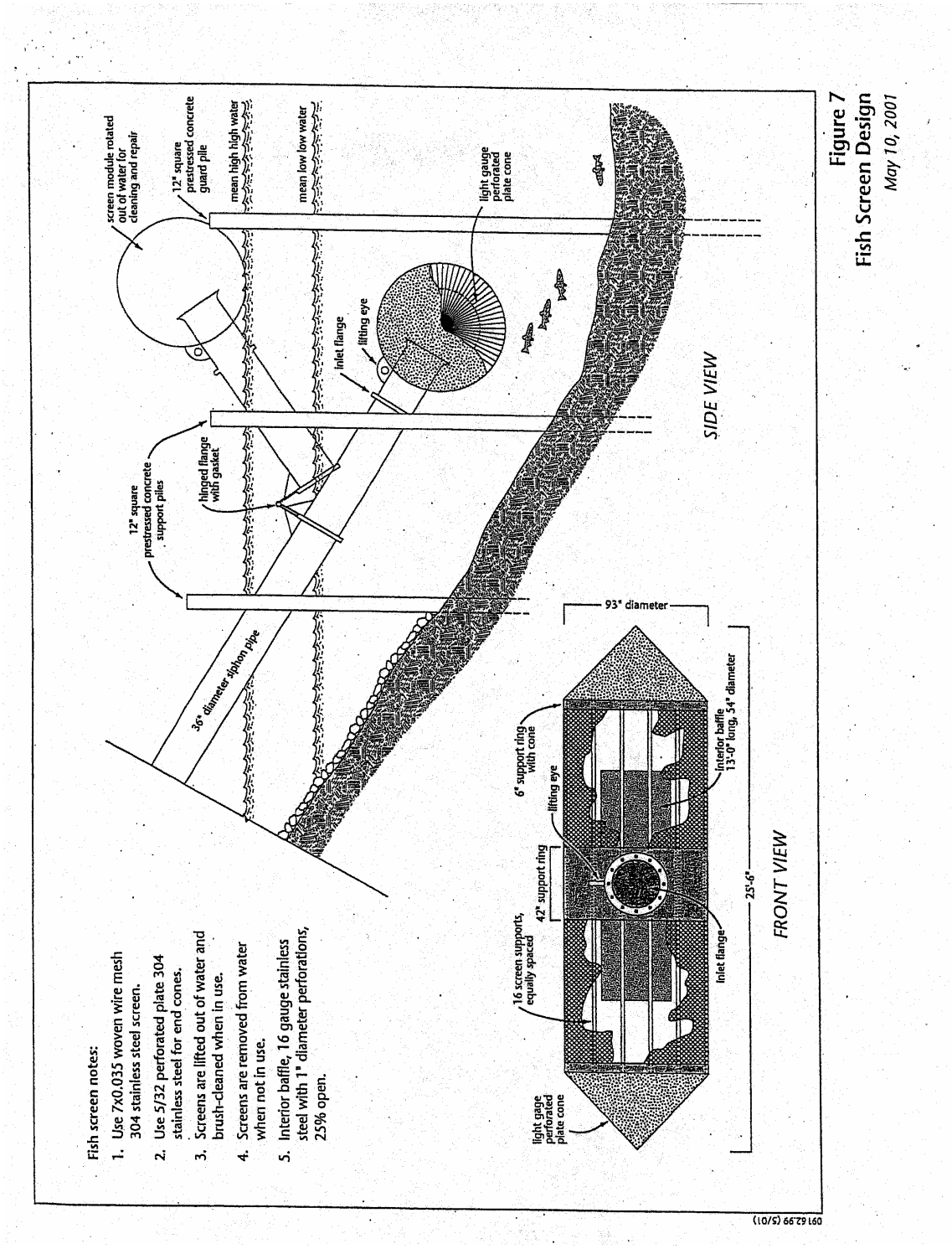


Figure 3-9. Fish screen design proposed by DW Properties in Alternative 1 – DW Project



In our analysis, we have addressed the merits and deficiencies of the DW Project concept as presented. The drawings dated May 10, 2001 show details different from those in the originally submitted EIR (Figures 3-8 to 3-9). Major changes relate to the position of the booster pumps on the intake pipes and a different pumping arrangement on the discharge facility. Comments are directed to these revised drawings, except when more information is provided in the EIR drawings or as noted below.

The conceptual intake facilities include fish protection screens. These screens are similar in concept to standard cylindrical screens used on a number of pump and siphon intake installations, such as manufactured by Lakos, CTC, Intake Screens Incorporated, Hendricks, U.S. Filter, and others. The main difference between this design and similar installations is screen unit size. The largest diameter wire mesh cylindrical fish screen installed in California was made by Lakos and is 68 inches in diameter. It consisted of two screens mounted together at the end of a slant pump and is similar to the DW design shown. This screen, installed in 1994, has a design capacity of 40 cfs (designed for 0.33 fps) and is fitted with an automated internal backwash system. It is located on the Sacramento River near Knights Landing in a deep and swift river section. Maintenance has been minimal, although the woven wire mesh was recently replaced with perforated plates due to screen wear and damage. Large woven wire screen units made by CTC have also been installed at DWR's Horseshoe Bend site on Sherman Island (1998), but at 54-inches in diameter, the two screens deliver only 30 cfs at peak capacity using the 0.2 fps approach velocity criteria (Figure 3-10). Like most large diameter screens installed to date, they are only removable by cranes with the assistance of underwater divers.

Other large cylindrical screens have been installed in California (and elsewhere), but most are designed using wedgewire screens and have air burst backwash systems. Larger diversions (i.e. larger than 40 cfs) typically manifold individual screen units together to achieve the higher flow rates. The periodic burst of air can lift debris if there is a strong sweeping flow to carry away debris, but it does not replace periodic manual brush cleanings by divers. The advantage of this type screen is that the screens are quite durable, if protected from heavy river debris, and do not have moving parts. The disadvantage is that the air cleaning is only marginally effective at cleaning the debris from the underside of the screens. In large river systems that carry heavy debris, these screens are more vulnerable to damage than screens along a bank and are thus usually protected by debris deflectors or protection piles.

Examples of recent installations using this design include the following sites:

- DFG's Grizzly Island diversion in the Suisun Marsh (by Hendricks, four screens, each 42-inch diameter and 40 cfs each);

- M&T Ranch Intake on the Sacramento River near Chico (Cook Design, four screens, each 42-inch diameter and approximately 40 cfs each);

- Maxwell Irrigation District Intake on Sacramento River near Princeton (Cook design, three screens, each 41-inch diameter and 35 cfs each).

Although these installations use large screens, they are nowhere near the size envisioned for DW Project (7'– 9" in diameter and 25'-6" long). In addition, with very few exceptions, most screened diversions use some type of automated cleaner, and no commercially available screens use the end caps as part of the screen area, likely due to cleaning issues. The proposed DW screens, like the example projects above, are not "off the shelf" designs. It should be noted that experience with smaller design are available, but there is no experience with a screen of the proposed DW configuration and size.

Figure 3-10. Removal of DWR's Horseshoe Bend fish screen in Delta (CTC Design – 15 cfs) (Screen mesh failure due to corrosion (dissimilar metals). Also note poor screen cleaning from internal backwash system.)

Fish Screen Criteria

Screens are required on any new or modified diversions as required by the California Fish and Game Code. Diversions are also screened to comply with endangered species protection laws giving the diverter protection from incidental take. Both NMFS and DFG have established criteria for intake screens in California (see Appendix A). These criteria address the needs of primarily juvenile anadromous salmon and steelhead trout (both are listed species). However, they are generally protective of most fish over 20 mm in length. USFWS does not have established fish screen criteria; however, a screen approach velocity criteria of 0.2 fps for delta smelt protection has been mandated in several biological opinions or agreed to for a number of projects in the Delta and Suisun Marsh Area (CCWD Los Vaqueros and Rock Slough Intakes, Banta Carbona ID new screen, SRCD Suisun Marsh screens, DFG's Grizzly Island Intake, DWR's Roaring River intake, City of Sacramento intake, DWR's Sherman Island screens, Tracy fish test facility, etc.). Other species and life stages have not been specifically addressed for this site, as required by the DFG 2000 Fish Screening Criteria (DFG Screen Criteria Section 2,(B)(3)).

Approach velocity criteria is only one criterion for screening effectiveness. Siting, maintenance, operation, and channel hydraulics are equally important. The established criteria of the DFG is "general screening criteria" and is vague for Delta diversion applications (tidal areas, varied species, variable conditions) and where the diversion magnitude is significant. The NMFS criteria is specific to anadromous fish and is also vague in regards to large Delta diversion applications. These applications would be handled on a "case by case" basis in consultation. Screen "criteria" can be subject to various interpretations due to the potential increased direct and indirect impacts. Although much of the applicable criteria for screening is seemingly mandated, it is the underlying objective of fish protection that really

must be applied to the intake design. With this in mind, a screen facility can be designed that may not meet all criteria, but still be considered acceptable to the fishery agencies. Accordingly, the Resource agency representatives must be involved in the design process to gain approval.

Egg and Larval Protection Criteria

Intake screens should take into account the best available technology and be protective of a variety of fish species and life stages in addition to those of threatened or endangered status. The DW proposed design screens, as with most exclusion screens intend to use a 5/32-inch mesh opening. While this may keep most fish out, this mesh will not protect larval fish from being entrained. Larval fish could be an important life stage to protect at the DW project depending on the final operating criteria and its coincidence with vulnerable life stages in the area. There are technologies that can screen egg and larval life stages, but they generally have extremely low approach velocities. A geotextile (fabric) barrier screen, such as the "Gunderboom," can be protective of smaller fish, but it too is unproven at such a large scale. Two installations of this design are proposed at Mirant Corporation's Pittsburg and Contra Costa Power Plant near Antioch, CA. Such installations have very low approach velocities (<0.05 fps) and extensive maintenance requirements (Gallo 2001 personal communication; see "Notes").

Screen Criteria Used in Delta Wetlands Proposal

Figure 3-9 lists the following specifications as they relate to screening criteria:

Screen Approach Velocity (Va):

> Approximate screen area = 720 square feet
> Flow per screen = 1375 cfs/16 intakes = 86 cfs
> Va = 86/720 = 0.12 feet per second
> [NOTE: Criteria is 0.2 fps max.]

Screen Openings and Porosity:

> Woven wire mesh = 7x0.035 mesh -- Approximate diagonal opening = 5/32 inch
> Perforated Plate = 5/32 inch holes, no open area listed.
> [NOTE: Criteria is 3/32 inch max. opening (measured diagonally for square openings with a 27% minimum open area.]

Screen Cleaning:

> Manual cleaning methods, presumably with a hand brush by diver or surface technician.
> [NOTE: DFG screen criteria for screens which are not self-cleaning shall be designed with an approach velocity one-fourth that required for the screen or Va = 0.05 fps. Also, the screen shall be cleaned before the approach velocity exceeds 0.2 fps.]

Discussion:

Major areas of criteria non-compliance relate to cleaning requirements, screen mesh (and perforated plate opening size), and screen area, as discussed below:

> Cleaning: Even with a full time cleaning maintenance staff, the screens will not be able to meet the cleaning requirement. Screens without automated cleaning devices (brushes, air, water backwash) therefore have to be sized four times greater or fitted with automatic cleaning devices. Issues and recommendations on structural features and operations and maintenance requirements are presented in other sections.
>
> Screen Mesh: Screen openings have recently been reduced for the protection of steelhead trout fry. To date, there is no exemption for screens in the Delta since they could be present. Screen

approach velocity is still calculated based on the gross area (less structural members), so this requirement applies to the screen only. The open area requirement of 27% minimum has impacts on screen material strength and cleaning. A lower open area will generally have higher strength, but correspondingly higher "through slot" velocities making cleaning more problematic. Higher open areas will generally have lower screen material strength, but fewer cleaning issues.

Screen Area: The screen area shown on Figure 3-9 appears to be marginally sufficient to meet the 0.2 fps approach velocity standard; however, this does not meet the requirement for manually cleaned screens. Also, for screens over 40 cfs, flow uniformity is critical. The approach velocity criteria can be interpreted as a maximum allowable velocity averaged over a small screen area, or as a "not to exceed" criteria. Regardless of the interpretation, careful attention should be placed on balancing flows throughout the screen. The designs show, in concept, an interior flow distributor. This feature has been successfully used on other screen designs to distribute flows around the screen surface. However, due to the size of these units, the screen velocity distribution should be modeled to determine how the screen and the flow baffle should be designed to achieve the flow uniformity objective. Flow uniformity is just as important for cleaning aspects as it is for fisheries protection.

Design Compared to Intent of Criteria

The basic intake design concept is unproven on such a large scale. The combined intake capacity of both Webb Tract and Bacon Island is approximately 9000 cfs (average daily), or approximately equal to the combined diversion of the existing state and federal water projects in the South Delta. Basic fish screen design does not mean that only approach velocity criteria are met. The concentration of fish drawn to the intake area and given little or no "escape" area must be addressed. If the intake flows create a sump or "bathtub drain" effect in this area of the Delta, simply keeping fish out of the intake with an exclusionary screen is only part of the issue. Screened intakes that create a sump condition are generally fitted with fish collection systems such as at the SWP and CVP fish facilities in the South Delta. Scenarios operated with the tides could lessen the need for collection systems, but this is not being addressed in this initial assessment.

Potential Environmental Impacts

The proposed project will impact both the aquatic and landside environments. Aquatic impacts, as noted in the previous sections, can be both directly and indirectly assessed. Indirect effects due to how this project impacts flows and fish distributions throughout the Delta are not addressed in detail here. Direct impacts can be measured in terms of impingement, entrainment, and localized predation losses due to the facility.

Good fish screens should minimize the impingement and entrainment losses since they are based on conservative criteria. Very small fish that have limited or no swimming abilities could be susceptible to losses. Operations plans could be developed to limit exposure of these impacts. The FOC mentioned in the biological opinions requires on-island monitoring to detect incidental entrainment of eggs, larvae and juveniles from January through August. The regulatory agencies require monetary compensation for the take of those life stages depending on the density and species.

The four new intake facilities would combine to make one of the largest full physical exclusion screens in the world. Screen systems of this magnitude require additional considerations due to the concentration of potential fishery activity at one location. A large concentration of individual screen units should not be evaluated on the performance of the individual screens, but instead as a system operating in its environment. The present configuration may draw more water than will sweep past the intakes at some times. During peak diversion, flows will be drawn from the surrounding channels and directed predominantly into the diversion screens. These conditions occur during peak high slack water periods and could last for several hours. Fish may be drawn progressively into this "dead end" area, creating a high concentration of juvenile and larval fishes that may be drifting in response to the flow. Increased predator opportunities may result which must be considered into the overall efficiency of the facility. At

the SWP's J. E. Skinner Fish Protective Facility, for instance, it has been determined that predation is one of the most significant losses at the facility. At the Tracy Fish Facility, predators are regularly removed to limit losses. Predatory fish may be able to take advantage of the DW intake facility's structures and hydraulic flow inconsistencies and prey on the concentrations of smaller fishes in the area. Smaller fish may be trapped and concentrated in this area due to the lack of bypass past the screens. Facilities also have limited cover for small fish, while larger fish can hold in these areas better and get their prey quicker.

While the fish screens and support piles are potential predator havens, other waterway obstacles, such as boat dock facilities can provide predator habitat. DFG and NMFS have typically assumed some predation losses associated with fish screen facilities, such as a 15% prescreen direct loss due to the Tracy Fish Facility.

Site impacts can occur both during construction and due to long term operation. Construction impacts are typically limited and can usually be mitigated. The temporary and long term loss of habitat are generally related to the facility footprint. For this project, the land-side of the levees will be reconstructed and disturbed regardless of the facility construction, so additional screen footprint impacts on the land-side will be minimal. The construction impact area is therefore primarily on the levees' water side area.

Temporary impacts can also occur during construction activities. These impacts can include potential habitat and riparian vegetation losses disturbed during construction; noise impacts, such as from pile driving, on fisheries and birds (Swainson's hawk nesting, burrowing owls, etc.); water quality degradation from possible dredging or river bed disturbances; and potential river bed impacts from rock protection, structure placements, or dredging operations.

Long term impacts will be related to the permanent losses of riparian vegetation (such as from additional rock protection), maintenance activities, access improvements, visual impairments, pump noise, recreation, and project lighting.

Maintenance around the intake and discharge facilities will be routine and will necessitate the need for access. Barge and/or truck mounted cranes will use these roads that will also be used for other purposes such as levee inspection. The intake and discharge station areas will have to be cleared periodically to visually inspect (and prime) the pipes and pumps. The fish screens will typically be accessed from the water as currently proposed. Dredging activities should be limited, and only performed if there is excessive sediment deposition beneath the screens that limit their function.

The fish screen and discharge facilities consist primarily of piled structures and pumps that will be visible most of the time. The area will also be fitted with safety features to warn boaters of the underwater structures and hazards. This may consist of additional lighting, floating booms, and buoys. When the fish screens are in the raised position, the visual impacts will be evident as all screens will be above the water surface. Noise impacts from the pump operations will vary according to proposed operations.

The operation and existence of the fish screens will pose a number of recreational impacts. Boat wakes should be limited to minimize structural damage, so speed reductions could limit current recreational activities in the area. The waterway will also be constricted due to the loss of waterway use occupied by the fish screens. Maintenance activities, especially when the barge mounted crane is operational, will further limit activities in the area.

Due to fluctuating water surfaces in the reservoir, it is not anticipated that there will be long term impacts due to the intake or discharge areas beyond those of the reservoir operations.

Operation and Maintenance Issues

Operations and maintenance costs are too often overlooked or minimized, but experience has demonstrated that these issues cannot be overlooked. Because capital costs for screen facilities can range from $2000 to $20,000 per cfs, it is often desirable to look for cost cutting features. Material selection, cleaning systems, retrieval systems, structural engineering review, safety features, and site

work can drive costs quickly. Standardized or "off the shelf" technologies have their place, but they must be carefully reviewed for their applicability at each site. A number of small screens have failed because of unanticipated loads and harsh riverine conditions. Experience gained from several small screen failures has helped improve designs and helped designers plan appropriate screen and protection systems, including proper material selection and cleaning systems. Most failures have been the result of poorly designed cleaning systems, were subjected to severe debris loads, or because maintenance schedules and inspections were not adhered to. To date, most failures have occurred on smaller cylindrical screens attached to pump intakes or siphon pipes.

Cylindrical screens have the advantage of being adaptable to a number of pump or pipe installations with minimal cost. Heavy site work is generally limited since most of the facility rests on driven piles instead of on engineered foundations. The main disadvantage is that these systems are generally difficult to access from the shoreline. Hinged screen systems are not truly retrievable since access to the screens is still limited from the shoreline (unless walkways are provided). Screen designs that are not retrievable are rarely inspected due to the added hassles and expense of inspections. Inspections on non-retrievable units are usually performed by divers, but underwater cameras can be used if water clarity is sufficient. This makes detecting or preventing problems difficult which can lead to total screen structural failures without warning. These screens are also often left in place during flood conditions and are susceptible to damage and shorter structure life.

Failed screen installations (Figures 3-11 through 3-13), such as the Butte Creek Farms screen and the Andreotti Farms screen units have since been replaced with redesigned screens. The new screens feature a number of improvements including the following:

- Automatic cleaners using brushes instead of water or air;
- Wedgewire screens in lieu of woven wire mesh;
- Retrievable screen systems using tracks for inspections and removal when not in use;
- Monitoring systems to shut off pumps and alert operators of problems;
- Corrosion resistant materials, such as stainless steel for all parts;
- Better flow balanced screens;
- Easy access for repairs and inspection; and
- Structurally designed for greater hydrostatic loads and impacts.

The additional cost of improved screens has been on the order of two to four times the original installation cost of the cheaper systems.

The proposed DW screen design has very few of these functional features. Specifically, the proposed design will be difficult and expensive to operate and maintain for the following reasons:

- No automatic screen cleaning system;
- Poorly retrievable system, even when raised, it will still be subject to corrosion, and poor access for inspection;
- No monitoring system;
- Poor access to the screen;
- Dissimilar metals on pipe and screen;
- Woven wire screen (stainless steel is good but not resistant to biofouling); and
- Appears to be structurally inadequate as described above.

To improve the design of this system, a significant redesign will be necessary without incurring a significant risk of failure. Some of the mentioned O&M issues are described below in more detail.

Figure 3-11. Removal of Butte Creek Farms screen (Yuba City Steel - 5 cfs) following structural collapse/failure (Note: Cleaning system problems, excessive debris buildup, and screen unit not designed for full head contributed to failure.)

Figure 3-12. Severe screen mesh clogging due to internal cleaning system failure on DWR's Horseshoe Bend fish screen (Note: Internal screen frame did not collapse/fail despite clogging.)

Figure 3-13. Collapsed screen (Lakos Plum-Creek Design) following failure of cleaning system and excessive debris (Note: Screen was not designed for easy removal and did not have monitoring features to turn off pumps.)

Debris management can be the most significant maintenance issue and pose the greatest risk factor to the system operation. A cumulative effect could occur during periods of maximum diversion due to poor sweeping flows through the area. Sweeping flows are important in shearing debris off the screens and carrying it away. If debris is not carried away, it must be removed from the system, not simply brushed aside only to be swept back on the screen. Clean screens are important to efficient diversion operations (reduces head losses) and to reduce fish injury (due to reduction in high velocity “hot spots” caused by poor flow uniformity). Clean screens and flow uniformity are both necessary criteria issues. DFG requires screens to be capable of being "continuously" cleaned at up to five minute intervals. It further stipulates that unless this requirement is met, screen area should be increased four-fold. Lifting screens out of the water for periodic cleaning will not satisfy this criterion.

As noted earlier, lifting screens out of the water when they are not in service may extend the service life of the screen unit and improve inspection. The use of a hinge in lieu of other methods however, still limits access unless access is provided via a walkway or boat. A hinge will also not remove the screen from its corrosive environment being just above the water. A barge-mounted crane is assumed to lift these screens and to lower them in the water. This operation will take the assistance of a boat crew and divers to raise each of the screen units for inspection and cleaning. Based on experience from DWR Operations personnel on Sherman Island screen maintenance, it may only be possible to inspect and clean four units per day. With one crew, it could take 16 days to complete inspections on just the new large screen units, or once every three weeks.

DWR experience on the Sherman Island screens and on Bacon Island has shown that hinged designs are problematic (Figure 3-14). If the screen is left in the open position (hinged up), the large cylinder screens will be subject to movement with the waves. This can cause fatigue and high stresses. Lateral support from a hinge design is also poor. The mass of the screen could cause excessive stresses on the pipe hinge and subject the system to additional damage.

Fatigue will also limit the service life of the screen and hinge if the screen is not completely removed from the water. Considerations could be given to manifolding two or more smaller screens together to reduce structural and foundation stresses.

Corrosion is another item frequently overlooked, but can drastically shorten the service life of screens in corrosive environments such as the Delta. The proposed DW design does not show any cathodic protection system such as anodes. The design does specify stainless steel, but only for some screen materials. The final design will need to consider the corrosion of the entire system, not just the screens. For instance, screen mesh laid over plain or even coated steel can be subject to corrosion due to galvanic action caused by dissimilar metals. Screen mesh has had to be replaced at both Horseshoe Bend (Figure 3-10) and at Pelgar-Mutual's fish screen due to this. Larger screen installations, including those at Roaring River in the Suisun Marsh, use expensive deep well anode systems to protect the metals. Coatings can also be effective if protected from potential surface nicks and abrasions.

Figure 3-14. Removal of Bacon Island fish screen (20 cfs total) due to hinge failure after two years of service (Note: This screen was raised by hand winch from shore when it was not in use. Screen design (Lakos Plum Creek) used phosphor-bronze (anti-fouling) woven wire mesh, and was cleaned with internal backwash system. Pipe shown is 16-inch diameter.)

Operation and Maintenance Costs

There is relatively little experience with the long term maintenance and operation costs of large screen systems using the proposed cylindrical screens. Costs that are incurred after construction are not always operations and maintenance costs but instead corrections for design deficiencies. The costs associated with the recent screen collapses at Butte Creek Farms for instance should be attributed to poor design, rather than to O&M. Similarly, DWR has experienced high maintenance costs on the Horseshoe Bend and other Sherman Island fish screens due to design changes and cleaning system failures.

Many larger screen systems in California are of the on-river vertical plate fish screen design. These screens which include RD108 (830 cfs), GCID (3000 cfs), Princeton Cordura-Glenn (600 cfs), Anderson Cottonwood Irrigation District (450 cfs), and RD1004 (240 cfs) have only recently been completed (since 1998). True maintenance costs for these installations have been minimal, and typically performed by District personnel who maintain the pump stations and perform routine dredging operations. These

Districts have not staffed up to maintain or operate the screens, although it is estimated that for these screens, between $40,000 and $150,000 may go towards screen related operations and maintenance.

Large cylindrical screen installations may be subject to more intense O&M however primarily due to access and screen removal issues. The proposed DW design will require the use of a fully equipped barge with crane and screen storage space. These screens will not be able to be lifted from shore. As estimated earlier, it could take three weeks to simply inspect and clean the screens even if they are used only once during this period. Assuming this is sufficient (and it is likely not), the crew could consist of two tug operators, a crane operator, two divers, and a deck hand for a total of 6 people. Working 270 days per year at say $5000/day (probably low), approximately $1.4 million will be needed just for cleaning and inspection. Routine maintenance should also include anode replacement, screen repairs.

Since the proposed DW design does not include sufficient provisions for screen cleaning, it is difficult to estimate cleaning costs when it is unlikely that this method of cleaning will be acceptable. The estimated annual O&M cost of $2.1 million by DW may not be sufficient to meet agency requirements just on cleaning.

3.1.4 Wildlife Resources

The island area of the Delta consists of approximately 600,000 acres on 60 islands. Agriculture lands are the predominant wildlife habitat in the Delta region. Approximately 72% of lands in the Delta are in agriculture. The remaining 28% is comprised of mostly open water, wetland, and riparian habitats. At least 230 species of birds and 43 species of mammals are found in the Delta (DFG 1987, cited in JSA 1995a). The region provides habitat of importance to shorebirds and waterfowl in particular. Thousands of shorebirds and waterfowl use fields flooded for weed control in late summer and fall and fields that flood shallowly from seepage and rainfall in winter (JSA 1995a).

3.1.4.1 Species in the Project Area

Wildlife information assembled for this section was obtained from several sources, including the DW 1995 DEIR/EIS, 2001 FEIS, 1995 Biological Assessments, and 2001 CESA Incidental Take Permit. JSA collected information on wildlife species occurrences and waste grain availability during surveys of the DW Project islands conducted in 1988. Distribution and acreage of wildlife habitats were determined from 1987 aerial photographs of the DW Project islands (see Chapter 3G of JSA 1995a). More current data about land use on the DW Project islands is presented in Section 3.1. Habitat groups and types, however, are not directly comparable with the land use categories. Therefore, the land use acreage values (Table 3.1 through 3.4) cannot be used to update the 1988 habitat acreage (Table 3-6).

General Birds

General bird species include fish-eating (piscivorous) birds, wading birds, shorebirds, gulls and terns, swallows, blackbirds and starlings, bird species typically associated with riparian woodland and scrub (riparian birds), and bird species typically associated with grassland and agricultural habitats. JSA conducted ground surveys to determine the occurrence and relative abundance of general wildlife species on DW Project islands during February-May 1988.

Webb Tract

Webb Tract was less intensively farmed than Bacon and Bouldin islands but supported more agriculture than Holland Tract in 1987. Nearly half the island was farmed for corn and wheat in 1987 (JSA 1995). Approximately 105 acres of open water habitat exists at two blowout ponds located in the northeast quarter of the island. Most of the 106 acres of riparian woodland and scrub and 172 acres of freshwater marsh on Webb Tract surround these ponds (see Table 3-12).

During ground surveys in 1988, JSA found more wading birds on Webb Tract, than on the other project islands. The average number of herons and egrets recorded per survey station on Webb Tract was more

than twice the number recorded on Bacon Island and four times the number recorded on Bouldin Island and Holland Tract. Most wading birds were found in the weedy marshland area on the north side of the island. No wading bird nesting colonies were found during aerial, ground, and boat surveys of all potential nesting habitats conducted during the nesting season.

More raptors were seen on Webb Tract than on the other islands; however, the number on Webb Tract was only slightly higher than the number on Holland Tract. The most common raptor species observed were white-tailed kites, *Elanus leucurus*, red-tailed hawks, *Buteo jamaicensis*, and American kestrels, *Falco sparverius*.

JSA observed moderate numbers of birds in riparian and wetland habitats on Webb Tract. However, the numbers recorded during surveys were low because access was not granted by landowners to a blowout pond that provides high quality wetland, riparian woodland, and open-water habitats on the eastern portion of the island. Furthermore, ground surveys were not conducted on Webb Tract in April or May 1988. Small numbers of other species were observed by JSA during 1988 surveys, including piscivorous birds, shorebirds, gulls, terns, and blackbirds.

Bouldin Island

Agricultural lands that support corn, wheat, and sunflower dominated wildlife habitats on Bouldin Island in 1987. Smaller amounts of other habitats existed, including fallow agricultural land and herbaceous upland.

During field surveys, JSA observed low to moderate numbers of most bird species on Bouldin Island. A large number of gulls were observed; no terns were seen, and no breeding habitat for gulls was found on the island. A large number of grassland and agricultural birds, primarily blackbirds and American crows, *Corvus brachyrhynchos*, were observed. A moderate number of wintering raptors were observed on Bouldin Island. The number of raptors decreased in spring. Red-tailed hawks were the only non-special-status raptor species observed during May, but the species did not nest on the island. A moderate number of swallows, primarily cliff swallows, *Petrochelidon pyrrhonota*, were observed using Bouldin Island.

JSA observed a small numbers of wading birds, shorebirds, and riparian and marsh birds. No herons or egrets nested on the island. Killdeer, *Charadrius vociferus*, were the only shorebirds observed. The most common birds observed in riparian habitats were white-crowned sparrow, *Zonotrichia leucophrys*, house finch, *Carpodacus mexicanus*, song sparrow, *Melospiza melodia*, American robin, *Turdus migratorius*, and black phoebe, *Sayornis nigricans*.

Holland Tract

Holland Tract was the least intensively farmed of the four DW Project islands in 1987. Agriculture accounted for approximately 31% (974 acres) of the island acreage in 1987. Holland Tract supported about 225 acres of herbaceous wetland, most of which is dominated by weedy species that invade fallow agricultural areas. In total, the island supported more woody riparian vegetation (105 acres) than Bouldin Tract and Bacon Island and about the same as Webb Tract, most of that was associated with a blowout pond located at the northeast end of the island. In 1987, DW constructed a shallow 63-acre demonstration wetland pond to evaluate vegetation establishment and growth under proposed operating conditions that would be present under the DW Project. It is unknown if this pond is currently being managed or is functioning as a wetland habitat.

JSA observed higher numbers of shorebirds, raptors, riparian and marsh birds, and blackbirds and starlings on Holland Tract relative to the other project islands. The most common raptors included white-tailed kite and red-tailed hawk. Raptors were most common in winter and declined to small numbers in April and May. A red-tailed hawk nest was found, and kites were suspected to have nested on the island.

JSA (1995) reported that shorebirds used the Holland Tract demonstration wetland, including an average of 60 sandpipers and 14 dowitchers observed per survey; no nesting by shorebirds were observed. The most common riparian birds included house finch, American robin, song sparrow, and white-crowned sparrow. Large numbers of yellow-headed blackbirds, *Xanthocephalus xanthocephalus*, and red-winged blackbirds, *Agelaius phoeniceus*, were observed during winter; blackbird numbers declined during spring, but red-winged blackbirds remained and nested in weedy and marsh areas. JSA observed moderate numbers of gulls, grassland birds, and swallows used Holland Tract during winter. Wading birds were less abundant on Holland Tract than on other project islands.

Bacon Island

Bacon Island was the most intensively farmed of the four DW project islands in 1987. In 1987, most of the island was farmed for potatoes and asparagus. The island supported a moderate diversity and density of wildlife species compared with the other project islands. JSA observed low- to moderate-sized populations of most general wildlife species on Bacon Island. The number of gulls observed during ground surveys was higher than on other project islands. Gulls congregated in areas flooded for weed control in winter and spring. JSA observed moderate numbers of raptors, shorebirds (primarily sandpipers), and wading birds during ground surveys in 1988. No great egrets, *Ardea alba*, snowy egrets, *Egretta thula*, or great blue herons, *Ardea herodias*, nest on Bacon Island and no potential nesting habitat exist. Few piscivorous birds or birds associated with riparian habitats, open water, or grasslands were observed on the island.

Waterfowl

The Delta supports nearly 10% of the waterfowl that winter in the Pacific Flyway. The Delta provides important waterfowl habitat on flooded and unflooded agricultural lands, natural wetlands, and sloughs. Duck clubs in the Delta flood approximately 12,000 acres of agricultural lands (USFWS 1978, cited in JSA 1995a). There are 25 species of waterfowl (1 swan, 4 goose and 20 duck species) that winter in the Delta. Mid to late winter is when most waterfowl use the Delta. The Delta is considered the single most important wintering area in the Pacific Flyway for tundra swans, *Cygnus columbianus*. The number of swans wintering in the Delta is estimated to range from 30–38,000 annually. This suggests that 32%-40% of the Pacific Flyway population winters in the Delta (DU 1994). More than one-third of all greater white-fronted geese, *Anser albifrons*, between 22-45,000, in the Central Valley winter in the Delta. The Delta also supports large populations of snow geese, *Chen caerulescens*, northern pintails, *Anas acuta*, and mallards, *Anas platyrhynchos*, (DU 1994).

Webb Tract

JSA conducted wildlife surveys and determined that Webb Tract supported high numbers of waterfowl use-days. In 1988 total waterfowl use observed on Webb Tract was 10 times higher than on any of the other islands. Of the four project islands, Webb Tract had the largest corn acreage in 987 and supported the largest number of swans during the midwinter survey period. Swans on Webb Tract used unflooded cornfields and flooded fields.

JSA observed the largest number of geese during aerial surveys of Webb Tract. Three-fourths of the white-fronted geese observed were resting on the eastern blowout pond; the remaining birds were seen in undisked cornfields. The snow goose population averaged 4,700 during December through March, with a peak of 10,000 birds in mid-January. Snow geese were usually seen resting on the eastern blowout pond but were also observed in undisked and flooded cornfields. Several groups of Canada geese, *Branta canadensis*, were seen; the largest group consisted of approximately 650 birds in an undisked cornfield. The survey data indicated that the eastern blowout pond on Webb Tract was an important resting area for geese in the Delta.

The number of ducks observed on Webb Tract was also high but varied substantially over the survey period. Both mallards and pintails were seen regularly. The largest populations, consisting of 20,000 ducks (both pintails and mallards), were found resting on the eastern blowout pond in mid-December.

Nearly all ducks on Webb Tract observed during winter were found resting on the eastern blowout pond. Twenty-seven mallards seen during each of the two May surveys were assumed to be breeding birds; their presence indicated the existence of a moderate sized breeding population (perhaps 20-50 pairs). JSA observed ten mallards (some of which may have been young-of-the-year) on the eastern blowout pond during a survey conducted in June.

Webb Tract produced a large amount of waste corn available for waterfowl and other wildlife, representing more than half the waste corn provided on the DW Project islands. Wheat also provided seed following harvest in summer and green forage for geese and other wintering birds during late fall and winter. Harvest rates of ducks and geese were highest on Webb Tract among the Project islands.

Bouldin Island

JSA estimated waterfowl use-days were moderate on Bouldin Island. Swan use on Bouldin Island was moderate compared with swan use of other islands; most swans were seen during the surveys in flooded grainfields, with fewer numbers in undisked grainfields. The number of geese using Bouldin Island was low to moderate, and daily populations varied substantially over winter. JSA observed a moderate number of white-fronted geese during aerial surveys; the highest count was 1,100 birds in early January 1988. Most white-fronted geese were observed in flooded, disked grainfields and undisked grain stubble. The few snow geese observed on Bouldin Island by JSA used disked cornfields. Canada geese were seen in small numbers in disked and undisked fields, and several flocks were seen in grazed fallow fields during ground surveys. Canada geese may have been slightly undercounted by JSA during aerial surveys because they were not easily distinguishable among larger groups of greater white-fronted geese, and snow geese. The number of ducks observed during surveys declined substantially in early January. Pintails are the most abundant species using the island. During surveys, mallards were observed in ditches and flooded fields. Only four mallards were seen in May, indicating a very small breeding population. There was a moderate amount waste corn and wheat available for waterfowl use on Bouldin Island. Hunters on Bouldin Island harvested small numbers of ducks and geese annually.

Holland Tract

The estimated total of waterfowl use-days on Holland Tract was low. JSA observed few tundra swans on Holland Tract during surveys. Nearly all birds were detected in flooded fields. Few geese were observed by JSA using Holland Tract. Few or no white-fronted geese were seen during November to March, but numbers increased during April. Snow geese were not recorded on Holland Tract during aerial surveys, but 2,000 birds were seen feeding in an unharvested cornfield near the blowout pond during a ground survey in early February. Several small flocks of Canada geese were seen during December and January; however, nearly all Canada geese recorded during Holland Tract surveys were flying and may not have landed on the island. Holland Tract supported moderate numbers of ducks. Most ducks were found during surveys in the Holland Tract demonstration wetland and the blowout pond, and the rest were observed in flooded fields. Species seen at the demonstration wetland by JSA included American wigeon, *Anas americana*, mallard, northern pintail, cinnamon teal, *Anas cyanoptera*, ruddy duck, *Oxyura jamaicensis*, and northern shoveler, *Anas clypeata* (JSA 1995a). A moderate amount of waste corn and wheat was available for waterfowl forage. Hunters on Holland Tract harvested few ducks and geese annually.

Bacon Island

The estimated total of waterfowl use-days was moderate for Bacon Island. Tundra swans, were observed using Bacon Island more than any other island except Webb Tract during the survey period. JSA observed an average of 300 tundra swans on Bacon Island. Nearly 90% of the swans were in cornfields that were flooded for weed control. The flooded cornfields made up less than one-third of the island's area.

Geese had a moderate number of use-days on Bacon Island. White-fronted geese arrived in substantial numbers in mid-December to late December and used flooded and unflooded agricultural fields. Snow

goose populations varied widely. All snow geese observed on Bacon Island used unflooded, undisked agricultural fields. No Canada geese were observed on Bacon Island.

JSA observed few ducks on Bacon Island. Flocks of pintails were seen twice in flooded potato fields, and mallards were seen in flooded fields and ditches. Only 10 mallards were seen during May surveys, indicating that few birds reproduced on the island. A moderate amount of waste corn and potatoes were available on Bacon Island for waterfowl forage. No waterfowl or upland game species were harvested on Bacon Island (JSA 1995a).

Upland Game species

Upland game species occurring on the Project islands included ring-necked pheasant, *Phasianus colchicus*, mourning dove, *Zenaida macroura*, and California quail, *Callipepla gambelii*.

Webb Tract

Webb Tract surveys recorded the highest number of mourning doves among the four islands, a moderate number of pheasants, and no quail. The high number of doves reflects the abundance of woodland perching sites and availability of grain in wheat fields. Among the four project islands, the harvest of pheasants was highest on Webb Tract.

Bouldin Island

Bouldin Island supports moderate numbers of ring-necked pheasants and mourning doves; no quail were seen on the island during surveys. Pheasant numbers were limited by the lack of cover on most parts of the island. Hunters on Bouldin Island harvested small numbers of pheasants annually.

Holland Tract

In 1988, pheasants and quail were more abundant on Holland Tract than on the other three DW project islands. The higher populations reflect the greater amounts of cover provided for pheasants by fallow areas and for quail by riparian shrubs and trees. Mourning dove populations were also high, presumably because of the abundance of perching sites in trees. Hunters on Holland Tract harvested few pheasants, doves, and quail annually.

Bacon Island

Low numbers of ring-necked pheasant, California quail, and mourning dove were observed on Bacon Island. In 1987, the island was intensively farmed and cover habitat was scarce; the number of pheasants observed on Bacon Island was lower than on the other DW project islands. No upland game species were harvested on Bacon Island.

Special-Status bird species

The 1995 DW DEIR/EIS (see table H2-2 in the DEIR/EIS) reported that 12 special-status bird species occur or potentially occur on the DW project islands (table H2-2 did not include species that were only listed as "fully protected' by the state). Since 1995 some species status has changed, Table 3-11 shows a list of the current special-status bird species that occur or could occur on DW Project islands. Special-status bird species includes species that are on the following lists:

- State or federally listed as threatened or endangered,
- Proposed or candidates for federal listing,
- Species of concern by the Sacramento Office of the USFWS,
- Delisted species (species monitoring is required for 5 years), and
- DFG species of special concern and species fully protected under the California Fish and Game Code.

Webb Tract

Surveys conducted in 1988 resulted in the Northern harrier, *Circus cyaneus*, being the only confirmed special status-species observed on Webb Tract. Webb Tract also supports potential habitat for 12 additional special-status species, including greater sandhill crane (*Grus canadensis tabida),* Swainson's hawk (*Buteo swainsoni)*, peregrine falcon (*Falco peregrinus)*, and tricolored blackbird (*Agelaius tricolor).*

Table 3-11. Special status bird species that occur or could occur on the In-Delta Storage Project islands

Common Name	Scientific name	Federal Status	State Status
Aleutian Canada goose	*Branta canadensis leucopareia*	Delisted (3/20/01)	Recovered
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Endangered/FP
Swainson's Hawk	*Buteo swainsoni*	None	Threatened
American Peregrine Falcon	*Falco peregrinus anatum*	Delisted	Endangered/FP
California Black Rail	*Laterallus jamaicensis coturniculus*	Species of Concern	Threatened/FP
Greater Sandhill Crane	*Grus canadensis tabida*	None	Threatened
Cooper's Hawk	*Accipiter cooperii*	None	Special Concern
Ferruginous Hawk	*Buteo regalis*	Species of Concern	Special Concern
Northern Harrier	*Circus cyaneus*	None	Special Concern
Burrowing Owl	*Athene cunicularia*	Species of Concern	Special Concern
Short-eared Owl	*Asio flammeus*	Species of Concern	Special Concern
Tricolored Blackbird	*Agelaius tricolor*	Species of Concern	Special Concern

Greater Sandhill Crane. (state threatened species, state fully protected) JSA biologists observed one sandhill crane (subspecies not identified) during a 1987 aerial survey of Webb Tract. However, Webb Tract provides suitable foraging habitat, including grainfields, fallow fields, pastures, exotic marshes, and herbaceous uplands. DFG has designated Webb Tract as a greater sandhill crane wintering area based on additional sightings. DWR staff observed over 200 greater and lesser sandhill cranes, *Grus canadensis canadensis*, while driving through Webb Tract in early October 2001.

Swainson's Hawk. (state threatened species) Webb Tract provides low- to moderate-quality Swainson's hawk foraging habitat. The nearest known nest site is located within 4 miles, and seven pairs nest within 10 miles of the island in 1990 (JSA 1995a). Thus, several pairs could forage on Webb Tract. JSA did not observe any Swainson's hawks during 13 hours of surveys on 4 days from late May to early August in 1988-1990. Suitable nesting trees may currently exist around the blowout ponds. Willow trees are now about 30-40 feet in height.

Northern Harrier. (DFG species of special concern) Webb Tract supports a high number of harriers in winter, with an average of 14 birds seen per survey in February 1988 by JSA. Harriers could nest in densely vegetated wetlands or fallow fields on the island.

California Black Rail. (state threatened species, state fully protected species) JSA biologists did not detect any California black rails, during surveys of the northern blowout pond, which is considered marginal habitat. Surveys were not conducted on the eastern blowout pond for black rails. Suitable California black rail habitat exists on the in-channels islands adjacent to Webb tract. However, surveys were not conducted on the in-channel islands for the preparation the Draft or Final DW EIR/EIS. Sonoma State University conducted wildlife surveys on three in-channel islands adjacent to Webb Tract, during late May to early June 1997. Visual surveys were conducted to inventory the species present on the in-channel islands. However, specific surveys for the California black rail were not conducted and none were observed during the visual surveys (Kjeldsen and others 1997).

Tricolored Blackbird. (DFG species of special concern, federal species of concern) Webb Tract provides suitable foraging and nesting habitat for the tricolored blackbird. No birds were observed during surveys conducted for the DW Draft EIR/EIS. This included during the breeding and non-breeding seasons. Pasturelands, grasslands, fallow habitats, and harvested crops provide seasonal foraging habitats for the tricolored blackbird. The 1995 DW draft EIR/EIS reported that the nearest nesting colony is 13 miles from Webb Tract. Therefore, the potential for nesting is not considered likely. It is more likely to find foraging tricolored blackbirds during the winter on Webb Tract when the birds forage widely.

Western burrowing owl. (DFG species of special concern, federal species of concern) No western burrowing owls, *Athene cunicularia hypugaea,* were observed during ground surveys for the DW DEIR/EIS. The DW EIR/EIS states that burrowing owls probably do not nest on Webb Tract because intensive agricultural and levee maintenance activities eliminated suitable burrows and ground squirrels that provide burrows.

Wintering Species. Webb tract supports marginal habitat for the following non-breeding special–status bird species: bald eagle, *Halialaeetus leucocephalus*, American peregrine falcon, ferruginous hawk, *Buteo regalis*, Cooper's hawk, *Accipiter cooperii*, and short-eared owl, *Asio flammeus* .

Bouldin Island

Greater sandhill crane, Swainson's hawk, and northern harrier were the only special-status species observed on Bouldin Island during surveys in 1987-1988 for the DW DEIR/EIS. Since surveys were conducted, JSA biologists observed other special-status species; these species included: peregrine falcon, Cooper's hawk, ferruginous hawk, and short-eared owl. Bouldin Island also supports potential habitat for five additional special-status species, including tricolored blackbird.

Greater Sandhill Crane. JSA observed sandhill cranes regularly during surveys conducted in October-February (1987-1988), but numbers subsequently declined rapidly and none were seen after early March. All the cranes seen during one October survey were lesser sandhill cranes, but 95% of the birds identified to subspecies in February-March were greater sandhill cranes. Based on additional observations, JSA (1995a) reported that Bouldin Island supports an estimated 0.8% - 5.0% of the monthly crane population in the Delta during November to January. DFG has designated Bouldin Island as a greater sandhill crane wintering area. DWR staff observed over 200 sandhill cranes in flooded fields on Bouldin Island in early October 2001 while driving on the levee road.

Swainson's Hawk. JSA biologists observed Swainson's hawks foraging on Bouldin Island during the breeding season and winter. One was observed flying over the island during surveys conducted in May 1988. Suitable foraging habitat on Bouldin includes, pasture, fallow fields, and agricultural fields. Vegetation in some fallow areas may be too tall and dense to be used for foraging by Swainson's hawks. The nearest known Swainson's hawk nest site is approximately 3 miles north of Bouldin Island, and 10 pairs of hawks nest within 10 miles of the island in 1990 (JSA 1995a). Foraging habitat on Bouldin Island is considered low to moderate; thus, several pairs could forage on Bouldin Island. Bouldin Island now supports a traditional winter roosting site for Swainson's hawks (see text within Section 5.1.4.3.).

Northern Harrier. JSA (1995a) reported that Bouldin Island supported moderate numbers of harriers during winter and early spring; they did not observe any birds during May 1988 surveys. Harriers were not known to nest on Bouldin Island. Potential nesting habitat on the island was limited to wheat fields and dense vegetation along the levee toe because of intensive cultivation and sheep grazing on the fallow lands and levee slopes.

California Black Rail. No suitable California black rail habitat, which consists of dense marsh, exists on Bouldin Island. However, suitable California black rail habitat exists on the in-channel islands adjacent to Bouldin Island. The in-channel islands were not surveyed for black rail in the preparation of the DW Draft or Final EIR/EIS.

Tricolored Blackbird. Bouldin Island does not support suitable nesting habitat for tricolored blackbirds, but pastures and croplands are suitable foraging habitat for breeding and wintering birds. No birds were observed during surveys conducted for the DW DEIR/EIS. This included during the breeding and non-breeding seasons. Pasturelands, grasslands, fallow habitats, and harvested crops provide seasonal foraging habitats for the tricolored blackbird. The 1995 DW DEIR/EIS reported that the nearest nesting colony was 17 miles from Bouldin Island. Therefore, the potential for nesting is not considered likely. It is more likely to find foraging tricolored blackbirds during the winter on Bouldin Island when the birds forage widely.

Western Burrowing Owl. No western burrowing owls were observed during ground surveys for the DW Draft EIR/EIS on Bouldin Island.

Wintering Species. JSA determined that Bouldin Island supports habitat for the following non-breeding special–status bird species: bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, and short-eared owl. This determination was based on species observed on Bouldin Island.

Holland Tract

JSA observed Swainson's hawk and northern harrier on Holland Tract. Also, potential habitat for additional special-status species, including, tricolored blackbird, and short-eared owl occurs on Holland Tract.

Greater Sandhill Crane. No greater sandhill cranes were observed on Holland Tract during JSA surveys; however, DFG subsequently reported an isolated observation of a greater sandhill crane on the island. JSA (1995a) indicated that Holland Tract provides suitable crane foraging habitat; however, because it is located approximately 7 miles from the nearest important wintering area, the island is not expected to support regular use by greater sandhill cranes.

Swainson's Hawk. JSA observed one adult Swainson's hawk during surveys of Holland Tract. Suitable nesting habitat on the island exists in trees over 25 years old, but no nests were found. Fallow areas, pasture, grassland, and agricultural fields are suitable for foraging use by Swainson's hawks. The nearest known nest site is approximately 3 miles east of the island. Seven pairs nested within 10 miles of the island in 1990, although only two pairs have been located nesting within 9 miles. Thus, although several pairs have nested within foraging distance of Holland Tract, it is probably less likely to be used than the other DW Project islands (JSA 1995a).

Northern Harrier. JSA observed four northern harriers throughout the survey period. Suitable nesting habitat existed in dense wetlands or in fallow fields on the island.

California Black Rail. Holland Tract supports breeding habitat for the California black rail. Surveys by JSA biologists did not find any black rails at the northern blowout pond location. The CNDDB reports that four California black rails were observed on an in-channel island located on the eastside of Holland Tract in 1992 (DFG 2001b).

Tricolored Blackbird. Holland Tract provides suitable foraging and nesting habitat for tricolored blackbirds. JSA biologist did not observe foraging or nesting tricolored blackbirds. Pasturelands, grasslands, fallow habitat, and harvested crops provide suitable foraging habitats for the tricolored blackbird during various seasons. The 1995 DW DEIR/EIS reported that the nearest known colony is over 8 miles west of Holland Tract.

Western Burrowing Owl. No western burrowing owls were observed during ground surveys for the DW DEIR/EIS on Holland Tract. Holland Tract supports marginal winter habitat for the western burrowing owl.

Wintering Species. In 1988 JSA determined that Holland Tract supported habitat for the following non-breeding special–status bird species: bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, and short-eared owls.

Bacon Island

Northern harrier and burrowing owl were the only special-status species observed on Bacon Island during the surveys conducted in 1987-1988. JSA (1995a) determined that potential habitat for other special status species, including Swainson's hawk and tricolored blackbird, existed on Bacon Island. JSA did not observe any greater sandhill cranes during surveys.

Greater Sandhill Crane. Most crops on Bacon Island in 1987 did not provide suitable foraging habitat for greater sandhill cranes. Cranes have not traditionally used Bacon Island, and none were observed during surveys of the island in 1987 and 1988. The 1995 DW DEIR/EIS indicated that DFG has reported an isolated observation of a greater sandhill crane on Bacon Island.

Swainson's Hawk. JSA determined that low- to moderate-quality foraging habitat for Swainson's hawks existed on Bacon Island in 1987. The nearest known Swainson's hawk nest site is located immediately to the east on Mildred Island, and seven pairs nest within 10 miles of the island in 1990. Although no Swainson's hawks were observed during surveys, Swainson's hawks have nested within foraging distance and could use the island. Fallow land, pasture, grassland area, and areas of grain and row crops, are suitable foraging habitats for Swainson's hawks. The DW DEIR/EIS reported that Bacon Island does not support suitable nesting habitat.

Northern Harrier. A small number of northern harriers were observed on Bacon Island. Harriers are not known to nest on Bacon Island because nearly all the island is cultivated and suitable nesting sites are limited.

California Black Rail. No emergent wetland or dense blackberry habitat suitable for nesting exists for the California black rail on Bacon Island. The DW Draft EIR/EIS reported that several rails were heard calling in dense emergent vegetation under the Bacon Island Bridge on an in-channel island on Middle River in May 1988. The CNDDB reported a sighting in the same location in April 1988. Also, the CNDDB reported that California black rails were observed on in-channel Islands in Old River, between Palm Tract and Bacon Island in May 1992 (DFG 2001b).

Tricolored Blackbirds. JSA did not observe any tricolored blackbirds or suitable nesting habitat during winter and spring surveys on Bacon Island in 1987-1988. Pasture, grassland, and grain crop habitats are suitable for foraging use by tricolored blackbirds at various seasons. The nearest known breeding colony to Bacon Island was over 8 miles away (JSA 1995a).

Western Burrowing Owl. JSA biologist observed one burrowing owl during surveys. It is unlikely that burrowing owls nest on Bacon Island because intensive agriculture and levee maintenance activities have minimized the availability of suitable burrows and the presence of ground squirrels that construct burrows.

Wintering Species. Bacon Island supported habitat for the following non-breeding special–status bird species in 1987: bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, and short-eared owl*s* (JSA 1995a). JSA did not observe these species during field surveys in 1987-1988.

Mammals

General species

The Project islands provide suitable habitat for numerous mammal species including marsupials, insectivores, rodents, rabbits, bats, and carnivores. Habitats on the DW islands support a moderate to low abundance of California voles, which are an important prey item for predators. Vegetated levees, riparian areas and the undeveloped portions of the islands within the project area provide important habitat for mammalian species. Some of the species observed or potentially occurring on the DW Project islands include: Virginia opossum, *Didelphis virginiana*, broad-footed mole, *Scapanus latimanus*, California vole, *Microtus californicus*, Botta's pocket gopher, *Thomomys bottae*, muskrat, *Ondatra*

zibethicus, beaver, *Castor canadensis*, Audubon's cottontail, *Sylvilagus audubonii*, Yuma myotis, *Myotis yumanensis*, California myotis, *Myotis californicus*, western pipistrelle, *Pispistrellus hesperus*, big brown bat, *Eptesicus fuscus*, hoary bat, *Lasiurus cinereus*, Mexican free-tailed bat, *Tadarida brasiliensis mexicana*, western red bat, *Lasiurus blossevillii*, mink, *Mustela vison*, river otter, *Lutra canadensis*, raccoon, *Procyon lotor*, gray fox, *Urocyon cinereoargenteus*, and skunks, *Mephitis mephitis*. A list of additional species observed or potentially occurring on the Delta Wetland project islands is located in the 1995 DW DEIR/EIS in Table H2-4 (JSA 1995a).

The western red bat was designated a high priority species by the Western Bat Working Group in 1998. The species is considered imperiled or at high risk of imperilment (WBWG 1998). The Western red bat is distributed statewide. The winter range includes western lowlands and coastal regions south of San Francisco Bay. Migration occurs between summer and winter ranges, and migrants may be found outside the normal range. Roosting habitat includes forests and woodlands from sea level up through mixed conifer forests. Roosting habitat on the DW Project islands is limited to areas with large trees with large leaves, such as cottonwoods. The red bat feeds over a wide variety of habitats including grasslands, shrublands, open woodlands and forests, and croplands. The red bat feeds on a variety of insects. The most important prey items are moths, crickets, beetles, and cicadas (Harris 1990a). Surveys for the western red bat were not conducted for the 1995 DEIR/EIS.

Special-Status species

Special-status mammalian species include those species listed as a species of concern by USFWS, and species listed as a species of special concern by the DFG.

Townsend's Big-eared Bat. (state species of special concern, and federal species of concern) Townsend's big-eared bat; *Corynorhinus townsendii,* is found throughout California. The specific details of the Townsend's big-eared bat distribution are not well documented. This species is found in most habitats at any season throughout its range in the state. Once considered common, Townsend's big-eared bat now is considered uncommon in California. It is most abundant in mesic habitats. Townsend's big-eared bats feed primarily on small moths, beetles and a variety of soft-bodied insects are also taken at night. It requires caves, mines, tunnels, buildings, or other human-made structures for roosting. It may use separate sites for night, day, hibernation, or maternity roosts. Roosting sites are the most important limiting resource. This species is extremely sensitive to disturbance of roosting sites. A single visit has resulted in abandonment of the roost (Harris 1990b). Specific surveys for the Townsend's big-eared bat were not conducted on the DW Project Islands and no species were observed during the diurnal surveys conducted by JSA biologists.

Pallid Bat. (state species of special concern) The pallid bat, *Antrozous pallidus*, is a locally common species at low elevations in California. It occurs throughout most of California. The pallid bat uses a wide variety of habitats, including grasslands, shrublands, woodlands, and forests. The species is most common in open, dry habitats with rocky areas for roosting. Pallid bats are yearlong residents in most of their range. They feed on a wide variety of insects and arachnids, including beetles, orthopterans, homopterans, moths, spiders, scorpions, solpugids, and Jerusalem crickets during the night. Pallid bat day roosts consist of caves, crevices, mines, and will occasionally roost in hollow trees and buildings. It is important that roosts protect bats from high temperatures. Night roosts may be located in more open sites, such as porches and open buildings (Harris 1990c). JSA biologists did not conduct surveys for pallid bats on the DW Project islands and no species were observed during the diurnal wildlife surveys.

Reptiles and Amphibians

General Species

The DW Project islands provide habitats for common reptiles and amphibians. This includes the western toad, *Bufo Boreas*, Pacific treefrog, *Pseudacris regilla*, bullfrog*, Rana catesbeiana*, western fence lizard, *Sceloporus occidentalis*, southern alligator lizard, *Gerrhonotus multicarinatus*, racer, *Coluber constrictor*, gopher snake, *Pituophis melaneoleucs*, and common garter snake, *Thamnophis sirtalis*.

Special-Status species

Special-status species are federal or state listed or proposed for listing as Threatened or Endangered, federal or state candidate species, federal species of concern or DFG species of special concern.

Giant Garter Snake. (federal and state threatened species, state protected species) Giant garter snake, *Thamnophis gigas,* habitats on the DW Project islands are considered poor to marginal quality. These habitats are fragmented and isolated from known populations of giant garter snakes. There is lack of suitable or low quality overwintering sites (e.g. levee slopes). The suitable foraging habitat and cover are scarce, particularly on Bouldin and Bacon islands. The DW Project islands are abundant with aquatic and terrestrial predators, such as, great egrets, great blue herons, and black-crowned night-herons (JSA 1995a).

Bacon Island contains approximately 5 miles of ditches that are considered marginal habitat for the giant garter snake because emergent or bank vegetation is lacking. According to the CNDDB records, the giant garter snake was recorded in one location approximately 1.75 miles northeast of Bacon Island in 1996 (DFG 2001b). Bouldin Island contains 7 miles of ditches and canals that are marginal habitat for the giant garter snake. Holland Tract supports approximately 2 miles of moderately suitable habitat and 4 miles of marginal habitat along ditches and canals. Webb Tract supports approximately 3 miles of moderately suitable giant garter snake habitat and less than 1 mile of marginal habitat along ditches and canals. No snakes were observed during surveys in the northern blowout pond, which is considered moderately suitable habitat. JSA did not conduct surveys in the area of the eastern blowout pond. DWR biologists found one giant garter snake on Webb Tract during reconnaissance surveys in 2002.

Western Pond Turtle. (federal species of concern, state species of special concern, and state protected species) The western pond turtle, *Clemmys marmorata,* is a known inhabitant of the project area. JSA (1995a) reported that there was no potential habitat on the interior of Bouldin and Bacon islands. However, the CNDDB reported several sightings of the western pond turtle on the surrounding in-channel islands off Bouldin and Bacon islands (DFG 2001b). The blowout ponds provide potential breeding habitat on Webb Tract. JSA biologists did not observe any pond turtles during surveys on Webb Tract. Pond turtle upland nesting and estivation habitat is limited on Webb Tract. Holland Tract supports potential breeding habitats for western pond turtle at the blowout pond. JSA (1995a) reported that western pond turtles have been observed in the Holland Tract blowout pond. JSA did not observe any pond turtles during surveys conducted for the Draft EIR/EIS. There was no western pond turtle habitat on the interior of Bouldin Island. The CNDDB contains three reports of western pond turtles on the in-channel islands surrounding Bouldin Island (DFG 2001b). JSA did not conduct surveys on the in-channel islands for the DW Draft or Final EIR/EIS.

Other Sensitive Species

Valley Elderberry Longhorn Beetle. (federal threatened species) Habitat for valley elderberry longhorn beetles (VELB), *Desmocerus californicus dimorphus*, is limited to one large cluster of elderberry shrubs located on the eastern levee of Holland Tract along Old River. No VELB exit holes or adult beetles were detected in the shrubs. The elderberry shrubs lack overstory and understory vegetation. The cluster is also isolated form other elderberry shrubs. Therefore, VELB probably do not occur on Holland Tract. No other elderberry shrubs were found on project islands. The 1995 DW Draft EIR/EIS reports that the

nearest known VELB population is located along Middle River approximately 17 miles south of Bacon Island.

3.1.4.2 Habitats in the Project Area

The wildlife habitats on the DW Project islands were based on 1987 conditions (JSA 1995a). The habitat types by acres and percent of each project island are listed Table 3-12 (JSA 1995a). Wildlife groups that use the specific habitat types are shown by breeding and foraging habitats in Table 3-13.

Table 3-12. Habitats on the Delta Wetlands Project islands in 1987

	Bacon Island		Webb Tract		Bouldin Island		Holland Tract		All
Habitat	(acres)	Percent of total (acres)	(acres)	Percent of total (acres)	(acres)	Percent of total (acres)	(acres)	Percent of total (acres)	(acres)
Riparian	3	0.06	106	1.93	17	0.27	105	3.35	231
Freshwater marsh	3	0.05	172	3.14	21	0.35	28	0.89	224
Exotic Marsh	30	0.55	783	14.32	115	1.92	196	6.23	455
Ponds	1	0.03	106	1.93	0	0.00	17	0.53	124
Mudflats	1	0.02	0	0	9	0.16	0	0.00	10
Canals/ ditches	92	1.66	50	0.91	118	1.97	39	1.26	134
Woody non-native	0	0.00	0	0	5	0.09	4	0.14	9
Herbaceous upland	528	9.54	839	15.33	349	5.83	633	20.16	2,349
Annual Grain crops	3091	55.81	2695	49.27	4530	75.69	614	19.59	2,358
Perennial crops	1348	24.33	0	0	0	0.00	423	13.49	1,771
Pasture	0	0.00	61	1.12	34	0.57	350	11.16	445
Fallow	355	6.41	638	11.66	712	11.89	689	21.98	2,216
Developed	86	1.55	20	0.37	75	1.25	37	1.20	218
Total	5,539	100	5,469	100	5,985	100	3,135	100	20,128

Table 3-13. Existing habitat by wildlife species groups on the Delta Wetlands Project islands

Species Group	Representative Species	Foraging Habitats	Breeding Habitats
Raptors	red-tailed hawk American kestrel great horned owl	riparian, herbaceous upland, annual grain crops, pasture, fallow	riparian, woody non-native
Upland Birds	ring-necked pheasant western meadowlark	annual grain crops-unflooded, exotic marsh, herbaceous upland, perennial crops, pasture, fallow	annual grain crops-unflooded, exotic marsh, herbaceous upland, perennial crops, pasture, fallow
Small Mammals	California vole deer mouse	annual grain crops, herbaceous upland, perennial crops, pasture, fallow, riparian, developed	annual grain crops, herbaceous upland, perennial crops, pasture, fallow, riparian, developed
Carnivores	Raccoon striped skunk	annual grain crops, herbaceous upland, perennial crops, pasture, fallow, riparian, freshwater marsh, exotic marsh, pond, woody non-native, canals, developed	riparian, woody non-native, developed
Migrating/ wintering Shorebirds	western sandpiper dowitcher long-billed curlew dunlin	annual grain crops-flooded, pasture-flooded, fallow-flooded, freshwater marsh, exotic marsh, mudflats, pond	Not applicable
Breeding Shorebirds	American avocet black-necked stilt	annual grain crops-flooded, pasture-flooded, fallow-flooded, freshwater marsh, exotic marsh, mudflats, pond	freshwater marsh exotic marsh
Cavity-nesting Birds	Nuttall's woodpecker House wren	riparian	riparian
Wading Birds	Great blue heron Great egret Black-crowned Night-heron	annual grain crops, herbaceous upland, pasture, fallow, riparian, freshwater marsh, exotic marsh, pond	riparian, freshwater marsh, exotic marsh
Songbirds	White-crowned sparrow Yellow warbler Yellow-rumped warbler savannah sparrow Plain titmouse Bushtit	riparian, freshwater marsh, exotic marsh, ponds, herbaceous upland, pasture, fallow	riparian, freshwater marsh, exotic marsh ponds, pasture, fallow
Wetland Songbirds	Marsh wren Red-winged blackbird Yellow-headed blackbird	freshwater marsh, exotic marsh, ponds, pasture, herbaceous upland, fallow, canals	freshwater marsh, exotic marsh, ponds, canals

3.1.4.3 Resource Issues and Impacts

DW Properties acquired the appropriate water right permits and proposes to inundate Webb Tract and Bacon Island with up to 20 feet of water. The water would be stored and delivered to improve the operational flexibility of the SWP and the CVP. The storage of water on these two islands would directly eliminate approximately 11,000 acres of agriculture and various wildlife habitats on two reservoir islands in the Sacramento-San Joaquin River Delta. The proposed action could affect over 180 species of birds,

30 species of mammals and 10 species of reptiles and amphibians; several of which are sensitive species under CESA and ESA.

DW is required to mitigate for the impacts to terrestrial species and habitats on the reservoir islands by developing and protecting habitat on approximately 9,000 aces on Bouldin Island and Holland Tract. In general, habitat loss on Webb Tract would be mitigated on Bouldin Island, while Holland Tract would be used to mitigate the impacts on Bacon Island. In order to assess the projects potential impacts, as required by NEPA, CEQA, ESA, and CESA, thorough systematic inventories of biological resources are necessary. DW attempted to document the impacts to wildlife species and habitats; however, several issues still need attention if the project becomes a public project. The issues are discussed below.

Unresolved or new wildlife issues

Several issues related to the scope of wildlife inventories and impact assessment should be addressed. The issues include:

- *Webb Tract*. The DEIR/EIS concluded that Webb Tract provided the most diverse and the highest habitat values of all the DW project islands. The proposed action would eliminate these habitat values from Webb Tract. No ground wildlife surveys were conducted on a 360-acre area on the eastside of Webb, which includes a blowout pond and dense riparian habitat. Ground surveys were only conducted on Webb Tract during February and March 1988. There were no ground surveys conducted in the summer or fall on all project islands. The lack of ground surveys would indicate that there is insufficient data to document the level of adverse impacts of the proposed action.

- *Island Levees and Perimeters Habitats*. It is unclear if the project islands' exterior levee habitats were surveyed for wildlife species. Freshwater tidal marsh habitats surround the perimeters of the project islands, which may provide habitat for tricolored blackbirds and western pond turtles.

- *Bat Species*. Only diurnal visual surveys were conducted for the DW Project. These survey techniques are not adequate to determine if and which bat species would be impacted by the project. Furthermore, there was no assessment of suitable habitat for breeding, foraging, roosting, or migrating bats in the 1995 DEIR/EIS. The Western Bat Working Group has determine that there are 16 bat species within the mediterranean region of California that are considered to be imperiled or threatened, and only 5 species are considered stable (WBWG 1998). Therefore, it is extremely important that project impacts on bat species be understood.

Soundness of Wildlife Survey Data

The majority of the ground and aerial wildlife surveys were conducted from 1987 – 1989 for the DEIS/EIR. Since then, there have been new observations of listed and sensitive species near the DW Project islands (DFG 2001b). Habitat conditions have changed on the islands; the riparian habitat associated with the blowout ponds has grown substantially since 1987. Thus, wildlife habitat uses, species composition, and abundance most likely has changed in specific habitats. Therefore, additional wildlife surveys should be conducted if the project becomes a public project.

Cumulative Impacts

The DEIS/EIR does not address impacts to terrestrial wildlife species in the project service area. The DW Project could result in the delivery of up to 250,000 AF of water annually to SWP and CVP service areas. This additional water delivery to the state and federal service areas could result in habitat conversion to urban and agriculture uses. Due to the potential significant impacts to wildlife in the DW Project service area, a subsequent environmental documentation should include an analysis to inform the public and decision-makers of the potential impacts.

3.1.5 Cultural Resources

A substantial amount of previous cultural resource compliance work has been conducted within the study limits of Alternative 1 – DW Project which encompass four Delta islands: Bacon Island, Bouldin Island, Webb Tract, and most of Holland Tract. The previous cultural resource studies, conducted between 1988 and 1993, are thoroughly documented in the draft and final EIR/EIS prepared for the DW Project (JSA 1995, 2001a, 2001b). All work was conducted in accordance with the requirements of Section 106 of the National Historic Preservation Act and its implementing regulations (36 CFR 800). The cultural resource assessment presented here draws heavily from the findings reported in the draft and final environmental documents, as well as from the original cultural resource technical documentation. In addition, a field review of the project area was conducted on October 9, 2001 by cultural resource staff from both the DWR and Reclamation, further contributing to the recommendations presented in this assessment. Below is a brief summary of all resources that have been previously identified and evaluated to date within the DW Project area, followed by a more detailed discussion of the cultural resource status for each island.

3.1.5.1 Summary of Cultural Resources Identified

Cultural resource investigations conducted to-date for the DW Project resulted in the identification of a total of 48 cultural resources throughout the four project islands, including archaeological sites, architectural properties, and isolated artifacts and features (Maniery 1988; Maniery and Syda 1989). Among the 48 cultural resources identified, 19 of them underwent formal cultural resource evaluations to determine their National Register significance. Sixteen of those resources were ultimately determined eligible for listing on the National Register of Historic Places and are, therefore, "significant" resources under the law (Maniery 1993; Maniery and Fryman 1993; Holson and others 1993). Bouldin Island contains only one significant resource, which consists of a historic archaeological site. Holland Tract contains two significant cultural resources, both of which are prehistoric archaeological sites containing Native American human remains. Holland Tract also contains three other unevaluated sites in which human remains were identified. None of the cultural resources identified on Webb Tract were determined to be significant. However, the fact that prehistoric human remains have been observed on Webb Tract in the past is a matter of concern that needs to be addressed. The remaining 13 significant cultural resources in the project area are located on Bacon Island. Together, these 13 resources, both architectural and archaeological, constitute an in tact historical landscape related to Japanese agricultural endeavors in the Delta. As a result, all of Bacon Island has been determined to be a significant Rural Historic District. More detailed descriptions of the resources and issues on each island are as follows.

Webb Tract

Prehistoric sites
No prehistoric cultural resources were identified on Webb Tract. Prehistoric human remains have, however, been reported on this island in the past. Furthermore, Webb Tract contains approximately 335 acres of piper sandy loam soils, which are typically considered to be areas of high sensitivity for prehistoric archaeological sites. These soil deposits are generally characterized by high mounds that would have protruded above sea level in prehistoric times, thus enabling human habitation. The past reports of human remains and the identified areas of high sensitivity both contribute to a strong probability that such resources could be encountered during future cultural resource investigations or during project implementation on this island.

Historical sites
Seven historic period cultural resources have been identified on Webb Tract. Only two of these resources were substantial enough to warrant formal evaluation, yet neither was found to be significant upon completion of the evaluation work.

Bouldin Island

Prehistoric sites
No prehistoric resources were identified on Bouldin Island during the cultural resource investigations conducted for the DW Project, nor have there been any reports or records documenting evidence of prehistoric remains in the past. Furthermore, no areas of potential prehistoric site sensitivity, such as piper sandy loam deposits, are known to exist on the island.

Historical sites
A total of 13 historic period cultural resources, most of which were isolated artifacts or features, were identified on Bouldin Island during the inventory efforts conducted for the DW Project. Two of these resources were evaluated by means of archaeological test excavations, of which only one was determined to be eligible for the National Register of Historic Places.

Holland Tract

Prehistoric sites
Holland Tract is among the most sensitive of the four project islands for prehistoric resources. A total of seven prehistoric sites have been identified on Holland Tract all of which are associated with the sensitive piper soil areas. There are roughly 220 acres of piper soils on this island. Only two of these resources underwent formal evaluations by means of archaeological test excavations, both of which were determined eligible for the National Register of Historic Places. In addition, human remains have been identified at both of these significant sites, as well as at three other unevaluated sites on the island. The presence of human remains is a matter of concern that must be addressed in consultation with the State Historic Preservation Officer (SHPO) and with local Native American representatives.

Historical sites
A total of six historic period cultural resources have been identified on Holland Tract, none of which were determined to be significant. It is not anticipated that any additional historic period resources of significance will be encountered on this island during project implementation.

Bacon Island

Prehistoric sites
No prehistoric cultural resources have been identified to-date on Bacon Island. In addition, no areas of prehistoric site sensitivity, such as piper soil deposits, are known to occur on this island. While the potential may exist for such resources to be encountered during project implementation, it is considered unlikely.

Historical sites
A total of 15 historic period cultural resources were identified on Bacon Island, 13 of which were evaluated and determined to be significant cultural resources, including architectural properties and historic archaeological sites. Furthermore, all 13 of these resources have been determined to be contributors to the overall significance of Bacon Island as a National Register Historic District reflecting a rural historic landscape related to early Japanese agriculture in the Delta.

3.1.5.2 Resource Issues and Impacts

A number of cultural resources within the study area of Alternative 1 have already been identified and evaluated for National Register significance. Table 14 provides a quick-reference for all the project islands along with current issues and proposed additional work. As much as 13 years have passed since the original cultural resource compliance work was conducted. Because of the length of time some additional inventory and/or evaluation work will be necessary in order to meet the most current regulatory standards and obligations. In addition, it will be necessary to consult with the State Historic Preservation Officer (SHPO) and with interested parties so that an appropriate course of action can be agreed upon in compliance with the most recent revisions of the Section 106 regulations prior to initiating any remaining

cultural resource work for the In-Delta Storage project. A summary of the laws that regulate the treatment of cultural resources is provided below.

Regulatory Context

There are a number of state and federal laws and regulations that pertain to the treatment of cultural resources. The National Historic Preservation Act (NHPA) and CEQA are the primary laws applicable to the proposed project. It should be noted that compliance with the NHPA is comprehensive enough to satisfy the requirements of CEQA.

Federal cultural resource regulations are governed primarily by Section 106 of the NHPA. Section 106 requires federal agencies (or entities receiving federal permits, approval, or funding) to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings. ACHP's implementing regulations, "Protection of Historic Properties," are found in 36 Code of Federal Regulations (CFR) Part 800. The goal of the Section 106 process is to offer a measure of protection to sites that have been determined eligible for listing on the National Register of Historic Places. The criteria for determining National Register eligibility are found in 36 CFR Part 60. These criteria state that eligible resources consist of:

> "…[D]istricts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that (a) are associated with events that have made a significant contribution to the broad patterns of our history; or (b) that are associated with the lives of persons significant in our past; or (c) that embody the distinctive characteristics of a type, period, or method of construction, or that possess high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction; or (d) that have yielded or may be likely to yield information important to history or prehistory."

Amendments to the National Historic Preservation Act (1986 and 1992) and subsequent revisions to the implementing regulations (1999 and 2000) have primarily strengthened the provisions for public participation and, in particular, Native American involvement and consultation throughout the Section 106 process.

State historic preservation regulations affecting this project include the statutes and guidelines contained in CEQA (Public Resources Code Sections 21083.2 and 21084.1, and Section 15064.5 of the CEQA Guidelines). CEQA requires state agencies to carefully consider the potential effects of a project on significant historical or archaeological cultural resources. Section 15064.5 of the CEQA Guidelines specifies the criteria for evaluating the importance of cultural resources. These criteria essentially mirror those of the NHPA (criteria (a) through (d)), described above.

Table 3-14. Cultural resource reference guide

	WEBB TRACT	HOLLAND TRACT	BOULDIN ISLAND	BACON ISLAND	VICTORIA ISLAND
APPLICABLE PROJECT ALTERNATIVE(S)	▪ Alternative 1-storage ▪ Alternative 2-storage ▪ Alternative 3-habitat	▪ Alternative 1-habitat ▪ Alternative 2-habitat ▪ Alternative 3-habitat	▪ Alternative 1-habitat ▪ Alternative 2-habitat ▪ Alternative 3-habitat	▪ Alternative 1-storage ▪ Alternative 2-storage ▪ Alternative 3-storage	▪ Alternative 3 - storage
NUMBER OF SIGNIFICANT CULTURAL RESOURCES	None	Two: prehistoric archaeological sites	One: historic archaeological site	Thirteen: historic archaeological sites/buildings comprising a significant historic district	None known
CURRENT ISSUES	▪ Presence of 335 acres of sensitive piper soils; ▪ Past observations of human remains	▪ Presence of 220 acres of sensitive piper soils; ▪ human remains identified at three unevaluated sites; ▪ one 100-acre parcel of land not previously surveyed	None	None	Not yet inventoried
ADDITIONAL WORK NEEDED	▪ Re-survey all sensitive piper soil areas (335 acres)	▪ Avoid or mitigate the two significant archaeological sites by means of data recovery excavations; ▪ Re-survey all sensitive piper soil areas (221 acres); ▪ Conduct an inventory of the parcel of land not previously surveyed (100 acres)	▪ Avoid or mitigate the one significant archaeological site by means of data recovery excavations	▪ Mitigate 10 significant archaeological sites by means of data recovery excavations; ▪ Prepare public education publication; ▪ Produce PBS-quality video	▪ Conduct a cultural resource inventory of the island (estimated 1200 acres to sample survey)

A series of publications providing technical advice on the procedures for identifying, evaluating, and determining project effects to resources has been produced by the Governor's Office of Planning and Research (OPR). This technical advice series strongly recommends that Native American concerns and the concerns of other interested persons and corporate entities, including but not limited to, museums, historical commissions, associations and societies, be solicited as part of the cultural resources inventory process. In addition, California law, like federal law, protects Native American burials, skeletal remains, and associated grave goods regardless of their antiquity and provides for the sensitive treatment and disposition of those remains. Furthermore, Section 7070.5(b) of the California Health and Safety code specifies the protocol that must be followed in the event that human remains are discovered either by archaeological investigation or by project activities.

Webb Tract

Prehistoric Sites
The past reports of human remains and the presence of piper soils contribute to a strong probability that sensitive resources could be encountered during future cultural resource investigations or during project implementation on this island. Given the duration of time that has passed since Webb Tract was last surveyed (approximately 13 years), all sensitive piper soil areas (approximately 335 acres) should be re-examined in advance of the proposed project.

Historical Sites
It is not anticipated that any additional historic period resources of significance will be identified on this island.

Bouldin Island

Prehistoric Sites
It is considered unlikely that prehistoric cultural resources will be encountered on Bouldin Island.

Historical Sites
One significant historic archaeological site identified on Bouldin Island may be adversely impacted by the project and will require mitigation prior to implementing any project-related activities that may impact the site. Given that project activities proposed for Bouldin Island involve habitat restoration, efforts to avoid impacting this site may be achieved through careful planning and by designating the site as an environmentally sensitive area to be avoided during project-related activities.

Holland Tract

Prehistoric Sites
Holland Tract is the most sensitive island with regard to prehistoric resources. Due to the duration of time that has passed since Holland Tract was last surveyed for cultural resources (approximately 13 years), all sensitive piper soil areas (roughly 220 acres) on the island should be re-examined. Any impacts that the project may have on the two significant archaeological sites, or on any of the sites containing human remains, will require mitigation measures prior to project implementation, if they cannot be avoided.

Historical Sites
It is considered unlikely that any additional historic period cultural resources will be encountered on Holland Tract.

Bacon Island

Prehistoric Sites
It is considered unlikely that prehistoric resources will be encountered on Bacon Island during the course of the project.

Historical Sites
As Bacon Island will be used for water storage, it is anticipated that most of the resources that comprise the National Register Historic District on this island will be adversely impacted by project implementation activities. Possible mitigation measures to minimize the impact are described in Section 3.2.

3.1.6 Hazardous Materials Assessment

The DWR Site Assessment Unit was asked by DWR's In-Delta Storage Program to perform ***modified*** Phase I Environmental Site Assessments (Phase I ESA) of the following properties located in the Sacramento/San Joaquin Delta: Webb Tract, Bouldin Island, Holland Tract, Bacon Island, and Victoria Island. These site assessments are part of a comprehensive project study associated with the DW Project for the purposes of evaluating and identifying potential hazardous materials related issues that could significantly impact the Project.

The purpose of a standard Phase I Environmental Site Assessment as defined by ASTM Designation E 1527-00, is to identify recognized environmental conditions. ASTM defines *recognized environmental conditions* as:

> "…the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws." (ASTM 2000)

The modified assessments for this study conform to the general framework of the standard Phase I ESA. It should be noted that some of the areas usually covered in a standard Phase I ESA, such as biological and cultural resources, are addressed by other contributing authors elsewhere in this document.

3.1.6.1 Limitations

Any level of assessment cannot determine that a property is free of all potential environmental impairments such as chemicals and toxic substances. DWR's Site Assessment Unit cannot certify or guarantee the absence of these conditions on the Site. Variations could exist beyond or between areas investigated for this assessment. Conditions listed or observed could change because of the migration of contaminants, change in grades, rainfall variation, temperature, and/or other factors not apparent at the time of this assessment.

This assessment was performed for the sole use of DWR. Any reliance or use of information contained herein by a third party is at such party's sole risk. Other parties who rely on information provided by the Site Assessment Unit for this project study are responsible for determining the adequacy of information provided by others.

The ASTM standard states that an environmental site assessment "…completed less than 180 days previously is presumed to be valid." A Phase I ESA more than 180 days old can be relied upon only if certain conditions are met. Although this investigation is not considered a full Phase I ESA, if the information contained herein is to be relied upon more than 180 days after its completion, further consultation with DWR's Site Assessment Unit is recommended.

The services performed by DWR have been conducted consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the state of California. No other warranty, either expressed or implied, is made.

3.1.6.2 Existing conditions on the islands

Webb Tract

This is a general description of Webb Tract as observed during the site reconnaissance performed on September 18, 2001. See Appendix B for Site photographs.

Results of preliminary hazardous materials assessment

A farm maintenance facility is situated along the west end of Webb Tract, approximately one mile north of the ferry dock. This facility consisted of three structures: a large equipment maintenance shed, a former worker's quarters, and a mobile home. The maintenance shed contained numerous parts and machinery commonly associated with such a facility. It also contained a 55-gallon drum of gear oil and numerous 5-gallon propane tanks. Stained soil was observed outside the shed on the west side (see Appendix B, Photos 1-6.)

Five aboveground storage tanks were observed along the north side of the maintenance shed: one 5,000 gallon tank and four 500-gallon tanks. None of the tanks had labels on them indicating what the contents are. Five 55-gallon drums were also observed in the same location. One drum was observed to have no lid and contained what appeared to be waste motor oil in it. A 5-gallon container and a portion of a 55-gallon drum were also filled with a motor oil-like liquid. The soil in the vicinity of the drums and tanks was observed to be stained (see Appendix B, Photos 7-10.)

Additional 55-gallon drums were observed outside the south and east shed walls. Nine drums were observed along the south outside wall of the shed. Eight drums were observed outside the east roll-up door. None of the drums were labeled. No staining or leaks were observed on or around the drums (see Appendix B, Photos 11-13.)

A trailer south of the shed was observed to serve as a chemical storage area. Numerous containers were stored or discarded in the trailer. No stains or leaks were observed within or outside the trailer. No labels or placards were observed on the outside of the trailer indicating its contents (see Appendix B, Photos 14-16.)

Numerous tractors and heavy equipment implements were stored at this location. The soil surrounding the many of the tractors was observed to be stained or discolored (see Appendix B, Photos 17-18.) Three 55-gallon drums were observed north of the maintenance shed. These drums were apparently used for burning trash. A dumpster was observed by the drums that apparently was where ash from the drums was placed. Among the waste in the dumpster, burned heavy equipment oil filters were present (see Appendix B, Photos 17-20.)

The worker living quarters was observed to be unsecured and open. It was observed to be in a dilapidated state. No hazardous materials or petroleum products were observed at these quarters (see Appendix B, Photos 21-23.)

The area east of the maintenance area is used for equipment implement storage. Numerous tractors, tires, and other equipment were observed. A drainage area where standing water was present was observed in this area. No discoloration or odors that would indicate a petroleum release were noted in the area surrounding the pond (see Appendix B, Photos 24-27.)

At the easternmost end of the tract is a single-family residence and a hunting club storage shed. East of the hunt club were two aboveground storage tanks. Both tanks have a capacity of approximately 750-1,000 gallons. One tank had a label indicating that it contained unleaded fuel. The other was unlabeled. No stains or signs of a release from these tanks were observed. Two 55-gallon drums were observed inside the club shed. Their labels stated that they contain herbicides. Various household chemicals were also stored in the shed. No signs of a product

release from these containers was observed. A 55-gallon drum was observed on the north side of the club. It is apparently used to burn trash in (see Appendix B, Photos 32-38.)

A water pumping station is situated along the south levee road approximately two miles west of the hunting clubhouse. A portable 5,000 gallon fuel tank trailer was at this location to supply the pump engines. Stained soil and distressed vegetation was observed under the tank. The water lines under the pump engines were coated with a petroleum-based liquid, likely fuel or oil from the engines. A 55-gallon drum was also observed at this location. The drum was unlabeled (see Appendix B, Photos 41-47.)

A gas well facility is situated along the south levee road approximately two miles west of the pumping station. The facility was open and accessible from the levee road. The well facility consists of two well heads, four large storage tanks, and various equipment and hardware associated with the well. Liquid was observed to be standing at the base of the well heads. However, no sheen or odors were noted. Discolored soil was observed on the large pad immediately north of the well heads. A 500-gallon aboveground fuel tank was observed. Its label indicated that it contains motor oil. In addition, two 55-gallon drums containing triethylene glycol and a 5-gallon container of thread cutting oil (lubricant) were observed at this facility. No signs or indications of a past product release were observed at this gas well during the Site visit (see Appendix B, Photos 48-59.)

A 5,000 gallon portable aboveground storage tank was observed in the northeast corner of the tract. Although two labels were on the tank, neither were filled-out. No evidence of current or a past release were observed around the tank (see Appendix B, Photos 31-32.)

A monitoring well was observed approximately one mile west of the hunt club facility, along the south levee road. Although this device appeared to be a well, it did not have a casing consistent with typical monitoring wells. The device may serve another purpose (see Appendix B, Photos 39-40.)

Environmental Database Search

A search of state and federal government environmental databases was conducted by BBL Consultants. The database search determines if any reported sources of hazardous materials contamination exist within the minimum prescribed search radius as stated in ASTM Designation E 1527-00. The complete database report is in Appendix C.

The following databases were reviewed:

- National Priority List (NPL)
- Federal Facilities (FEDFAC)
- Site Enforcement Tracking System (SETS)
- Enforcement Docket System/Consent Decree Tracking System (CDETS)
- Criminal Docket System (C-DOCKET)
- Federal Enforcement Dockets (FD)
- RCRA Violators List (CORRACTS)
- Annual Work Plan (formerly Bond Expenditure Plan - AW)
- Historical Abandoned Site Survey Program (CALSITES)
- State of California Office of planning and Research (CORTESE)
- Leaking Underground Storage Tanks (LUST)
- Solid Waste Information System (SWIS)
- Well Investigation Program (WIP)
- Drinking Water Program (WQ)
- Toxic Releases (NT)
- Toxic Pits (TPC)
- Solid Waste Assessment Test- Regional (SWAT(R))

- State equivalent CERCLIS list (SCL)
- No Further Remedial Action Planned Site (NFRAP)
- Permitted Underground Storage Tanks (UST)
- Emergency Response Notification System of spills (ERNS)
- Resource Conservation and Recovery Information System - Generator (RCRA-G)
- Superfund Amendments and Reauthorization Act (SARA Title III)
- Nuclear Regulatory Commission Licensees (NC)
- PCB Waste Handlers Database (PCB)
- Permit Compliance System (PCS)
- AIRS Facility System (AFS)
- Section Seven Tracking System (SSTS)
- Federal Insecticide, Fungicide, and Rodenticide Control Act (FIFRA)
- Federal Facilities Information System (FFIS)
- Chemical in Commerce Information System (CICIS)
- USEPA Facility Index System (FINDS)
- Hazardous Waste Information System (HWIS)
- Resource Conservation and Recovery Information System – Treatment, Storage, & Disposal (RCRA-D)

Site Assessment staff reviewed database information for those sites listed within the approximate minimum search distance of Webb Tract, emphasizing those locations expected to be up-gradient of the Site and that have been subject to groundwater contamination. In most cases, further file review is conducted only on listed sites identified as being 1) subject to groundwater contamination, 2) within one-eighth mile of the Site, and/or 3) that may be up-gradient of the Site. The environmental database report identifies recorded contaminated sites within one mile of the search area. If contaminated sites are identified, they are plotted to determine their relation to the Site.

The database search produced four areas situated either within or approximately one-half mile of the tract. The Emergency Response Notification System reports the release of approximately 500 gallons of diesel fuel when the vessel “Glenn” sank at Fisherman’s Cut along the west side of Webb Tract. It is reported that the following agencies were notified: U.S. Coast Guard, California Department of Health Services, USFWS, and California DFG’s Office of Spill Prevention and Response. The date of this occurrence is not reported. No information regarding cleanup efforts or further action is reported. Further investigation regarding this spill and any remediation actions that were taken is recommended.

The Drinking Water Program database reported the presence of two wells within one mile of the tract. Both wells are active. However, both are situated on Bethel Island, south of Webb Tract. Therefore, the likelihood of these wells having an impact on the environmental quality of Webb Tract is minimal.

The Permitted Underground Storage Tanks database reported the presence of one underground storage tank on the tract. No information was reported regarding the size, condition, construction, contents, or current status of the tank. Further investigation with the State Water Quality Control Board and the landowner regarding the status of this tank is recommended.

Baseline Conditions for Any Future Hazardous Materials Liability

The farm maintenance headquarters on the west side of the tract has numerous potential areas of contamination that warrant further investigation. The extensive staining surrounding the drums and aboveground storage tanks on the north side of the maintenance shed indicates that there may be extensive soil contamination. The discolored soil surrounding farm equipment and stained soil under heavy equipment are indications that local housekeeping practices may have allowed release of farm chemicals including grease, oil, herbicides, pesticides, and fertilizers. The trash burning area could also be a source of heavy metals contamination. Based on the age of the facility, the former worker living quarters adjacent to the maintenance shed may potentially contain lead and asbestos containing construction materials.

The fuel tanks along the south levee road warrant further investigation. The tanks at the hunting clubhouse, water pumping station, and gas well facility all exhibit various degrees of product spillage or release.

The monitoring wells on the site could potentially serve as a conduit for contaminants to reach groundwater. If federal and state entities are not going to use the wells, Site Assessment recommends that they be properly decommissioned and removed.

Site Assessment staff recommends that a complete Phase II Environmental Site Assessment be performed for this tract. Such an investigation would further establish the nature and extent of suspected contaminated areas that should be assessed prior to the purchase and subsequent use of Webb Tract. Sampling, analyses, and characterization of suspected areas should be conducted to minimize federal and state agencies' potential liability for cleanup and remediation of suspect areas.

Bouldin Island

This is a general description of Bouldin Island as observed during the site reconnaissance performed on September 17, 2001. See Appendix D for Site photographs.

Results of Preliminary Hazardous Materials Assessment

A farm headquarters and equipment maintenance facility is situated along the east side of the island, approximately one-half mile south of the Highway 12 Terminus Bridge. The facility consists of two equipment storage buildings, a chemical storage shed, a large equipment maintenance shop, and caretaker mobile home (see Appendix D, Photo 16.)

The chemical storage shed contained six unlabeled 55-gallon drums and numerous other chemical containers. Two additional 55-gallon drums were observed outside the shed. Three 1,500 gallon fuel tanks were observed above the shed, on the levee bank. Stained soil was observed under the fuel tanks and in the area around the storage shed (see Appendix D, Photos 17-21.)

The equipment storage shed was observed to contain six 55-gallon drums of motor oil, numerous farm implements and equipment, and spare engines. Stained soil was observed in the shed where the engines were stored. Numerous cars, parts, and equipment were observed behind the shed (west side). Four 55-gallon drums and other chemical containers were observed on the southwest end of the shed. Stained soil and distressed vegetation was present under and around the drum (see Appendix D, Photos 23-27.)

Site Assessment staff was unable to inventory the storage shed on the northeast end of the facility because it was secured at the time of the Site visit. Signs on the outside of the shed indicate that it is used to store flammable chemicals or fuels (see Appendix D, Photo 22.) The area west of this shed stored approximately 25 55-gallon drums and farm machinery parts. Some of the drums were observed to be empty. However, others were sealed and unlabeled. Stained soil was observed in the area under and around the drums and equipment. A large pile of tires was also observed along the southwest side of this shed. No recognized environmental conditions were observed in the area of the tires (see Appendix D, Photos 28-30.)

A 1,500 gallon aboveground fuel tank was observed west of the equipment maintenance shop. No signs of a product release or spill was observed around this tank. Stained soil was observed on the east side of the maintenance shop (see Appendix D, Photos 31-32.)

Two monitoring wells were identified during the Site visit. One well is situated north of Highway 12, approximately one and one-half miles east of the Mokelumne River bridge. The second well is located two and one-half miles east of the bridge, also on the north side of Highway 12 tank (see Appendix D, Photos 1 and 6.) No marks indicating ownership of the wells were observed. Numerous single family

residences are situated along the north side of the island. A 7,500 gallon diesel fuel tank was observed near the northwestern most residence. No signs of product release from this tank was observed (see Appendix D, Photos 4-5.)

A large trash and debris pile was observed along the island's north levee road, approximately one and one-half miles west of the Highway 12 Terminus Bridge. The pile contained tree and other yard cuttings as well as mattresses, auto parts, and the remains of a mobile home. Site Assessment staff could not fully inventory the contents of the pile because of its large size and the potential safety hazards associated with such a pile (see Appendix D, Photos 12-13.)

A 6,000 gallon aboveground storage tank was situated one-half mile south of Highway 12, one and one-half miles east of the Mokelumne River bridge. The tank was unlabeled. A white crust was observed on the soil down-gradient from the tank. In addition, an agricultural drainage pond is south of the tank approximately 30 feet away (see Appendix D, Photo 38.) A portable tank was also observed along the south levee road. The label on the tank indicated that it contained 17-0-0 nitrogen fertilizer (see Appendix D, Photos 39-40.)

A large plastic chemical over-pack container was observed along the southwest levee road. The container label indicated that it contained a poisonous substance, but did not identify what it was. The container had numerous bullet holes in it and appeared to be empty (see Appendix D, Photo 41.)

Environmental Database Search

A search of state and federal government environmental databases was conducted by BBL Consultants. The database search determines if any reported sources of hazardous materials contamination exist within the minimum prescribed search radius as stated in ASTM Designation E 1527-00. The complete database report is in Appendix E. The databases searched for this island are the same as were searched for Webb Tract. See above within the text for a complete list of databases.

Site Assessment staff reviewed database information for those sites listed within the approximate minimum search distance of Bouldin Island, emphasizing those locations expected to be up-gradient of the Site and that have been subject to groundwater contamination. In most cases, further file review is conducted only on listed sites identified as being 1) subject to groundwater contamination, 2) within one-eighth mile of the Site, and/or 3) that may be up-gradient of the Site. The environmental database report identifies recorded contaminated sites within one mile of the search area. If contaminated sites are identified, they are plotted to determine their relation to the Site.

The database search produced 18 potential problem areas situated either within or approximately one-half mile of the island. The Emergency Response Notification System database reported four product releases within the Mokelumne River, west of Bouldin Island. One incident was the sinking of a vessel while two other incidents were reported as releases of an undocumented quantity of fuel. The fourth incident was an unknown oil release. None of these reports indicate the quantity of product released. The two fuel spills were reportedly dealt with through the use of absorbent pads or boom. The method used to contain the other releases was not reported. Although these incidents were relatively close to Bouldin Island, they likely had little, if any, impact on the environmental quality of the island.

The Historical Abandoned Site Survey Program identified one potential hazardous waste sites. According to California Department of Toxic Substances Control (DTSC), the site is not considered problematic. Since the spray service in question is not on or contiguous to Bouldin Island, it likely will have little impact.

The CALSITES – No Further Action database reported six reported incident locations. In addition, Leaking Underground Storage Tanks database reported five incident locations and the Permitted Underground Storage Tanks database reported seven tanks. All eighteen of these reported areas occurred on or near Brannan Island Road in the City of Isleton or in the Lodi area. Although they all fall within the 1-mile radius of Bouldin Island, none of the incident locations are on or contiguous to the island. Therefore, it is unlikely that the incidents will impact the environmental quality of the island.

The Drinking Water Program database reported two water wells within one mile of the island. One well is located east of the island near the Terminus Marina. It likely will have no impact on the island. The second well is on the northwest corner of Bouldin Island. It is reported as being active and is identified as well number 03N/04E-07A01M. No further information regarding the well construction type, date, or depth were reported.

Baseline Conditions for Any Future Hazardous Materials Liability

Site Assessment staff recommends that a complete Phase II Environmental Site Assessment be performed for Bouldin Island. Such an investigation would further establish nature and extent of suspected contaminated areas that should be assessed prior to the purchase and subsequent use of Bouldin Island. Sampling, analyses, and characterization of suspected areas should be conducted to minimize DWR's potential liability for cleanup and remediation of suspect areas.

The nature and extent of contamination at the farm headquarters needs to be properly assessed. Sampling, analyses, and classification of the stains around the large fuel tanks and leaky 55-gallon drums is recommended.

The monitoring wells on the site could potentially serve as a conduit for contaminants to reach groundwater. If federal and state agencies are not going to use the wells, Site Assessment recommends that they be properly decommissioned and removed.

Site Assessment recommends that the large trash pile along the north levee road be properly divided and disposed of. Such piles have historically contained a large mix of debris, waste chemicals, and other items. Careful assessment of the contents of the pile may be necessary in order to prevent an accidental chemical release if such products are present.

The contents of the unlabeled 6,000 gallon tank should be assessed. Based on the observations made, evidence of a product release was apparent. Since there is a drainage pond approximately 30 feet down gradient of the tank, the potential for accidental product release into the farm's waterways is great.

Holland Tract

This is a general description of Holland Tract as observed during the site reconnaissance performed on September 19, 2001. See Appendix B for Site photographs.

Results of Preliminary Hazardous Materials Assessment

An equipment storage shed was observed approximately one mile north of the southeast corner of the island. The shed contained numerous farm implements, four unlabeled 55-gallon drums, and numerous smaller chemical containers. Some staining was observed on the concrete foundation of the shed. The shed foundation outside of where the drums are stored also exhibited some staining. The soil in this area of the foundation was also observed to be stained (see Appendix F, Photos 24-29.)

A farm equipment staging area was observed approximately one-half mile south of the north tip of the island. Numerous tractors, trucks, and implements were observed at this location. A 10,000 gallon diesel fuel trailer was observed here. The soil under the trailer was stained. Two 55-gallon drums at this location are apparently used for burning trash. Approximately 12 more unlabeled 55-gallon drums were observed at this location. Their use could not be determined. Five 55-gallon drums at this area were labeled as being tractor hydraulic fluid (see Appendix F, Photos 33-44.)

Two single family residences are situated north of the equipment staging area. One structure was found to be open and in a dilapidated state. The second structure was occupied and in use at the time of the site reconnaissance.

A cattle corral is situated one and one-half miles north of the south levee entrance gate. Site Assessment staff observed the presence of one 10,000-gallon railroad tank and two 3,000-gallon tanks. The tanks appear to be used to hold water for the corral animals. No signs of a product release were observed on or around these tanks (see Appendix F, Photos 46-47.)

Also present at this location was a 500-gallon aboveground storage tank, 28 55-gallon drums, approximately 30 used engine oil filters, and two tractor batteries. Wide-spread soil staining was observed in the area surrounding the drums and 500-gallon tank. A few of the drums where labeled as containing 15w-40 motor oil (see Appendix F, Photos 48-53.)

Site Assessment staff also observed the presence of heavy equipment immediately north of the corral area. The tractors appeared to be out of service. Stained soil was observed under the equipment. One unlabeled 55-gallon drum was at this location. No signs of a product release from the drum were apparent (see Appendix F, Photos 54-56.)

The area in the southeast corner of Holland Tract consists mostly of marinas. The marinas are situated on the water side of the levee while a parking area is provided on the inland side of the levee. The parking area in the south easternmost corner has a storage shed, two outhouses, a propane tank, and a water pump. Site Assessment staff observed a 55-gallon drum on the north side of the shed. The drum was in a water trough which seemed to serve as an over-pack container. The marina south of the parking area consists of a general store, fuel pumps, docks, and berthing slips. An unused gasoline pump was observed on the levee, north of the general store (see Appendix F, Photos 2-15.)

A 5,000 gallon storage tank was observed west of the marina on the south side of the levee road. No signs or placards were present which would indicate the tank contents. No signs of product release were observed at the time of the Site visit (see Appendix F, Photo 4.)

North of the marina parking area is a storage area where four 2,500 gallon former underground storage tanks are stored. Two trailers were also at this location. Site Assessment staff was unable to determine the contents of the tanks or the trailers, as no labels or placards were visible. No signs or evidence of a product release were observed under or around the tanks. Immediately north of the tanks was a lined water sump. The use and purpose of the sump could not be determined.

Site Assessment staff observed numerous rows of trash, debris, unused farm equipment and vehicles along the southern portion of the east levee road. Included in the debris were 30 large stainless steel discs, 5-gallon propane tanks, and household appliances (see Appendix F, Photos 16-20.)

North of the debris pile ten chemical containers were observed. The container labels identify that they used to contain an herbicide (see Appendix F, Photos 21-22.) No signs of a product release was apparent in the area around the containers.

A portable 10,000 gallon tank was observed in the northeast corner of the tract. The tank label was found to be absent of any markings. No signs of a product release were visible under or around the tank (see Appendix F, Photo 45.)

The majority of the center and northern areas of the tract is used for cattle grazing (see Appendix F, Photos 58-61.)

Environmental Database Search

A search of state and federal government environmental databases was conducted by BBL Consultants. The database search determines if any reported sources of hazardous materials contamination exist within the minimum prescribed search radius as stated in ASTM Designation E 1527-00. The complete database report is in Appendix G. The databases searched for this island are the same as were searched for Webb Tract. See above within the text for a complete list of databases.

Site Assessment staff reviewed database information for those sites listed within the approximate minimum search distance of Holland Tract, emphasizing those locations expected to be up-gradient of the Site and that have been subject to groundwater contamination. In most cases, further file review is conducted only on listed sites identified as being 1) subject to groundwater contamination, 2) within one-eighth mile of the Site, and/or 3) that may be up-gradient of the Site. The environmental database report identifies recorded contaminated sites within one mile of the search area. If contaminated sites are identified, they are plotted to determine their relation to the Site.

The database search produced 31 areas situated either within or approximately one-half mile from the tract. Of the 31 reported incidences, permits, or registered tanks, two of them are located on Holland Tract. All other reported incidences occurred east of Holland Island on or near Bethel Island. In light of the fact that Holland Tract is not contiguous with the areas where other reported releases occurred, it is unlikely that the releases or incidences had a significant effect on the tract.

The Hazardous Waste Information System database reported one incident at 4500 Holland Tract Road #100. No information was provided as to what incident occurred, what product was released, and the nature and extent of the release. The Permitted Underground Storage Tanks database reported the presence of an underground storage tank at the same location. No information was reported regarding the size, condition, contents, or status of the tank.

The Emergency Response Notification System database reported water sheen of unknown size in May 1996. The source, nature, quantity, and remediation of the release was not reported. The Permitted Underground Storage Tanks database reported the presence of underground storage tanks at the same location. The report states that four fuel tanks are present: two 4,000-gallon, one 2,000 gallon, and one 300-gallon tank. No information was reported regarding the tank type, year installed, or current status and condition of the tanks.

Baseline Conditions for Any Future Hazardous Materials Liability

Site Assessment staff recommends that a complete Phase II Environmental Site Assessment be performed for this island. Such an investigation would further establish the nature and extent of suspected contaminated areas that should be assessed prior to the purchase and subsequent use of Holland Tract. Sampling, analyses, and characterization of suspected areas should be conducted to minimize DWR's potential liability for cleanup and remediation of suspect areas.

Site Assessment staff recommends that the areas on Holland Tract that were identified as having stained soil be sampled to identify the nature and extent of soil contamination. Specifically, the equipment storage shed, equipment staging area on the east levee road, and the corral area in the center of the tract require various levels of assessment to determine the extent of contamination.

The dilapidated single-family residence on the east levee road by the equipment staging area is also a potential source of hazardous materials liability. Based on the age of the structure, it may contain lead-based paints and asbestos containing construction materials. Thorough sampling and analysis of the construction materials is recommended so a management or abatement plan can be implemented. In addition, the type of sewage system used for the structure should be researched. Proper decommissioning and removal of the system should be conducted prior to any habitat or water storage activities occur to prevent a sewage release into standing surface water. This recommendation regarding asbestos, lead, and sewage also applies to all other structures on Holland Tract.

This investigation revealed the presence of water wells on the island. In light of the fact that wells could potentially serve as a conduit for groundwater contamination, Site Assessment staff recommends proper decommissioning of any well that will not be used by DWR.

Bacon Island

This is a general description of Bacon Island as observed during the site reconnaissance performed on September 21 and 24, 2001. See Appendix B for Site photographs.

Results of Preliminary Hazardous Materials Assessment

A storage shed was observed near the east levee road, north of the Bacon Island bridge. The shed contained stacks of unused bee boxes and seven 55-gallon drums. The drums were unlabeled. Site Assessment staff did not observe any signs of a product release from these drums. One unlabeled 55-gallon drum and an unlabeled 500-gallon aboveground storage tank was observed outside the southwest corner of the shed. The drum was observed to be on its side with stained soil under it. No stains or signs of a product release were observed under the larger aboveground tank. In addition, three pole-mounted electrical transformers were observed outside the south wall of the shed. Although the transformers appeared to be old and rusted, no signs of leaks were observed (see Appendix H, Photos 1-6.)

Three structures formerly used as worker housing were observed along the east levee road, approximately one mile south of the northeast corner of the island. Three 55-gallon poly drums and one 55-gallon steel drum were observed in one of the structures. Only one of the poly drums was labeled. It was labeled as "Pennwalt Decco," a water pH stabilizing chemical used in fruit packing sheds. No sign of product release was visible around the drums. A 500-gallon aboveground storage tank was observed on the inside levee bank adjacent to the worker housing structures. No labels or markings were visible on the tank. No signs of a product release were visible under or around the tank (see Appendix H, Photos 9-14.)

A farm equipment storage and staging area was observed approximately one mile southwest of the northeast corner of the island. The staging area consists of two large sheds: one an equipment storage shed, the other a packing shed. Three aboveground storage tanks with the capacities of 500, 750, and 6,000 gallons were observed northwest of the sheds. A small chemical storage area was observed under the 500-gallon tank. The area contained various commercial farming chemicals used with spreaders. Four 55-gallon drums were also observed in the vicinity of the aboveground storage tanks. None of the drums were labeled. A second 750-gallon aboveground storage tank was situated south of the other tanks. It was labeled by hand as containing used oil. No evidence of product release was observed in the vicinity of these aboveground storage tanks (see Appendix H, Photos 15-20.)

The north end of the storage shed contained various farming implements and equipment. Two poly and two steel 55-gallon drums were observed in this area. One drum was observed to be open and was three-quarters full of what appeared to be waste motor oil. Some stained soil was observed in the vicinity of these drums (see Appendix H, Photos 21-28.) The south side of this shed also contained various farm implements. Stained soil was observed in the area under the implements. Palletized bags of dry fertilizer were observed among the implements. Small quantities of dry fertilizer were observed to be spilled on the ground.

Two 500-gallon aboveground storage tanks and one 55-gallon drum were observed at the southwest corner of the packing shed. None of the tanks or the drum were labeled or placarded. Stained soil was observed under the tanks. In addition, stained soil was observed south of the packing shed. The source of the stain could not be identified, as no tanks or drums were in the immediate vicinity of the stain (see Appendix H, Photos 30-31 and 38.)

The area southeast of the packing shed is littered approximately 24 unused cars, various farm implements, and unused aboveground storage tanks. No stained soil or evidence of a product release was visible under or around the tanks. Among the debris near the southwest corner of the packing shed, three crushed 55-gallon drums were observed. Stained soil was observed in the vicinity of the crushed drums (see Appendix H, Photos 34-37.) Two 750-gallon tanks are also situated near the packing shed. One tank was observed on a trailer east of the packing shed, the other on a stand west of the packing shed. Site Assessment staff could not determine if these tanks are currently in use or had product in

them. No labels or placards were visible on either of them. No signs of leakage or product release was visible under either of the tanks (see Appendix H, Photos 39-40.) An equipment wash-down area was observed east of the packing shed. The soil in this area was observed to be wet, but also exhibited some signs of being stained (see Appendix H, Photo 41.)

Two aboveground storage tanks were observed approximately one-eighth mile southeast of the packing shed. One tank has a capacity of approximately 3,000 gallons; the other tank has approximately a 750-gallon capacity. A fenced enclosure in this area also contained four 55-gallon drums and one 5-gallon container. A sign in on the enclosure states that the drums and containers contain poison. No labels or placards directly on the drums or container were visible. The larger storage tank was stenciled with a label indicating that the contents are or were gasoline or stove oil (both labels were present.) Stained soil was observed under the 55-gallon drums as well as in the vicinity of the 750-gallon tank (see Appendix H, Photos 42-47.)

A large farm shed was observed on the west side of the island approximately one-half mile south of the northernmost point of the island. Two aboveground storage tanks were observed on the west levee road by the shed. The tank capacities are approximately 500 and 750 gallons. No labels or placards were visible on the tanks indicating their contents. A 5-gallon storage container was also observed by these tanks which was labeled as containing Roundup herbicide. No signs of leaks or a product release were observed in the area surrounding these tanks. A fuel pump was observed downhill from the tanks. Stained soil was observed in the area surrounding the pump (see Appendix H, Photos 67-70.)

Two unused chemical tanks were observed to be stored south of the shed. No signs of product release were observed in the area surrounding these tanks. No labels or placards were observed indicating what product the tanks held. In addition, ten 55-gallon drums and approximately 20 tires were observed at the northeast end of the shed. None of the drums were labeled. No signs of product release were observed in the area surrounding the drums. One open drum was observed to be used to burn trash in. Within the burnt debris in the drum, burnt oil filters were observed (see Appendix H, Photos 71-75.)

An equipment storage area was observed southeast of the shed. Three unused aboveground storage tanks were observed there as well as one 55-gallon drum, three old automotive batteries, and various farm implements. No labels or placards were observed on the tanks or drum. Some soil staining was observed in the area around the drum possibly from the hydraulic cylinder placed on it (see Appendix H, Photos 76-79.)

A farming packing shed and equipment storage area was observed along the west levee border, approximately two miles north of the southwest corner of the island. Numerous harvesting trucks, tractors, aboveground storage tanks, 55-gallon drums, single-family residences, and two packing sheds were observed there. The five aboveground storage tanks observed at this location had the capacities ranging from approximately 530 gallons to 3,000 gallons. No labels or placards were observed on the tanks indicating their contents. No signs of a product release were observed in the area surrounding these tanks. However, stained soil was observed in the area where the heavy equipment and harvesting trucks were stored, as well as in other areas where no obvious source of staining could readily be identified. The observations made at this location were not comprehensive since access was limited due to the farming operations that were in progress at the time of the Site reconnaissance (see Appendix H, Photos 80-85.)

A farming operations headquarters was observed in the southeast corner of the island, along the east levee road. The facility consisted of an equipment maintenance shop, storage shed, approximately eight single-family residences, and farming implement staging and storage area (see Appendix H, Photos 88-89.)

Three aboveground storage tanks were observed north of the headquarters and single-family residences. Two of the tanks have a capacity of approximately 530 gallons, while the third has a capacity of approximately 425 gallons. It appeared that the tanks are no longer in use. No labels or placards were observed on the tanks indicating their contents. Based on the presence of fuel pumps near them, they

likely contained gasoline or diesel fuel. Stained soil was observed under the 530-gallon tanks (see Appendix H, Photos 103-104.)

Two 55-gallon poly drums were observed in the maintenance shop. The labels on the drums indicated that they contained a defoliant harvest liquid and an inorganic bisulfite solution (see Appendix H, Photos 92 and 94-95.) No signs of a product release from these drums were observed. A 550-gallon aboveground storage tank was observed at the south end of the shop. No signs or placards were observed on the tank. Stained soil was observed down-gradient from the tank (see Appendix H, Photo 90.)

Three large aboveground storage tanks were observed in the area south of the maintenance shop, but east of the storage shed. The capacity of the tanks is approximately 930, 2,000, and 7,500 gallons respectively. No placards or signs on the tanks were observed, however, the presence of a fuel pump indicates that they likely contain gasoline or diesel fuel. No signs of a product release or spill were observed in the area surrounding the tanks (see Appendix H, Photo 96.)

A large area south of the equipment staging area was observed to have been burnt. In the vicinity of this burnt area, approximately fifteen 55-gallon drums were observed. Some of the drums were apparently within the burnt area, while others were not. Some of the drums had a label identifying them as having contained Mobil DTE 25 hydraulic fluid. Site Assessment staff did not determine if the drums still contained product. No signs of a product release was observed in the area surrounding the drums (see Appendix H, Photos 98-102.)

A trash burn pit was observed in the southwest corner of the Site. The pit is located approximately one-half mile east of the west levee road. It appeared that the pit is used to burn household trash. Also visible in the burnt debris were one gallon paint cans and automotive oil filters (see Appendix H, Photo 48.)

Two portable aboveground storage tanks were observed east of the lake at Young's Slough. The tanks have a capacity of approximately 300 gallons. No labels or placards were visible on the tanks. No evidence of a product release was observed in the area surrounding the tanks (see Appendix H, Photo 50.)

An unpaved aircraft runway was observed approximately one and one-half miles north of the Bacon Island bridge, near the east levee road. The runway is situated in a east-west direction. An aboveground storage tank, two 55-gallon tanks, and one 5-gallon container were observed at the east end of the runway. The tank has a capacity of approximately 4,000 gallons. No placards or labels were observed on any of the tanks or containers. Stained soil was observed in the area south of the tank (see Appendix H, Photos 63-66.)

A packing shed, old barn, and single-family residence were observed approximately two miles north of the Bacon Island bridge. The packing shed was observed to be empty except for some food-processing machinery. The barn was also empty except for miscellaneous home appliances. Four aboveground storage tanks were observed southwest of the barn. None of the tanks appeared to be currently in use. The capacity of the tanks ranged approximately from 500-1,000 gallons. No placards or labels were observed on the tanks. No signs of a product release was visible under or around the tanks (see Appendix H, Photos 52-60.)

A large pile of burlap sacks was observed along an unpaved road in the southwest corner of the Site. The pile is approximately six-tenths of a mile long. In addition to the sacks, household trash, appliances, and other debris were observed in the pile. A used chemical container storage area was observed at the east end of the pile. The container consisted of a wood frame and wire fence wall that contained used chemical containers. Many containers were observed to be open and inverted. Stained soil was observed around the perimeter of the storage area. Those chemical containers with labels indicate that they contained Horizon F-6000 (humic acid), Rozol squirrel bait, and Roundup herbicide. Many

containers were observed to have no label on them, therefore, this inventory was based on only what could be reasonably viewed from outside the storage area (see Appendix H, Photos 86-87.)

Environmental Database Search

A search of state and federal government environmental databases was conducted by BBL Consultants. The database search determines if any reported sources of hazardous materials contamination exist within the minimum prescribed search radius as stated in ASTM Designation E 1527-00. The complete database report is in Appendix I. The databases searched for this island are the same as were searched for Webb Tract. See above within the text for a complete list of databases.

Site Assessment staff reviewed database information for those sites listed within the approximate minimum search distance of Bacon Island, emphasizing those locations expected to be up-gradient of the Site and that have been subject to groundwater contamination. In most cases, further file review is conducted only on listed sites identified as being 1) subject to groundwater contamination, 2) within one-eighth mile of the Site, and/or 3) that may be up-gradient of the Site. The environmental database report identifies recorded contaminated sites within one mile of the search area. If contaminated sites are identified, they are plotted to determine their relation to the Site.

The database search produced 10 potential problem areas situated either within or approximately one mile of the island. The Resource Conservation and Recovery Information System database reported a registered hazardous material generator. The Atchison Topeka and Santa Fe Railroad is listed as having a generator permit at the Orwood Middle River Bridge. However, this facility is listed as being situated approximately one-quarter mile southeast of Bacon Island. Therefore, environmental degradation from the facility is not likely.

The other nine potential problem areas reported are all situated near Holland or McDonald Islands or near the cities of Holt or Stockton. Based on the distance all other reported incidents and tanks are from Bacon Island, the threat they pose to the environmental quality of Bacon Island is minimal.

Baseline Conditions for Any Future Hazardous Materials Liability

Site Assessment staff recommends that a complete Phase II Environmental Site Assessment be performed for Bacon Island. Such an investigation would further establish the nature and extent of suspected contaminated areas should be assessed prior to the purchase and subsequent use of Bacon Island. Sampling, analyses, and characterization of suspected areas should be conducted to minimize DWR's potential liability for cleanup and remediation of suspect areas.

Site Assessment staff recommends that the areas on Bacon Island that were identified as having stained soil be sampled to identify the nature and extent of soil contamination. Specifically, the east side storage shed, numerous areas at the northeast farm headquarters, aircraft runway, both farm headquarters on the west side of the island, and the chemical container storage area in the southeast corner of the island. These areas all require various levels of assessment to determine the nature and extent of contamination.

Most of the single-family residences on the island are also a potential source of hazardous materials liability. Based on the age of the structures, they may contain lead-based paints and asbestos containing construction materials. Thorough sampling and analysis of the construction materials is recommended so a management or abatement plan can be implemented. In addition, the type of sewage system used for the structures should be researched. Proper decommissioning and removal of the systems should be conducted prior to any habitat or water storage activities occur to prevent a sewage release into standing surface water.

This investigation did not reveal the presence of water wells on the island. However, the fact that no wells were reported by the database search does not definitively determine their absence. In light of the fact that wells could potentially serve as a conduit for groundwater contamination, Site Assessment staff

recommends proper decommissioning of any well found to exist on Bacon Island that will not be used by DWR.

3.1.6.3 Resource Issues and Impacts

The conditions observed on Bouldin Island, Holland Tract, Webb Tract, and Bacon Island will require remediation before the islands can be used for any aspect of the In-Delta Storage project. Site Assessment staff observed six general areas of concern that must be addressed prior to the acquisition and subsequent use of the Site: chemical containers, stained soil, pesticide use, wells, structures, and debris. The scope of this assessment is to only identify the presence of potential sources of hazardous materials contamination. Further investigation will be necessary to properly assess the nature and extent of hazardous materials on these islands and tracts.

Chemical Containers

Chemical containers ranging from five gallons to 6,000 gallons in capacity were observed on all properties being considered for use in the In-Delta Storage project. Aboveground storage tanks and 55-gallon drums were the most common container observed. The majority of these containers were observed to be in good condition. However, many were observed to be open, leaking, or stored in a manner that prevented an accurate assessment without the use of intrusive measures. In addition, many tanks and containers were observed to have no labels or markings indicating what the contents are or were.

Site Assessment recommends that all chemical containers and tanks be removed and properly decommissioned and disposed of prior to the acquisition and use of the Site. The removal of large storage tanks may require compliance with specific decommissioning, disposal, and regulatory agency reporting protocols.

Stained Soil

Numerous areas were identified that had stained soil. Stained soil is evidence that a product release has occurred. The majority of the stains were likely due to poor house-keeping practices at refueling and equipment maintenance areas. However, stains may be a small indication of a larger plume of contamination underground. Such product releases pose a threat to surface and groundwater quality, as well as to all organisms that utilize the aquifer.

Site Assessment staff recommends that further investigation be conducted to determine the nature and extent of stained areas identified in the Site reconnaissance. Such investigation may include, but not limited to, sample collection and analysis of soil, surface water, and groundwater. Such samples would help determine what product was released and the extent of any contamination. Site Assessment also recommends that all contaminated soil be properly remediated prior to the use of the islands and tracts for habitat or water storage purposes.

Historic Chemicals Use

The islands and tracts under consideration for use have historically been used for farming. Over the course of time, farmers tend to use whatever state-of-the-art chemicals are available to them during that time. As chemical technology advances and regulations change, so do the chemicals that are utilized. This may result in a variety of residual chemicals in the soil. Such chemicals may gradually accumulate in topographic depressions or be transported by surface and groundwater. Such chemicals may pose a threat to surface and groundwater quality, as well as to all organisms that utilize the area.

Site Assessment recommends that all soil and water samples be analyzed for pesticides, herbicides, and other chemicals that may have been used on the land over the course of time. In addition, baseline soil and water sampling is recommended to establish their condition prior to use under this project.

Wells

Numerous groundwater and monitoring wells were identified during this investigation. Wells do not pose a direct threat to environmental quality. However, they may serve as a conduit for contamination to travel between the surface and groundwater, as well as between groundwater aquifers.

If DWR is not going to use the groundwater or monitoring wells, Site Assessment recommends that they be properly decommissioned and removed.

Structures

Site Assessment identified numerous structures on the Site. Although the most of them were barn or shed structures associated with farming operations, many were also single-family residences. Most of the single-family residences on the island are a potential source of hazardous materials liability. Based on the age of most of the structures, they may contain lead-based paints and asbestos containing construction materials. If DWR will acquire these residences and structures as part of the project land purchase, the potential liability associated with structure demolition needs to be assessed.

Thorough sampling and analysis for lead and asbestos construction materials is recommended. Based on the sampling results, a management or abatement plan can then be implemented. Site Assessment recommends that such an assessment be performed prior to the Site acquisition.

In addition, the type of sewage system used for the structures should be investigated. Proper decommissioning and removal of the systems should be conducted prior to any habitat or water storage activities occur to prevent a sewage release into standing surface water.

Debris

Site Assessment staff identified numerous debris piles on each island and tract. Although the debris does not pose a direct threat to environmental quality, it poses a physical hazard and may conceal potential sources of hazardous materials contamination. Some debris, such as automobiles, may not pose an environmental threat as is. However, if they become submerged by the water storage project, a release of fuel and oils may occur.

Site Assessment recommends that all debris piles be removed and properly disposed of prior to acquisition of the Site by DWR.

3.1.7 Recreation

The demand for recreation opportunities in the Delta is expected to increase, primarily as a result of growth in major population centers such as Sacramento, Stockton, Tracy, Pittsburg, and the Bay Area. Delta recreation is supported by these major population centers and the Bay Area, in general. Recreation use in the Delta exceeds 12 million user days annually, with boating being the most popular recreation activity, accounting for approximately 2,016,000 annual recreation visits. Fishing (not including boating) is the next most popular activity, attracting an estimated 1,800,000 recreation visits, and hunting accounts for approximately 72,000 recreation visits (JSA 1995a).

The most popular recreation alternatives in the Delta are boating and angling. Hunting, swimming, camping, picnicking, and nature viewing are also of interest to many people. Most recreationists in the Delta are local, coming from Contra Costa, Sacramento, and San Joaquin counties and traveling less than 50 miles from home to the Delta (DPR 1997). The four DW project islands are used primarily for perennial and annual agricultural production, with some hunting and fishing recreational uses.

Due to the increasing popularity of recreation in the Delta, the Department of Parks and Recreation (DPR) completed a survey in 1997 of boaters and anglers' likes and dislikes for the DPC and the Department of Boating and Waterways (DBW). Both groups identified shortages in public facilities, such as restrooms,

beaches, fishing piers, bicycle trails, hiking trails, hunting areas, fish cleaning stations, and public access points, as unmet needs. Most of the navigable waterways in the Delta are public, but most of the land is private. The lack of public lands serves to limit the use of the Delta for recreation. Public use of the Delta is concentrated in a few areas where marinas and other facilities provide access to waterways. There are very few public parks in the Delta, and some of the recreation areas in the Delta are only accessible by boat, further limiting use by the general public. The Delta's 1,100 miles of improved levees also provide access for some recreationists, mainly bank anglers. However, much of the levee system is also private. Overall, the survey shows that recreation opportunities in the Delta are limited because facilities are insufficient, access is limited, and the demand for parking, boat launch ramps, camp sites, and picnic areas exceeds supply (DPR 1997).

There are approximately 120 commercial recreation facilities in the Delta, including at least 100 marinas. Marinas provide services to regional boaters, including temporary and permanent berthing, mooring, and dry storage (JSA 1995a). While there are more than 12,000 berths in the Delta, there are over 67,000 registered vessels in Sacramento and San Joaquin counties alone, including anything from a large sailing vessel to a personal watercraft (DPC 1997). Other commercial facilities include resorts, restaurants with guest docks, and recreational vehicle parks. There are approximately 23 public recreation facilities in the Delta that include areas or facilities for boat launching, camping, fishing access, swimming, and picnicking (JSA 1995a).

Some hunting in public areas in the Delta is conducted from boats and on small, unnamed Delta islands. The state owns 15,000 acres in Suisun Marsh at the western edge of the Delta, including approximately 6,000 acres of public hunting areas at Grizzly Island Wildlife Area. The state also owns the Lower Sherman Island Wildlife Area north of Antioch, with 3,300 acres open to hunting. There is also public hunting on the state limited-ownership portion of Twitchell Island.

Hunting in the Delta occurs mainly on privately owned islands, with owners and their guests hunting waterfowl on agricultural lands. A typical private hunt club in the Delta accommodates between eight and 16 hunters on a shoot day. There are approximately 200 people with private memberships in Delta hunting clubs (JSA 1995a).

3.1.7.1 Existing Recreational Resources

Webb Tract

Webb Tract, located in Contra Costa County, is only accessible by boat or ferry and currently has limited recreational opportunities. The majority of Webb Tract falls under the CCCGP designation of Delta Recreation and Resources, with a small portion under Open Space (CCC 1996). The CCCGP identifies agriculture and wildlife habitat as the most appropriate uses in this area. The Delta Recreation and Resources designation allows for a residential density of one unit permitted per 20 acres, with marinas, shooting ranges, duck and other hunting clubs, campgrounds, and other outdoor recreation complexes allowed through issuance of a land use permit. All recreational uses should be accessible by a publicly maintained road. The Open Space designation includes areas involving resources management, such as those maintaining endangered habitats and low-intensity, private recreation (JSA 1995a).

Access to Webb Tract is limited; there are no County roads to the island, but there is a ferry service to Webb Tract from Jersey Island (Clamurro 2001). Table 3-15 details the current recreational uses on Webb Tract.

Table 3-15. Recreation on Webb Tract – existing conditions

Recreation Category	Users	Time of Use	Fees	Rec Use/ Season (Days)
Hunting				
Waterfowl	Invited Guests	Wed, Sat, Sun in Dec and Jan after Corn Harvest	None	320
Pheasant	Invited Guests	Nov 12 – Dec 1	None	320
Fishing				
Levee	Need Written Permission			90
Northern Blowout Pond	Need Written Permission			
Boating				
Marinas	None			
Swimming	None			
Camping	None			
Picnicking	None			
Nature Viewing	None			
Source: JSA 2001b				

Bouldin Island

Bouldin Island is located in San Joaquin County and is primarily used for agriculture. Bouldin Island is designated as agricultural and resource conservation under the San Joaquin County General Plan (SJCGP) and would require development plan approval for hunting and fishing clubs. Conditional use permits would be required for marinas and uses ancillary to marinas (JSA 1995a). Route 12 traverses the northern portion of Bouldin Island, and there are no county roads on the island (Clamurro 2001). Table 3-16 details the current recreational uses on Bouldin Island.

Holland Tract

Two marinas are located at the southern boundary of Holland Tract on Rock Slough. The Lindquist Landing Marina on the southern boundary features boat docks and other structures ancillary to marina uses. The Holland Riverside Marina, at the southeastern corner of the island, is a large facility with numerous boat docks, covered slips, and ancillary marina uses (JSA 1995a).

DW Properties owns a majority of Holland Tract parcels. However, DW Properties does not own the Beaulieu Foundation parcel (857 acres) in the southwestern corner of the site, several small parcels adjacent to the Beaulieu parcel in the southwestern corner of the island, and the marina parcels along the southeastern perimeter of the island. The marina parcels, the Beaulieu Foundation parcel, and other small parcels would not be purchased as part of the project and are, therefore, excluded from environmental evaluations in subsequent sections (JSA 1995a).

Table 3-16. Recreation on Bouldin Island – existing conditions

Recreation Category	Users	Time of Use	Rec Use/ Season (Days)
Hunting			
Waterfowl[a]	Invited Guests	Wed, Sat, Sun during the Waterfowl Season[b]	150
Pheasant[a]	Invited Guests	Wed, Sat, Sun over 30-Day Period	60
Fishing			
Levee[a]	Workers, Invited Visitors	Weekends and Weekday afternoons, Oct-Mar	360
Boating			
Marinas	None		
Swimming	None		
Camping	None		
Picnicking	None		
Nature Viewing	None		

[a]No fees were charged for any of these activities.

[b]Waterfowl hunting is allowed over a 59-day period during waterfowl season. Waterfowl season is set by Pacific Flyway Committee and timing varies annually.

Source: JSA 2001b

The Contra Costa County zoning designations for Holland Tract are General Agricultural District (A-2) and Heavy Agricultural District (A-3). Uses allowed under A-2 zoning were discussed above for Webb Tract. There are no apparent zoning restrictions that would constrain the development and operation of recreational facilities. (JSA 1995a).

The CCCGP designation for all of Holland Tract is Delta Recreation and Resources. Uses allowed under the Delta Recreation and Resources designation are the same as discussed under Webb Tract. Table 3-17 details the current recreational uses on Holland Tract.

Bacon Island

Bacon Island is located in San Joaquin County and is primarily used for agriculture. Bacon Island is designated as agricultural under the SJCGP and would require development plan approval for hunting and fishing clubs. Conditional use permits would be required for marinas and uses ancillary to marinas (JSA 1995a). A county road provides limited access to portions of the island and access to Mandeville Island (Clamurro 2001). Table 3-18 details the current recreational uses on Bacon Island.

Table 3-17. Recreation on Holland Tract – existing conditions

Recreation Category	Users	Time of Use	Rec Use/ Season (days)
Waterfowl Hunting	For-Fee and Friends	Wed, Sat, Sun During the Waterfowl Season	50 at Hunt Clubs, 10-15 at Private
Fishing			
Marina			4,000
Launch Ramp			4,500-7,000
Levee			200
Boating			
Marinas			25,600
Launch Ramp (Use Mostly Related to Fishing and Water-skiing			22,750-38,500
Swimming	None		
Camping	None		
Picnicking	None		
Nature Viewing	None		
Source: JSA 1995a			

Table 3-18. Recreation on Bacon Island – existing conditions

Recreation Category	Users	Time of Use	Rec Use/ Season (Days)
Hunting			
Waterfowl	None		
Upland Game[a]	Workers and Family	3-Week Period, Mid-Nov to Mid-Dec	100
Fishing - Levee	Employees and Relatives		3,120
Boating			
Marinas	None		
Swimming	None		
Camping	None		
Picnicking	None		
Nature Viewing	None		
[a] No fees charged for hunting. Source: JSA 1995a			

3.1.7.2 Resource Issues and Impacts

Review of DW Proposed Recreation

In 1987, DW Properties, a private venture, filed water rights applications with the SWRCB to divert and store water on four islands in the Delta. The original proposal was to use all four islands as water storage reservoirs, but this was modified to the configuration that uses Bacon Island and Webb Tract as reservoir islands and Bouldin Island and Holland Tract as wildlife habitat islands.

The following description of the DW project-proposed recreation facilities comes from the JSA (1995a) but has been altered to halve the number of recreation boat slips that would be allowed under the SWRCB agreement (SWRCB 2001) due to fish predation concerns.

The DW project proposes recreation on all four islands. On the reservoir islands, Bacon Island and Webb Tract, a maximum of 11 recreation facilities are planned, each with a 5-acre footprint. Living quarters with up to 40 bedrooms (80-person occupancy), a 15-berth floating dock with gangway to provide access from neighboring water channels, an 18-berth floating dock on the interior of the island to provide small-boat access to hunting areas, and a 40-car parking lot are proposed. For the habitat islands, construction of up to 10 new recreation facilities is proposed on Bouldin Island, with six new facilities on Holland Tract, also each on 5 acres. These facilities would be similar to those planned for the reservoir islands.

On the reservoir islands, waterfowl hunting is proposed during both shallow-water wetland conditions and water storage conditions. In addition, hunting of upland birds could occur if habitat for these birds is established when the reservoir islands are managed for shallow-water habitat. Predicting when the islands would be available for hunting during shallow-water wetland periods is difficult, however, because the water management regime may change from year to year. The estimated number of recreation use days for hunting is shown in Table 3-19 and has been adjusted to account for unpredictability in storage conditions.

Table 3-19. Estimated recreation use days on all four islands – proposed conditions

Island	Hunting (Use Days)	Fishing/Boating (Use Days)[a]	Other (Use Days)
Reservoir Islands			
Bacon Island	2,591	14,589	11,137
Webb Tract	2,664	14,589	11,137
Habitat Islands			
Bouldin Island	8,632	13,290	10,157
Holland Tract	4,011	36,078	6,098
TOTAL	17,898	78,546	38,530

[a] The number of fishing/boating days has been reduced by 50 percent due to the limit on boat slips required in SWRCB Decision 1643 (SWRCB 2001)

Source: JSA 1995a

On the habitat islands, 2,122 acres on Bouldin Island and 933 acres on Holland Tract are proposed to be managed as spaced-blind hunting zones, with a density of one blind per 50 acres and up to four hunters per blind. A total of 2,331 acres on Bouldin Island and 1,308 acres on Holland Tract are proposed to be managed as free-roam hunting zones for waterfowl and upland game, with maximum hunter density of one hunter per 60 acres. In addition, 104 acres for upland game hunting are proposed on Bouldin Island.

The estimated number of recreation use days for hunting is shown in Table 3-19.

Under the proposed project, up to an additional 38 recreation facilities would be added to the Delta, with permanent boat docking for up to 399 boats (assuming a 70 percent occupancy rate of the 15-berth boat docks). The estimated number of recreation use days for fishing and boating is shown in Table 3-19, assuming an average of three people per boat.

The proposed project would likely result in increased recreation uses other than hunting, boating, and fishing. Such activities could include birdwatching, photography, nature study, walking, relaxing, skeet and trap shooting, swimming, canoeing, windsurfing, and other activities. The estimated number of recreation use days for fishing and boating is shown in Table 3-19.

Since inception of the DW project, DW Properties has worked with DFG, USFWS, and NMFS to establish fishery resource protection measures. A comprehensive list of criteria was established during endangered species consultation, and FOC were established to protect listed and non-listed fisheries in the Delta (Anonymous 2001). In February 2001, the SWRCB adopted its decision to issue water rights permits for the DW project. In an agreement with the East Bay Municipal Utility District (EBMUD), DW agreed to remove many existing siphons, limit new facilities, and include operating restrictions to protect out-migrating Mokelumne River salmon (SWRCB 2001).

Although the majority of potential impacts and issues surrounding the construction and operation of the DW project have been resolved, there is a concern that the development of recreational facilities could increase trespass on neighboring levees and islands. It can be reasonably argued that the provision of managed facilities, open and accessible to the public, will reduce the incidence of trespass. All anticipated recreational facilities will be located on project islands and should not lead to trespass on non-project lands.

The project, as described above, would consist of facilities proposed by the DW project. Alternative 1 of the In-Delta Storage project would entail federal and state entities acquiring properties from DW Properties and operating it in accordance with the terms and conditions of the SWRCB Permit and all other permits, agreements, and limitations imposed on the Project.

Conflicts With Reclamation/DWR Purchasing the Project

The project, as described above, would consist of facilities proposed by the DW project. Alternative 1 of the In-Delta Storage project would entail federal and state entities acquiring properties from DW Properties and operating them in accordance with terms and conditions of the SWRCB permit and all other permits, agreements, and limitations imposed on the project. Although federal and state entities would own the four islands, a private entity, through leases or other agreements, would operate and maintain the recreation facilities as proposed by DW.

The 1997 survey by the DPR of boaters and anglers in the Delta identifies shortages in public facilities, such as restrooms, beaches, fishing piers, bicycle trails, hiking trails, hunting areas, fish cleaning stations, and public access points. If the federal and state agencies purchased the project islands and had a private entity provide the recreation, there could be a conflict if the facilities were not affordable and, thus, not available to the general public.

The number and type of facilities may not be appropriate for a public project either, as the survey did not indicate that the recreating public wants more places to stay overnight, as is described under Alternative 1. In addition, both the Draft EIR/EIS and SWRCB Decision 1643 indicate that the increase in boat use (although the number of boat slips proposed was reduced by 50 percent from the original project description) would have a significant and unavoidable impact on the quality of recreational boating in the Delta.

The project facilities, as designed under Alternative 1, provide for 38 overnight facilities with room for 80 people apiece, 40-car parking lots at each site, and boating facilities. In accordance with SWRCB

Decision 1643, the location of boat slips is critical for out-migrating Mokelumne River salmon, and DW has agreed to apply additional restrictions on boats in specific areas adjacent to the migration routes (SWRCB 2001). Thus, the design and operation of private facilities would have to be carefully planned so as not to conflict with other recreation and resource uses.

It is not likely that the timing of recreation activities would conflict, because the activities tend to occur at different times of the year. Waterfowl hunting generally occurs October through December, while fishing occurs almost year round but with limited activity in December and January and the most activity from April through June. Swimming, water-skiing, and jet skiing occur during summer months, primarily May through September.

Are the Facilities Appropriate for a Public Project?

The private-use facilities proposed under the DW project are not likely to be considered appropriate for a publicly owned and operated project.

How Will Project Design and Operation Affect Recreational Opportunities?

Project design and operation on the habitat islands will not affect recreational opportunities. Operation of reservoir islands significantly reduces recreational opportunities.

Conflicts With Operation and Maintenance

There are no apparent conflicts between recreational use and operation and maintenance of the project facilities. DW proposed 171 fish screens, siphons, and pumping stations on the reservoir islands. Those structures will conflict with recreational activities near the structures on both the reservoir and channel sides of the islands. Even if recreational use is limited to levee bank access, markers need to be installed to keep recreational users away from the area to prevent accidents and provide safeguards for public health and safety. Because areas around the 171 inlet and outlet structures will be off limits to recreational users, levee access for fishing is reduced. (We are estimating a total linear feet of 7,380 impacted on Webb and Bacon.) For this reason, the recreational facilities proposed on reservoir islands are limited to four fishing access sites and four boat docks for each island. The biking and walking trails on the levee crown would not be in conflict with the siphons.

Costs of Recreational Facilities Proposed by the DW

The DW project proposed providing opportunities for private recreation, but did not envision building any facilities (Forkel 2001 personal communication; see “Notes”). The DW concept is to set aside areas for facilities and uses that would be leased or purchased by individuals or groups. The design, scope, or scale of facilities such as clubhouses, portable housing, or boat docks would be at the discretion of the lessee or purchaser.

For the purposes of environmental impact assessment and disclosure, the DEIR/EIS assumed a maximum footprint of 5 acres for each “conceptual recreational facility.” It also assumed 40 users and their guests would occupy each facility. These assumptions provide a basis for impact assessment and generation of reasonable estimates of use and economic benefit to the surrounding region.

No costs for private recreational facilities are assumed by DW, and no profits from the lease or sale of recreational facilities are assumed by DW.

Status in DW Permitting

No specific permits for recreational facilities have been sought by DW. Under their private-use concept, all permits and costs are the responsibility of those who obtain use rights through purchase or lease.

3.2 Mitigation and Possible Solutions

3.2.1 Land Use Mitigation

JSA (2001b) identified two significant adverse impacts to agricultural land from the DW Project: conversion of prime farmland and conflicts with land use plans and policies. DW Project did not propose mitigation measures to reduce the impacts on agricultural lands to less than significant levels. The SWRCB issued a Statement of Overriding Considerations in D-1643 and considered the project's value to water supply to outweigh the importance of maintaining agriculture on the islands. Another possible benefit of converting the islands to nonagricultural uses is a decrease in the rate of soil loss from the reduction of peat oxidation and subsidence. However, we are unable to quantify that benefit at this time.

If state and federal agencies lease or buy the DW Project as it is currently designed, the impacts to agriculture will remain significant and unmitigated. Some level of mitigation for agricultural impacts should be included in the project.

CALFED (2000a) identified 31 mitigation measures that could be used to reduce potential effects on agricultural land. If the DW Project is purchased by federal and state agencies, the agencies could incorporate acquiring easements on surrounding agricultural land through the California Farmland Conservancy Program. This would add an unknown cost to the project but would not require the modification of permits, biological opinions, etc. It would also reduce the impacts to agricultural land. Additional work in the next phase of the In-Delta Storage Program will be necessary to identify specific land use mitigation measures, develop a schedule for implementation, and resolve any remaining Williamson Act issues with the Department of Conservation.

3.2.2 Habitat Management Plan

In order to determine the impacts on wildlife species and habitats, DW conducted an analysis using Habitat Evaluation Procedures (HEP). The HEP team could not resolve some issues, and were unable to determine all of the project impacts. The DW habitat islands HMP was prepared at the request of the SWRCB to fully compensate for impacts on wildlife and wetlands caused by operation of the DW reservoir islands. A team comprised of staff from DFG, SWRCB, and Jones and Stokes Associates (JSA) prepared the HMP. The team coordinated with experts from USFWS, Ducks Unlimited, California Waterfowl Association, and the Contra Costa County Fish and Wildlife Committee.

3.2.2.1 Summary of the Delta Wetland's Habitat Management Plan

The HMP would develop and protect approximately 9,000 acres of wildlife habitat on Holland Tract and Bouldin Island to mitigate for the loss of approximately 11,000 acres of habitat on Webb Tract and Bacon Island. The habitat to be developed is shown in Table 3-20.

The HMP goals include the following in order of priority:

- Compensate for the loss of foraging habitat on the reservoir islands for Swainson's hawk and greater sandhill crane, which are protected species under the California Endangered Species Act (CESA),
- Develop wintering waterfowl habitat,
- Compensate for loss of jurisdictional wetlands, including riparian habitat,
- Provide the greatest benefit to upland wildlife species,
- Enhance breeding habitat for waterfowl,
- Develop roosting habitat for greater sandhill cranes,
- Develop nesting habitat for Swainson's hawks, and
- Enhance habitat conditions for migratory shorebirds, non-game water birds, and species associated with riparian habitats.

The HMP will establish a hunting program for the habitat islands. Hunting would be managed for waterfowl, upland game species, and furbearers. Facilities would be constructed to accommodate hunters; this includes a total of 16 facilities. Closed hunting zones have been included in the plan to minimize the impact to greater sandhill crane.

Table 3-20. Habitats to be developed on the habitat islands (JSA 1995a)

Habitat Type[a]	Bouldin Island		Holland Tract		Habitat Islands	
	Total Acres	Percent of Total Acres	Total Acres	Percent of Total Acres	Total Acres	Percent of Total Acres
Corn/wheat	1,629	27	955	31	2,584	29
Small grains	106	2	152	5	258	3
Mixed agriculture/seasonal wetlands	1,014	17	631	21	1,654	18
Seasonal managed wetland	1,723	29	393	13	2,116	23
Season pond	66	1	68	2	134	1
Pasture/hay	132	2	72	2	204	2
Emergent marsh	208	3	194	6	402	4
Riparian	170	3	217	7	387	4
Lake	111	2	33	1	144	2
Herbaceous upland	479	8	253	8	732	8
Developed	177	3	58	2	235	3
Canal	70	1	10	0	80	1
Borrow pond	89	1	0	0	89	1
Total	5,974	100	3,036	100	9,010	100

[a]Includes existing habitat to be protected

3.2.2.2 Adequacy of the Habitat Management Plan

Wildlife and Botanical Resources

Swainson's hawk. The DW Project would result in the loss of 10,048 acres of Swainson's hawk foraging habitat. Based on DFG guidelines, approximately 6,708 acres of suitable Swainson's hawk habitats are required to be managed and protected on the habitat islands to compensate for project impacts. The HMP would provide a total of 7,539 acres of suitable foraging habitat. This is approximately 830 acres more than required under the CESA. Additionally, foraging habitat for wintering populations would be provided in the HMP by managing habitats to increase prey accessibility and provide prey species refugia from flooding. Furthermore, 122 acres of existing riparian habitat and 265 acres of additional riparian habitat will be created, which would be of sufficient size in 15-20 years for Swainson's hawks. DFG has issued an Incidental Take Permit for the DW Project with the above mitigation requirements. It should be noted that if a new Incidental Take Permit is required, mitigation requirements could increase based upon revised mitigation guidelines. The mitigation guidelines being revised could have mitigation ratio as high as 1½: 1, if not higher.

Greater Sandhill Crane. The DW Project would result in the loss of 7,028 acres of suitable greater sandhill crane foraging habitat. The HMP team established a mitigation goal of replacing the affected foraging habitat acreage at a ratio of 1:1. The HMP would provide for a total of 7,673 acres of potential crane foraging habitat on Bouldin Island and Holland Tract, which is 645 acres more than required for compensation. The HMP would also increase habitat values by leaving unharvested strips of corn in fields, periodically mowing densely vegetated habitats to improve access for foraging, and maintain dry or shallow-water conditions as roost sites. The HMP would develop some suitable roost sites within closed hunting zones by completely mowing seasonal managed wetlands on the east side of Bouldin Island.

However, the HMP does not specify the quantity of roosting habitat to be managed. DFG has issued an Incidental Take Statement for the DW Project with the above mitigation requirements.

Waterfowl. Approximately 10,514 acres of low to moderate value waterfowl foraging habitat will be eliminated on the reservoir islands. The compensation requirements were derived from Habitat Units (HU) computed in an earlier HEP analysis for white-fronted goose winter foraging habitat. It was determined in the HEP that mitigation could be achieved with the development of 8,220 acres of habitat (JSA 1991). This would be comprised of 6,549 acres of high-value winter foraging habitat and 1,670 acres of lower value habitat. Additionally, creating open areas in dense vegetation, limiting the amount of corn and wheat harvested to provide abundant food sources, and flooding harvested fields and wetlands would enhance winter foraging habitat values. Waterfowl breeding habitat would be enhanced over existing conditions by providing 5,490 acres of suitable nesting and brood habitats on the habitat islands. Additionally, 800 nesting boxes and platforms would be installed for wood ducks and geese. The existing breeding habitat on DW Project islands was not quantified in the HMP or DEIR/EIS.

Upland Wildlife Species. Nearly all upland habitats would be lost on the reservoir islands. Upland habitat would also be lost on the habitat islands when the area is flooded for fall and winter wetlands. The HMP would manage approximately 990 acres of small grain fields and herbaceous upland for wildlife species. An additional 6,683 acres of seasonal crops, wetlands, and pasture will provide seasonal upland habitat during periods when not flooded.

Other Special-Status Species. According to the HMP, habitat development could provide suitable habitat for 22 special-status species. Other than the goals mentioned for state listed species, there are no management goals or objectives for potentially occurring special-status species. The Incidental Take Permit issued by DFG, requires DW to monitor for giant garter snake and yellow-billed cuckoo should they be discovered on the project islands. The ITP and the HMP would be modified to include management goals for special-status species that occur once habitat develops. Additionally, the HMP requires surveys prior to management activities and those activities would be modified if necessary, to assure that there would be no adverse impact to sensitive species.

Corn Rotated with Wheat. A total of 2,584 acres of corn would be established. The corn would be rotated with wheat every fourth year. Cornfields would be managed to compensate for project impacts on foraging habitat for wintering swans, geese, and greater sandhill cranes. This habitat also provides high forage value for wintering ducks and moderate forage value for Swainson's hawks following harvest and fall flooding.

Small Grain Crops. A total of 258 acres of fields will be developed in small grains. This habitat would be managed to provide nesting cover for ducks. Grain fields will also provide forage for waterfowl, and cranes in spring and Swainson's hawk foraging habitat following harvest in July.

Mixed Agriculture/Seasonal Wetland. A total of 1,645 acres of mixed agriculture/seasonal wetland habitat would be established on the habitat islands. This would consist of strips of corn interspersed among seasonal emergent wetlands. This habitat would be managed to mitigate for project impacts on wintering waterfowl. Dry to shallow-flooded portions would provide suitable crane foraging areas, and following spring drawdown, dense vegetation growth would provide nesting cover for ducks and other ground nesting species. Portions of this habitat would be mowed in the summer to provide Swainson's hawk foraging habitat.

Seasonal Managed Wetlands. A total of 2,116 acres of seasonal managed wetland habitat would be established on the islands. Smartweed and watergrass would be the dominant vegetation in these wetlands. Species management objectives are the same as described above.

Pasture/Hay. A total of 204 acres of pasture and hay fields would be developed on the habitat islands to provide foraging habitat for cranes and Swainson’s hawks. Approximately 25% of each pasture would be harvested in early spring and summer to provide Swainson's hawk foraging areas. Fields (75%) would be

mowed and flooded to enhance the availability of invertebrate prey for cranes in the fall and winter. This habitat would also provide late winter herbaceous forage for waterfowl.

*Seasonal Ponds***.** A total of 134 acres of small seasonal ponds, ranging in size from 2 acres to 10 acres would be established. Seasonal ponds are not required to mitigate for project impacts. Seasonal ponds would be managed to provide high quality duck brood habitat.

Permanent Lakes. Two permanent lakes of 50 acres and 60 acres would be established on Bouldin Island. The lakes would mitigate for the loss of the Webb Tract blowout ponds. The lakes would provide resting areas for waterfowl in the winter. Lakes would also provide brood and foraging habitat for waterfowl and other water birds.

Herbaceous Upland. A total of 732 acres of herbaceous upland habitat would be established on the islands. The herbaceous uplands would consist of a mix of native and exotic grasses and forbs. Herbaceous uplands would be managed to compensate for projects impacts on Swainson's hawks, greater sandhill cranes, and other upland nesting or foraging species.

Emergent Marsh. A total of 402 acres of permanent emergent marsh dominated by bulrush and cattail would be developed on the habitat islands. Emergent marsh would be established to mitigate for loss of jurisdictional wetlands. Additionally, emergent marsh would provide habitat for waterfowl and other water birds, as well as nesting and foraging habitat for rails, blackbirds, marsh wrens, and other marsh-dwelling species, such as giant garter snake.

Borrow Ponds. Borrow areas would be required for levee repairs and construction. Ponds would be created as materials are excavated and water fills, but habitat values would diminish as periodic disturbances occurred.

Riparian Scrub. A total of 122 acres of riparian scrub would be created and maintained on the habitat islands. Approximately 40 acres of existing riparian scrub would be maintained. This habitat development would mitigate for project impacts to jurisdictional wetlands. Riparian scrub habitat would provide habitat for migratory songbirds, voles, mice and raccoons and beavers.

Riparian Woodland. Approximately 143 acres of riparian woodlands would be established on the habitat islands. Additionally, approximately 99 acres of existing riparian woodlands would be maintained. This habitat would mitigate for jurisdictional wetland loss from project impacts. Once established riparian woodland habitats would support the greatest diversity of wildlife among the island habitats. Large trees would provide suitable nest sites for Swainson's hawks, other tree nesting raptors, and other species. Cavities associated with older trees provide nest or roost sites for numerous species including American kestrels, woodpeckers, bats, wood ducks and raccoons. Some riparian woodlands would be flooded to provide winter foraging habitat for dabbling ducks.

Lake Islands. Ten small islands would be constructed in the Bouldin Island lakes to support emergent vegetation for nesting and escape cover for waterfowl.

Wetland Islands. Small islands would be constructed in corn/wheat fields, mixed agriculture/seasonal wetlands, and seasonal managed wetland habitats to provide waterfowl loafing sites and refugia for small mammals.

Wildlife Issues

Recreation Facilities Locations. The primary objective of the HMP is to mitigate the project impacts on listed species. The recreation facilities that are proposed on Holland Tract and Bouldin Island will require site specific analysis and monitoring to ensure the use and locations are compatible with the prime objective. Potential conflicts could be resolved by eliminating sites, restricting use of facilities during sensitive season or monitoring habitat use prior to opening facilities.

Hunting Program. The HMP would allow waterfowl and game hunting on the habitat islands. The HMP would allow free-roam and space blind hunting. Closed hunting zones would be established to minimize impacts to greater sandhill cranes. Free-roam hunting would be restricted adjacent to the closed zones but blind hunting would be allowed. The effectiveness of using closed hunting zones on the habitat islands is unknown. Continuous monitoring will be required to ensure that disturbances from hunting don't conflict with the HMP primary objective of providing foraging and roosting habitat for greater sandhill cranes. Alternatively, a study could be conducted to determine the type of hunting program that would be compatible with the primary objectives of the HMP after the habitat is established. DW is required to monitor use by hunters to insure compliance with rules and restrictions.

Fire Suppression. The HMP does not include a wildfire management plan for the habitat islands. The HMP is relying on existing emergency fire response agencies to control fires. However, there is no analysis that verifies the level and timing of control needed from local agencies to adequately respond to wildfires in 9,000 acres of variable wildlife habitat. Furthermore, there is no strategy for controlling fires that would minimize adverse affects to sensitive species and habitats.

Fire management issues could be resolved by assembling fire control experts, local fire stations and staff from the California Department of Forestry and Fire Protection to develop a fire management plan. The plan should assure that adequate fire suppression resources would be available and should develop the strategies and management practices for protecting sensitive species and habitats.

Bouldin Island Airport. The airport would be used for fixed winged aircraft during the hunting season. The impacts of this operation on greater sandhill crane and waterfowl are not clear. DW will develop a monitoring plan for approval by DFG to monitor the effects of the airstrip operations. Management of the airstrip could be modified based upon the monitoring results.

Incidental Water Storage. The HMP states that DW may use the habitat islands for incidental water storage for water transfer, banking, or future discharge and sale. There are no specific details on the incidental water storage or how it would affect wildlife habitats. DW would coordinate with DFG, USFWS, NMFS, and other groups prior to implementing.

Botanical Resource Issues

Special-Status Plant, Rare Natural Community, and Habitat Management

In regard to the perimeter of the habitat islands, construction, operation, and maintenance occurring on levees, and cumulative impacts from boats (i.e., boat wakes) could affect special-status plant species, their habitat, and coastal and valley freshwater marsh. Boat wakes could contribute to erosion and recreational enthusiasts, like those who fish from levees, could widen the boundaries of a recreational impact zone as they spread out along the levees to fish. They could inadvertently trample or disturb special-status plant species and other native wetland plants growing on or at the toe of island levees. How recreational activities could affect in-channel island habitat, invasive species composition, special-status species, and geomorphology (i.e., erosion) is unknown. As mentioned previously (Section 3.1.2.1), native habitat, wetlands, and special-status plants could be affected by boating activity, especially increased wave action from boat wakes (Kjeldsen and others 1997).

Application of herbicides for agricultural production and the removal of woody vegetation from levees are two techniques used to control invasive plants on DW Project islands (JSA 1995a, 1995b). Although herbicides can be used to manage weed infestations and undesirable plant growth, they might also damage and kill species that make up native habitat, especially special-status plants or species in the coastal and valley freshwater marsh community.

Exotic weeds out compete native plant species for resources like nutrients and space. Some invasive taxa that are difficult to control include giant reed, perennial peppergrass, purple loosestrife (*Lythrum salicaria*), and Brazilian elodea. The HMP lacks information about (a) how exotic weed dispersal from the

edges of cultivated wildlife foraging habitat (e.g., sandhill crane foraging habitat) can impact adjacent native habitats and species, and (b) how exotic weed infestations could be eliminated with minimal impact to native habitat and species. Exotic weeds will impact native habitats on the perimeter and interior of the habitat islands.

In regard to the interior of the habitat islands, no special-status plant occurrences were found during the 1988 and 1994 surveys (JSA 1995a), suggesting that at that time appropriate habitat was not available in the presence of intensive farming practices.

Solutions to Botanical Issues

The HMP states that before recreation facilities, pump stations, or other project facilities are constructed on perimeter levees, surveys will be conducted at proposed facility locations to ensure that special-status plant populations will be avoided (JSA 1995b). Management goals and guidelines for special-status species and coastal and valley freshwater marsh would be included in the management and monitoring programs. This would reduce conflicts between botanical resource management, (a) wildlife, aquatic, and cultural resource management, (b) exotic species management, (c) project operation and maintenance, and (d) recreation activities.

A boat berth mitigation fee will mitigate for recreational boat impacts on habitat of listed species (like Mason's lilaeopsis) found along the exterior of habitat islands (Section 3.1.2.1) (DFG 2001a). Also, according to Condition 12 of the DFG Incidental Take Permit, floristic studies will be required in areas likely to be affected by the DW Project. Areas likely to be affected include the exterior levee slopes and the interior of each island. Condition 12 addresses listed plants in the event that they are found prior to the implementation of the DW Project or become established during implementation of the HMP (DFG 2001b). In addition, DFG will be responsible for the oversight of the DW Properties' daily management of the habitat islands and a Habitat Management Advisory Committee (HMAC), established by the SWRCB, will provide long-term technical oversight of habitat island management (JSA 1995b). Regulatory supervision by DFG and the HMAC will presumably cover the long-term management of special-status plant occurrences on the habitat islands in the event that populations become established. If impacts to listed plant species are unavoidable, a mitigation and monitoring program will be implemented (DFG 2001a).

In the Delta, eradication of terrestrial and aquatic weeds consumes much time and money. An assessment of (a) which invasive taxa are most likely to cause impacts, (b) control strategies to lessen the impacts, and (c) mitigation plans to offset impacts should be included in the HMP.

3.2.2.3 Habitat Islands and Impacts to Agriculture

The habitat islands would be managed to provide suitable habitats for a diverse assemblage of wildlife species. The islands would not be optimized for agriculture production. Bouldin Island's 1987 agriculture included approximately 4,530 acres of corn, wheat, and sunflower crops and 34 acres of pasture. Holland Tract agriculture in 1987 was comprised of approximately 550 acres of corn and wheat, 423 acres of asparagus, and 350 acres of pasture for a total of 1,323 acres. The impacts to agriculture would be somewhat compensated for by implementing the HMP. The HMP (Table 3-20) would include planting approximately 2,780 acres of corn/wheat, small grains, and mixed agriculture and seasonal wetlands, and pasture on Bouldin Island and about 1,810 acres on Holland Tract.

The HMP requires that there be a total of 2,584 acres of corn rotated with wheat annually. This includes 1,292 acres (50%) in a corn-to-corn rotation. Also, 646 acres (25%) would be in a corn-to-wheat rotation. The remaining 646 acres (25%) would be in a wheat-to-corn rotation. Approximately 866 acres of corn would be harvested in the corn-to-corn rotation. Also, approximately 426 acres in the corn-to-wheat rotation would be harvested annually by September 1. A total of 1,292 acres of corn would be harvested annually and approximately 323 acres of wheat would be harvested annually after July 15. A total of 1,615 acres (63%) would be harvested annually. Corn would not be harvested in the mixed agriculture/seasonal wetland habitat type. Approximately 129 acres (50%) of the small grains would be

harvested. Pasture/hay habitats (153 acres) would be harvested each year. Overall, approximately 4000 acres of crops would be planted but only 49% would be harvested.

3.2.2.4 Possible Changes to the HMP to Meet the Needs of a Public Project

Additional analysis will be required to determine the number of recreation facilities and the locations that are compatible with the overall objectives of the HMP, as discussed above. The use of private hunting clubs could be changed to a DFG or USFWS administered hunting program. This may require that the scope of the hunting program be modified to assure that overall management objectives are met.

The HMP does not contain specific management objectives for shorebirds and migratory land birds. National, regional and local habitat management objectives for shorebirds and migratory land birds should be evaluated to determine specific objectives to be included the HMP and how this would affect the other species' objectives. The HMP emphasizes the development of waterfowl habitat that appears to be in excess of mitigation requirements. Therefore, it may be possible to modify some specific management objectives to provide an overall ecological benefit by increasing habitat values for other wildlife groups.

3.2.2.5 Estimated Costs to Implement the HMP and Associated CESA Requirements

The preliminary cost estimates for the HMP plan are based on limited site information, limited planting specifications, and no engineering information. The engineering designs would include site analysis for construction plans and specification for habitat development. Once engineering and construction requirements are determined, more specific cost estimates for site construction, habitat development and operation and maintenance can be developed. Site construction and earthwork estimates are based upon the quantities provided by DW Properties. The unit cost of was based upon the 2000 In-Delta Storage investigation Pre-Feasibility Study Draft Report (CALFED 2000b).

Table 3-21. Preliminary cost estimates for habitat development in the Habitat Management Plan[a]

Activity	Estimated Cost
Site construction (earthwork)[b]	$ 19,245,784
Vegetation installation[c]	$ 1,975,131
Subtotal	$ 21,220,915
Contingencies (20%)	$ 4,244,183
Contract subtotal	$ 25,465,098
Eng., legal, & adm (25%)	$ 6,366,274
Total Cost	$ 31,831,373

[a] Estimates are based on limited site information, limited planting specifications, and no engineering information.
[b] Site construction and earthwork estimates are based upon quantities provided by DW Properties. Unit cost was based upon the 2001 In-Delta Storage Program Draft Report on Engineering Investigations.
[c]Habitat vegetation cost estimates were based on the information in Table 3-22C.
Note: Cost of borrow pond development, and pumps, siphons, & culverts associated with the habitat management are not included. Land acquisition costs are not included.

Habitat vegetation cost estimates were based on cost from similar projects in the region (i.e. Prospect Island, Decker Island, Stone Lakes, Cosumnes River Preserve, Hill Slough), current catalogs from plant nurseries, published information (EPA 1999) and adjusted for specific habitat development requirements (Tables 3-21 and 3-22). The cost estimates for developing corn and wheat fields was based upon UC Davis studies (Kearny and others 1994, 2000).

Table 3-22. Preliminary cost estimates for vegetation installation[a]

Develop Habitats	Total Acres	Estimated cost/acre	Estimated Cost
Corn/wheat	2,584	$ 69	$ 178,296
Small grains	258	$ 25	$ 35,346
Mixed agriculture/seasonal wetlands (50% corn)	823(1,645)	$ 69	$ 56,787
Seasonal managed wetland (existing smartweed)	2,116	$ 25	$ 52,900
Season pond (existing smartweed)	134	$ 25	$ 3,350
Pasture/hay	204	$ 87	$ 17,748
Emergent marsh (min 30% cover after 3 years)	130(390)	$ 500	$ 65,000
Riparian (>350 seedling/acre after 3 years)	266	$ 5000	$ 1,330,000
Herbaceous upland (assume 25% native grass seed)	732	$ 322	$ 235,704
Total	8,329		$ 1,975,131

[a] Estimates are based on costs from similar projects in the region (i.e. Prospect Island, Decker Island, Stone Lakes, Cosumnes River Preserve, Hill Slough), current catalogs from plant nurseries, EPA (1999), Kearny and others (1994 and 2000) and adjusted for the specific habitat development requirements.

Table 3-23 provides an estimate of the on-going costs of mitigation and monitoring required for the project. The costs in Table 3-23 do not reflect reductions obtained by harvesting and selling approximately 1,700 acres of corn and wheat.

Cost for borrow pond development was not included. Borrow ponds would provide incidental habitat that would develop as borrow material is removed for levee construction and repairs. Therefore, the cost of borrow ponds would be included in the cost for levee construction and is not included here.

Table 3-23. Estimated ongoing costs for mitigation and monitoring for the Habitat Management Plan for the life of the project

Description	Unit	Cost (dollars)
Wildlife/habitat monitoring	Salary/year	$ 91,500[a]
DFG monitoring support fund	Salary/year	$ 80,000[b]
Airstrip operations monitoring	Salary/year	$ 30,500[c]
Monitoring subtotal		$ 202,000
Annual O&M cost for Habitat Islands	Salary & materials	$ 800,000[d] - 1,200,000
Total ongoing annual cost		$ 1,002,000 – 1,402,000

[a]DWR ES III salary (benefits & overhead) for 75% of the year (includes monitoring for listed and sensitive species, habitat requirements, & 404 permit requirements)
[b]Current August 2001 cost based on $75,000 per year, January 1998 dollars adjusted for inflation.
[c]DWR ES III salary (benefits & overhead) for 25% of the year
[d]Cost estimate includes salary for DWR Habitat Manager, 2 maintenance staff, and annual cost for habitat management.
Note: All costs are based on August 2001 dollars.

Cost for the purchase and installation of pumps, siphons, and culverts were not included in this estimate. Annual average operations cost are based upon staff and equipment requirements for similar projects in the region. This includes costs for weed control. DWR salaries were used to determine monitoring costs. This includes one full time habitat manager and 2 full time maintenance staff. The estimate does not

include the cost of land acquisition or for the purchase of equipment. The monitoring plan development and implementation of the monitoring are based upon DWR staff time cost (Table 3-24).

Table 3-24. Additional one time costs for mitigation and monitoring requirements for botanical and wildlife resources

Description	Unit	Cost (dollars)
Wildlife/botanical monitoring plan development	Salary	$ 31,000[a]
Habitat construction monitoring	Salary/year	$ 61,000[b]
Reservoir construction monitoring	Salary/year	$ 306,300[c]
Total one time costs		$ 398,300
[a]DWR ES III salary (benefits & overhead) for three months [b]DWR ES III salary (benefits & overhead) for six months [c]DWR ES III salary for 50% of the year for 5 years of construction		

The preliminary cost estimates for implementing the habitat requirements in the HMP is approximately $32 million. This includes earthwork, vegetation installation, contingencies and engineering, legal and administrative costs. Annual costs are estimated to be approximately $1.4 million. This includes implementing terrestrial monitoring requirements and the annual operations and maintenance costs. Total one time mitigation monitoring costs would be approximately $400,000.

Estimated Costs for Aquatic Invasive Species Management

Section 3.1.3 addresses operation and management issues in regard to fish screens necessary for pump and siphon activity on the reservoir islands. In particular, aquatic weeds and other debris can damage and prevent normal operations of fish screens and pumps. The estimated cost of weed control for the DW Project reservoir islands is not available in the DEIR/EIS (JSA 1995a). However, the cost can be estimated using information from DWR's weed control practices at CCF as one example.

At CCF aquatic weeds, like Brazilian elodea, watermilfoil, and crispate-leaved pondweed (*Potamogeton crispus*) are controlled by the aerial application of herbicides. The cost of the chemical, aerial application by helicopter, and DWR person hours add up to approximately $140,000 for one treatment per year (CCF is 2109 acres at its maximum operating elevation, so it costs $66.38 per acre for aerial application of herbicides.) (Janik 2001 personal communication; see "Notes").

At $66.38 per acre for aerial application of herbicides, herbicide treatment would be $359,448 per application per year on Webb Tract (5415 acres) and $362,568 per application per year on Bacon Island (5462 acres). If more than one application is necessary, the cost would go up incrementally. The cost of weed management on CCF levees was not available. Based on the cost of weed management per levee mile at the forebay, the cost of management could be calculated for Webb Tract and Bacon Island levees and would be added to the totals above.

There are several other strategies, besides the chemical application of herbicides, that can be used for weed management in the Delta. These include manual removal, mechanical removal, and the use of biological agents. Weed management on the reservoir islands may benefit from a combination of strategies. Costs may vary depending upon a number of factors including the type of herbicide chosen, the amount of water requiring treatment, new environmental regulations, and the combination of strategies used.

3.2.2.6 Additional Permitting or Consultations Required

Pesticide applications into jurisdictional waters of the United States would require a NPDES permit from the SWRCB. This may include application of pesticides into ditches and canals. Additional monitoring requirements would be required as part of the NPDES permit.

3.2.3 Aquatic Resources Mitigation and Monitoring

Careful monitoring of mercury should be a component of any In-Delta Storage Alternative in order to determine the actual effects of newly constructed wetlands or reservoir islands in the Delta. Monitoring should include an analysis of the mercury content of the soils on both the reservoir and habitat islands as well as the dissolved and particulate mercury content of the diversion water used to flood the islands. Based on Slotton and others (2000), the organic peat soil could have a high mercury methylation potential. Also, the lack of tidal flushing on the habitat and reservoir islands might result in significant local effects. Thus, even low to moderate soil mercury concentrations could result in high levels of biologically available mercury.

Pre flooding soil analysis and tank experiments are needed to estimate how much mercury might be released from the peat soils. In addition, collaborative work on these experiments with UC Davis researchers currently working on the Delta mercury problem can help to answer operational concerns and basic scientific questions such as how important wetland habitat is to methyl mercury production in the entire system. It will be important to incorporate any information from Slotton's proposed mercury project on Prospect and Liberty Islands (Slotton 2001 personal communication; see "Notes"). These two projects represent different wetland restoration strategies, one requires extensive earth moving and the other floods existing, undisturbed soils. If mercury turns out to be a significant problem for these projects, the information can be used to help minimize the mercury problem on the reservoir and habitat islands. Experimentation can identify potential mercury problems before the reservoirs and habitat islands are filled and help to guide the decision making process. For example, if tank experiments suggest that methyl mercury production is high because of organic peat soils then there might be an additional reason to consider Alternative 3 with Victoria Island and its more mineral soils, instead of alternatives that uses Webb Tract as a reservoir.

3.2.3.1 Review of Mitigation Measures for Alternative 1 - Delta Wetlands Project

The DW Project proposes the construction of habitat islands on Bouldin Island and Holland Tract, however, this mitigation is not for fisheries impacts. Impacts to fisheries will be mitigated through restrictions on project operations, financial payments, restoration and maintenance of shallow water habitat, conservation easements and monitoring. To offset potential significant impacts of the project on fish, impact avoidance and other measures are also proposed to protect individual species and, when possible, to implement an ecosystem-based approach to sustain habitat conditions protective of multiple species and life stages throughout the Estuary.

Fisheries mitigation measures are described in the USFWS and NMFS biological opinions, DFG Incidental Take Permit, Final Operation Criteria and SWRCB D-1643 Water Rights Permit (SWRCB 2001) and include:

Environmental Water Fund- The purpose of the fund is to minimize adverse impacts on winter-run salmon and delta smelt. DW will pay an initial installment of $300,000 prior to the commencement of diversion to storage and $50 per acre-foot of "Net Environmental Water" (DFG Incidental Take Permit COA 5.4) to this fund. The fund will exclusively benefit and be controlled by DFG and be used at DFG's discretion to buy water or fund other environmental enhancement opportunities.

Aquatic Habitat Restoration Fund- The purpose of the fund is to mitigate impacts on listed aquatic species. DW will provide an initial installment of $700,000 to DFG prior to the commencement of diversion to storage. The fund will exclusively benefit and be controlled by DFG and be used at DFG's discretion to fund environmental enhancement opportunities.

Aquatic Habitat Development Measure- The purpose of the measure is to minimize impacts on delta smelt associated with moving X2 upstream. Funds in the Aquatic Habitat Restoration Fund will be used for restoration and maintenance of at least 100 acres of shallow shoal/low elevation tidal wetland in the eastern Suisun Marsh and Bay or western Delta. The habitat acquired may be purchased from a mitigation bank. Currently, there are about 40 acres of shallow water habitat available from the Kimball

Island Mitigation Bank, Wildlands Inc., at a cost of $23,500 per acre. The opportunity and cost to create additional habitat are unknown but could be substantially higher than $23,500 per acre.

Fish Screens- All diversions must occur through screened siphons.

Monitoring and Avoidance Measures- These measures avoid or minimize take of winter- run salmon, steelhead, delta smelt, splittail and non-listed species. Monitoring programs are yet to be developed by USFWS, NMFS, DFG and DW according to the FOC and Fish Monitoring Program dated January 27, 1997. Complete siting and sampling specifications will be determined during final design of the DW monitoring program. For example, a monitoring program to evaluate performance criteria, such as the fish screen requirement of a maximum approach velocity of 0.2 fps, must be submitted for approval by USFWS, DFG, Corps, SWRCB and NMFS at least 90 days prior to commencing operations. A general description of the aquatic monitoring program is currently available and includes the following components:

1) During diversions to storage, DW will provide daily in-channel monitoring for the presence of juvenile and adult delta smelt in the immediate vicinity of diversion sites. Diversions at a diversion station will be reduced by 50% of the previous day's diversion rate if delta smelt are present. If delta smelt are present on the first day of diversion, the diversion rate will immediately be reduced by 50%. Reduced diversion rates will remain in place until delta smelt are no longer present at a diversion station. This sampling is to be supplementary to existing IEP monitoring programs. However, on approval, if IEP monitoring is being conducted in a manner that satisfies DW sampling requirements, then DW could use those data and not be required to duplicate monitoring efforts, for example, the Real-Time Monitoring Program in Middle River and Old River near the DW reservoir islands.

2) During diversions to storage, DW will provide daily on-island monitoring to identify incidental entrainment of eggs, larvae and juveniles of striped bass, American shad, splittail, longfin smelt and delta smelt. Depending on the number of eggs, larvae and juveniles per acre foot of water, DW will pay to a mitigation fund between $500 and $1,000 per thousand acre feet of water.

3) During discharges for export, DW will provide daily in-channel monitoring for the presence of juvenile and adult delta smelt in the general vicinity of the reservoir islands. The objective of this component is to detect juvenile and adult delta smelt that could be vulnerable to entrainment at Delta export facilities. Discharge for export must be reduced to 50% of the previous day's diversion rate during the presence of delta smelt. If delta smelt are present on the first day of discharge for export, the discharge rate will immediately be reduced by 50%. Reduced diversion rates will remain in place until delta smelt are no longer present at the in-channel sampling site. With approval, if IEP monitoring is being conducted in a manner that satisfies DW sampling requirements, then DW could use those data and not be required to duplicate monitoring efforts, for example, the Real-Time Monitoring Program in Middle River and Old River near the DW reservoir islands.

4) Weekly and daily monitoring reports will be transmitted to USFWS, NMFS and DFG via fax and internet, respectively.

5) A QA/QC protocol that insures the correct identification of fish will be developed as part of the final monitoring program plan. The current plan calls for identification of salmon from specific runs by daily size intervals. This method has limitations and identification methods might shift to genetic methods as they become available thereby increasing the cost of monitoring.

6) As mentioned in 1) and 3) above, if the IEP is monitoring in a manner and location that satisfies the required monitoring, DW could, with approval, use those data and not be required to duplicate monitoring efforts. Otherwise, DW will be solely responsible for conducting the required monitoring. If DW is able to use IEP monitoring data in this way, then DW will compensate IEP for the use of these data by contributing financially to the IEP monitoring program at a rate proportionate to the share of DW exports to the total Delta exports for the period.

7) A monitoring technical advisory committee will be established to advise and resolve monitoring issues that may develop over the life of the DW project.

March Restrictions- This restriction will avoid or minimize the take of winter run salmon and delta smelt. Diversions in March will be limited to 550 cfs unless the previous day's QWEST is positive and is calculated to remain positive throughout the day.

No diversions to storage will occur in April or May and if the delta smelt FMWT index is less than 239, no diversions to storage will occur from February 15 to June 30- This restriction is to reduce the take of delta smelt and salmon.

DW will not enter into a contractual agreement that would provide for the export of more than 250,000 AF of water on a yearly basis- This measure conforms the water transfer criteria set forth in the 1995 CVP/SWP delta smelt biological opinions as set forth in the FOC.

X2- From September through November, DW will not initiate diversions to storage until X2 is located at or downstream of Chipps Island for a period of ten consecutive days. After that, diversions will be limited to 5,500 cfs for five consecutive days. The location of X2 is defined as the average daily location of a surface water of salinity of 2.64 EC. From October through March, diversions will stop if they cause an upstream shift in X2 in excess of 2.5 kilometers. From September through March, DW will not divert water when X2 is upstream of the Collinsville salinity gauge. From September through March, diversions will not occur when X2 is located upstream of a point 1.4 kilometers west of the Collinsville salinity gauge if the FMWT is less than 239. If the FMWT is less than 239, diversions to storage will not occur from February 15 through June 30. The FMWT was less than 239 in eight of the last 32 years. A delta smelt Fall Mid-Water Trawl index (FMWT) of less than 84 may require reinitiation of the USFWS biological opinion.

Delta Cross Channel- During periods when the delta cross channel (DCC) gates are closed for fisheries protection, November 1 through January 31, and the inflow to the Delta is less than or equal to 30,000 cfs, DW will restrict diversions to 3,000 cfs. When the gates are closed and flows are between 30,000 and 50,000 cfs, DW will restrict diversions to 4,000 cfs.

Costs of Aquatic Resources Monitoring and Mitigation

Tables 3-25 and 3-26 provide a summary of the estimated initial and ongoing costs of the aquatic resources mitigation and monitoring required in the FOC, DFG's Incidental Take Permit, and the USFWS and NMFS biological opinions. The total initial costs may range from 1.8 to 2.3 million dollars. The average ongoing costs of the aquatic resources monitoring and mitigation are estimated at 1.5 million dollars. The maximum ongoing costs are estimated at 2.8 million dollars.

3.2.3.1 Fish Screens

The proposed DW intake system discussed in Alternative 1 – DW Project consists of 64 new intakes with pipelines, pumps, screens, and structures, as well as 57 retrofitted intakes with screens and structures. The applicability of this concept is unproven at this scale and may necessitate smaller and more manageable facilities. However, structural and hydraulic considerations should not be the only criteria modified as described above. Functional cylindrical intake screens should be designed based on lessons learned from other installations and failures. The lessons learned from the poor performance or failure of those facilities could prevent costly mistakes and redesigned facilities for the DW Project.

Table 3-25. Initial costs of mitigation and monitoring for aquatic resources

Description	Cost
Aquatic Habitat Restoration Fund	$ 700,000
Environmental Water Fund	$ 300,000
Develop Monitoring Plan, QA/QC Plan, and Conservation Easement Management Plan	$ 122,500[a]
Purchase of 27 to 48 acres[b] of Shallow Aquatic Habitat as 3:1 Mitigation for Pipes and Docks Impacts	$ 634,500 to $ 1,128,000[c]
200 Acre Conservation Easement	Unknown Cost

[a] Mid-range ES III salary including benefits, overhead, etc. Assuming one year to develop all plans and obtain agency approval.
[b] Calculated from Figures 2-4 and 2-7 in Appendix 2 in 1995 EIR. There could be a maximum of 610 new berths on Delta channels, based on the 38 proposed recreational facilities, each with 15 berths. There would also be 10 berths at each of the four siphon (diversion) stations. On average, each berth would have an impact footprint of approximately 500 to 1000 square feet as they would extend about 50 feet into the channel and be about 10 to 20 feet wide each. The total impact footprint of the boat docks would be about 7 to 14 acres and the siphons would impact about two additional acres.
[c] Based on $23,500 per acre, the cost to DWR of shallow water aquatic habitat from the Kimball Island Mitigation Bank, Wildlands Inc. However, only about 40 acres of this habitat is currently available. The opportunity and costs to create additional habitat are unknown but could be substantially higher than $23,500 per acre.

Table 3-26. Ongoing costs of mitigation and monitoring for aquatic resources

Description	Cost per Unit	Average Cost per Year	Maximum Cost per Year
Environmental Water Fund	$ 54.56 per AF[a]	$ 365,600[b]	$ 1,091,200[c]
Staff Biologist for Monitoring, QA/QC	Salary	$ 122,500[d]	NA
In-Channel Monitoring During Diversion/Discharge	$ 1,000 per Day	$ 270,000[e]	NA
On-Island Monitoring	$ 1486 per Day[f]	$ 360,000[g]	NA
Incidental Entrainment Compensation	$ 0.56 to $ 1.11 per AF[h]	$ 75,040 to $ 148,740[i]	$ 218,400 to $ 432,900[j]
Maintenance, in perpetuity, of 200 Acre Conservation Easement	Unknown	Unknown	Unknown
Environmental Research Fund	$ 2 per AF	$ 234,000[k]	$ 500,000[l]
Boat Wake Erosion Mitigation	$ 111 per Berth[m]	$ 67,710[n]	NA

[a] Current August 2001 cost based on $50 per AF, January 1997 dollars.
[b] Based on "Net Environmental Water" see DFG's Incidental Take Permit, COA 5.4, (5% of average diversion of 134,000 AF per year, assuming no credits from habitat island discharges or environmental water, etc...) (Note: This should not be confused with the EWA.)
[c] Based on DFG's COA 5.5 assumed maximum "Net Environmental Water" of 20,000 AF in any water year.
[d] Mid-range ES III salary including benefits, overhead, etc…
[e] Assumes 9 mo. diversion/discharge activity requiring monitoring.
[f] Daily cost is greater than in-channel monitoring because entrainment monitoring requires two crews (one for each island).
[g] Assumes 242 total days; 6 mo. diversion activity requiring monitoring plus 60 days for training, clean up and data processing.
[h] August 2001 cost based on 0.5 to $1 per AF in January 1996 dollars.
[i] Based on assumed average diversion of 134,000 AF per year.
[j] Based on assumed maximum diversion of 390,000 AF per year.
[k] From FEIS page 2-11. Based on assumed average sale of 117,000 AF per year.
[l] Based on assumed maximum sale of 250,000 AF.
[m] Current August 2001 cost based on $100/berth, January 1996 dollars.
[n] Based on a total of 610 berths.
NA means not applicable.

Downsizing each diversion may result in a more manageable size, say to 40 cfs, for a screen unit. Therefore, the number and complexity of the intake pipes and facilities will increase four-fold, or to approximately 248 new diversion structures and pipelines. For this concept, it would be recommended that each of these screens be designed and equipped with automatic cleaning systems, retrievable screen systems, cathodic protection, wedgewire screens, monitoring systems, and able to withstand higher structural loads and pressures. The resulting redesigned cylindrical screens may be manageable on an individual level, but unmanageable when considered as a whole.

Consolidated diversion facilities looking at different intake types may offer a better solution. Engineered, flat plate screened diversions along river banks have proven to be highly reliable under a wide variety of flows and conditions, including for those in the Delta. Examples of facilities utilizing this concept include the new Contra Costa Water District Los Vaqueros Intake Screen (250 cfs), Reclamation District 108's new fish screen (830 cfs), and Glenn Colusa Irrigation District's new fish screen (3000 cfs). All concepts are similar and all have functioned well with very low and easy maintenance. The Team recommends that the agencies investigate the design of consolidated facilities in future work as a more workable solution to the problems discussed in Section 3.1.3.

3.2.4 Cultural Resources Mitigation

This section describes possible mitigation measures for impacts to cultural resources under Alternative 1 – DW Project. The assumption regarding the mitigation measures presented here is that all significant resources within the project study area will be impacted by the project. It is, however, important to point out that the need for mitigation work on this project can be reduced if plans are made to avoid these significant resources during the environmental document phase. This would require close coordination between cultural resource personnel and those preparing and implementing the HMP, so that avoidance of resources can be integrated with the proposed habitat enhancement activities. If avoidance of some cultural resources is possible, provisions for their continued avoidance and periodic monitoring would be written into the Programmatic Agreement (PA) and the HPMP, both of which are described below. It must be emphasized that all proposed mitigation measures presented herein are provisional. Any mitigation plan developed will require evaluation and consultation with the SHPO and the ACHP prior to implementation of the proposed plan.

3.2.4.1 Programmatic Agreement

The process of meeting cultural resource compliance obligations for this project will also entail a substantial amount of inter-agency coordination. It is anticipated that the 1998 *Programmatic Agreement (PA) among the U. S. Army Corps of Engineers, the California State Water Resources Control Board, the California SHPO, the Advisory Council on Historic Preservation, and Delta Wetlands Properties regarding the implementation of the Delta Wetlands Project*, will be updated and modified to reflect the most current roles and responsibilities of the parties presently involved, as well as to reflect the changes in those parties who shall be signatories to the new PA. For example, DWR and Reclamation, were not party to the original PA and must be included if they operate the project. The content of the revised PA is not expected to change substantially from that of 1998 PA.

3.2.4.2 Historic Property Management Plan and Long Term Obligations

It is expected that most cultural resource compliance obligations will be met prior to implementation of the project by means of mitigation or avoidance. It should, however, be emphasized that, due to the ongoing nature of this project as a habitat enhancement and water storage program, it will be necessary to establish a long-term plan for managing cultural resources within the project area. That is, the protection of known significant cultural resources must be maintained for the life of the project, and all inadvertent finds will need to be treated appropriately upon discovery. In this respect, the preparation of a HPMP will provide the necessary guidance for the consideration and treatment of cultural resources that may be accidentally impacted during the course of the In-Delta Storage Program.

3.2.4.3 Public Participation and Native American Consultation

Pursuant to the Section 106 and CEQA regulations, efforts must be made to solicit input from both interested members of the public and local Native American tribes regarding potential impacts to cultural resources within the project area. Both federally recognized, as well as non-federally recognized Indian tribes must be consulted. Federal recognition affords such tribes a governmental status, which elevates consultation requirements with them to a government-to-government level. Some tribes may wish to enter into an agreement (Memorandum of Understanding) to establish protocols for consultation with them regarding cultural resources. Among those tribal groups that may have an interest in the project area and vicinity are the Coast Miwok, Coastanoan, Patwin, Miwok, Northern Valley Yokut, and Maidu. Potential interested members of the public include historic preservation interest groups, historical societies, and museums that are local to the project vicinity. Of particular importance for this project is the need to solicit input from the Japanese-American community in the Delta area, as a number of the historic period resources in the project area are related to early Japanese settlement and agricultural practices.

It should be noted that members of the Native American tribes, members of the Japanese-American community, historical societies and museums in the Delta were contacted as part of the public outreach done for the In-Delta Storage Program as a whole. See Section 6.0 for more details.

3.2.4.4 Mitigation Measure by Island

Webb Tract

As mentioned previously, all sensitive piper soil areas on Webb Tract (approximately 335 acres) should be re-examined in advance of the proposed project. This may or may not result in the identification of new sites. Should any new sites be identified, it will be necessary to evaluate them for significance. If any such sites are determined to be significant and cannot be avoided, mitigation measures would be necessary prior to project implementation. If no sites are discovered during the re-examination of the piper soil areas, it would still be prudent to avoid such areas, if possible, due to the high likelihood of encountering buried archaeological deposits. Delineation and avoidance of these sensitive areas, if possible, may decrease the potential for unanticipated impacts. Measures for the treatment or avoidance of buried resources, if inadvertently encountered during project implementation, will be detailed in the HPMP.

The HPMP will also outline the treatment procedures for any additional historic period resources that may be identified during the surveys or during project implementation.

Bouldin Island

The HPMP will provide guidance for the treatment of any prehistoric sites encountered during project implementation.

The one significant historic archaeological site identified on Bouldin Island will require mitigation prior to implementing any project-related activities that may impact the site. Data recovery excavations at the site should be conducted to mitigate for project impacts. Given that project activities proposed for Bouldin Island involve habitat restoration, efforts to avoid impacting this site may be achieved through careful planning and by designating the site as an environmentally sensitive area to be avoided during project-related activities. The HPMP will detail the appropriate measures to be taken depending upon whether or not avoidance measures are possible. If mitigation is in fact necessary, a Mitigation Plan will need to be prepared prior to project implementation in consultation with the SHPO and all interested parties.

Holland Tract

Additional surveys have been proposed for Holland Tract's piper soil areas. This may or may not result in the identification of new sites. Should any new sites be identified, it will be necessary to evaluate them for significance. If any such sites are determined to be significant, mitigation measures would be

necessary prior to project implementation if they cannot be avoided. If no sites are discovered during the re-examination of the piper soil areas, it would still be prudent to avoid such areas, if possible, due to the high likelihood of encountering buried archaeological deposits. If these areas cannot be avoided, it may be necessary to have an archaeologist monitor them during project implementation. Given that Holland Tract has been designated as a habitat restoration island, efforts to avoid impacting these sites and any areas of sensitivity may be achieved through careful planning and coordination during the environmental document phase. The HPMP will address the appropriate measures to be taken depending on the proposed project activities and their effects on the resources.

It is considered unlikely that any additional historic period cultural resources will be encountered on Holland Tract. Should such resources be encountered during project implementation, guidance for their subsequent treatment will be detailed in the HPMP.
Any impacts that the project may have on the two significant archaeological sites on Holland Tract, or on any of the sites containing human remains, will require mitigation measures prior to project implementation, if they cannot be avoided. Such mitigation measures will require the preparation of a Mitigation Plan in consultation with the SHPO and the Native Americans groups.

Bacon Island

Prehistoric Sites
It is considered unlikely that prehistoric resources will be encountered on Bacon Island during the course of the project. The HPMP will detail the appropriate measures to be taken in the event that any prehistoric resources are inadvertently discovered during project implementation.

Historical Sites
As Bacon Island will be used for water storage, it is anticipated that most of the resources that comprise the National Register Historic District on this island will be impacted by project implementation activities. Mitigation measures that have been proposed in the DW EIR/EIS include: archaeological data recovery excavations; completion of the Historic American Building Survey/Historic American Engineering Record (HABS/HAER) forms, including photographic documentation; the preparation of an educational publication for use by museums, cultural centers, and schools; and the production of a video of Public Broadcasting System (PBS) quality. The DW EIR/EIS indicated that, despite such mitigation measures, the level of impact would still not be reduced to a less-than-significant level. The implication of such impacts results in a requirement that the environmental document be elevated to an EIR/EIS (which it already is), at which point it becomes a matter of public disclosure. In other words, the project may proceed after the environmental document phase as long as the lead agency has thoroughly examined all possible alternatives and disclosed to the public the impacts that will result from the proposed project. Any proposed mitigation work will require the preparation of a Mitigation Plan in consultation with the SHPO and interested parties, in particular the Japanese American community, regarding the impacts to resources on this island and potential mitigation measures.

3.2.4.5 Project Costs and Timeline

The cultural resource compliance obligations for this project are multi-faceted and include a number of different tasks that must be considered when projecting overall costs. The major tasks to be completed and their associated timeframes are shown in Table 3-27.

Table 3-27. Timeline for implementing remaining cultural resources consultation and mitigation

Activity	Duration of Time
Consultation and coordination with other agencies.	On-going
Consultation with the public and with Native American tribes.	Begin after meeting with SHPO then on-going
Conduct additional field inventories on Webb Tract, Holland Tract, and Victoria Island, and prepare appropriate documentation.	6 – 12 months
Conduct evaluations for any newly-identified cultural resources, if necessary, and prepare appropriate documentation.	6 – 18 months
Prepare Programmatic Agreement.	6 months
Prepare a Historic Property Management Plan (HPMP) for the long term management of resources within the project area	6 months
Prepare a Mitigation Plan and conduct mitigation work for all significant resources that cannot be avoided.	12 – 30 months
Address any cultural resource management issues according to the guidelines in the HPMP, if and when they arise, throughout the life of the In-Delta Storage project.	On-going throughout the life of the project

The unpredictable nature of cultural resources, particularly of archaeological remains, is problematic for projecting the costs involved in meeting compliance obligations. For instance, it is not known if any of the additional survey work will result in the identification of more resources that need to be evaluated, or if significant resources will be inadvertently impacted during project implementation. Furthermore, it will not be until a project alternative is selected that we can begin to determine if some significant resources can be avoided or if they will need to undergo mitigation for project impacts. These are all factors that may increase or decrease overall project costs. The cost estimates presented here are, therefore, gross approximations of a "worst-case scenario" based on what is currently known at this time. These expenditures include costs incurred by DWR staff, as well as those conducting work under contract. Thus, time and effort required to write the contracts and implement the work is included. The basis for the proposed cultural resource compliance costs presented here have been estimated according to other projects of similar scope and caliber. As mentioned above, if some resources can be avoided by planning habitat management activities around them, mitigation time and costs could be significantly reduced.

The overall project cost estimates can be divided into two phases: (1) the projected costs required to meet all compliance obligations and final project approval; and (2) the projected costs for managing cultural resources over the long term according to the stipulations of the HPMP. These will be discussed below.

Estimated Costs for Project Approval

The bulk of the overall projected costs for this project will lie in meeting compliance obligations for obtaining project approval. Thus, the majority of expenses will be incurred prior to implementation of the project. The cost estimates described below, based on previous undertakings of similar scope, are meant to encompass any consultation and coordination with other agencies, the public, and the Native Americans.

Additional surveys have been proposed for Webb Tract (335 acres) and Holland Tract (321 acres). The cost to complete surveys on Webb and Holland Tracts, including both fieldwork and report preparation, is estimated to amount to between $5,000 and $10,000.

The majority of anticipated costs and time commitments will lie in the preparation of Mitigation Plans and the implementation of the proposed mitigation measures for the project, particularly, for Bacon Island. The cost of producing a PBS-quality video of the desired quality can amount to thousands of dollars per

minute. Thus, the cost of preparing a 30-minute video may total $150,000 – $300,000. The cost of preparing an educational publication will depend on the breadth of such a publication, but may total upwards of $50,000 to $100,000 dollars. The preparation of the HABS/HAER documentation is estimated to cost up to $10,000. A total of at least 10 archaeological sites on three project islands (Holland Tract, Bouldin Island, and Bacon Island) have been identified as requiring data recovery excavations for mitigation of proposed project impacts. The cost of conducting 10 archaeological data recovery excavations may amount to approximately $300,000 - $500,000, including fieldwork, laboratory processing, special analyses, report preparation, and the review period. The duration of time needed to complete this data recovery work may take up to two or three years to allow for consultation with interested parties and for all studies to be completed, documented, and reviewed. Data recovery efforts must be completed prior to the start of construction.

The work involved in preparing the PA is not considered to be substantial, as it is probable that the existing (1998) PA will be used with some modifications. An estimated cost of $5000 is projected for the preparation of the PA. The preparation of the HPMP, on the other hand, is expected to be a more involved task requiring both interagency coordination and public/Native American consultation. The content of the HPMP will outline the procedures for the management of cultural resources within the project area for the life of the project. The cost of preparing the HPMP is estimated to total approximately $10,000 - $20,000 dollars.

The maximum cost estimate for completing all anticipated compliance obligations described above result in a total of $945,000 to obtain project approval. The duration of time needed to complete the proposed work is estimated to take up to four years. As mentioned above, these estimates are based on a worst-case scenario and therefore, the actual totals will vary according to the findings of the various studies.

Projected Long Term Cost Estimates

Upon completion of all compliance obligations required for project approval, the cultural resources within the project area will need to be managed and treated in accordance with the stipulations of the HPMP. As described above, the HPMP will guide the consideration and treatment of cultural resources within the project area. As unexpected discoveries or impacts to cultural resources may occur in the project area during project implementation, provisions for monitoring or evaluating resources will be necessary. An annual budget for addressing any potential cultural resource issues related to the implementation of the project should be allocated to ensure that the requirements of the HPMP can be met. An estimated cost of $10,000 per year may be considered adequate to meet these needs.

3.2.5 Recreation Solutions

3.2.5.1 Recreation Plan

The following sections discuss recreational opportunities that could be incorporated into a publicly owned In-Delta Storage Project.

General Design

Under public ownership, it is assumed that recreational opportunities would be available to the general public and that the range of facilities and experiences would go beyond those anticipated by the private project. All recreational facilities and use opportunities on the habitat islands would be designed and managed to avoid conflict with the objectives of the HMP. Facility design and siting, seasonal periods of use, and the density of use would focus on compatibility and avoidance of conflict between potentially competing consumptive and non-consumptive uses. Quality of the experiences will be emphasized over quantity of uses and users.

In August of 1997 the *Sacramento-San Joaquin Delta Recreation Survey* was published (DPR 1997). Findings of that survey were used to identify unmet needs that could be accommodated on the islands and levees of the In-Delta Storage project, and managed as public opportunities. A summary of survey

results is available in a technical memorandum appended to the project study (Appendix L). Shortages identified by boaters surveyed included: public restrooms, swimming beaches, fishing piers, other fishing access, bicycle trails, hiking trails, and hunting areas.

Bouldin Island and Holland Tract lend themselves to a wide variety of recreational uses that need not be in conflict with the HMP and which are compatible with each other. The majority of the uses and facilities would take advantage of the concentration and variety of wildlife and wildlife habitats generated by the HMP.

The reservoir islands, Webb and Bacon, provide limited opportunities. Because of the highly variable water surface elevation, the relative difficulty associated with access, and maintenance, safety, and habitat concerns, the recreational use opportunities at the reservoir islands should be limited to the levees and facilities that could be constructed on the outboard water side of levees.

Management of Facilities

There is no single state or federal entity that currently manages the full range of recreational facilities and uses anticipated under the In-Delta Storage project. The options are: (1) to manage the recreational facilities as part of the SWP with DWR staff; (2) to manage the facilities as an element of the CVP with Reclamation staff; (3) to contract with the DFG or USFWS to manage hunting, wildlife observation, and interpretation programs; and (4) to contract with the DPR or private contractors to manage the various opportunities for fishing access.

Because the DFG currently manages hunting programs on Sherman and Twitchell islands for the DWR, as well as programs similar to that proposed for Bouldin Island and Holland Tract at 24 locations around the state, the DFG is well suited to manage the public hunting programs. DFG could provide interpretative services on the habitat islands, as well as enforcing hunting and fishing regulations.

The hiking and cycling trails could require little or no management and could be rolled into overall management of the habitat islands. Likewise, the fishing access sites and boat docks would not require management, per se. If regulations in the form of use time limits are established for boat docking facilities, enforcement would be the responsibility of the counties through their Sheriffs' Departments.

Operation and Maintenance of Recreational Facilities

Operation and maintenance would include the following responsibilities:
- Hunter Access Control and Enforcement
- Road and Parking Maintenance
- Signs and Posters
- Information Leaflets
- Blind Maintenance
- Maintenance of Restroom Facilities
- Trash Pickup
- Staff and Budget Management
- Clerical Support Functions

All of these responsibilities could be delegated to the management entity or entities. The DFG performs these duties in the areas it currently manages. USFWS does so in the National Wildlife Refuges it manages, and the DPR provides these services in park locations it manages.

Recreational Opportunities Given Project Design and Operation

Bouldin Island

Bouldin Island lends itself to hiking trails on the levees and the less-sensitive wildlife habitat areas. There are 18 miles of levees in total and approximately 12 miles of levee that could be used without crossing

Highway 12. Loop trails could be constructed with cut-off or turn-back points to provide hiking or jogging distances of 1 to more than 12 miles. The trails could extend along the inland toe of the levee, ramp up to the levee crown, and include areas on the floor of the island adjacent to seasonal and permanent wetlands. Restroom facilities could be sited to accommodate hikers, bikers, hunters, anglers, and wildlife observers on the island or levees.

The same trails established for hiking could be used by cyclists. Trail surfaces would most likely consist of dirt or small-sized crushed rock. (Maintenance of paved surfaces would be difficult on peat soils and subsiding levees.)

Wildlife observation or birdwatching could be easily incorporated into the recreational design for Bouldin Island, as the multiple-use facilities associated with hiking and cycling could serve wildlife observation as well. Additional facilities could include informational signage, photography blinds, and an interpretative center. The interpretative center could be a simple kiosk or a staffed building. Interpretative center topics could include wildlife and Delta ecology, Delta cultural resources, Delta history, and water projects. Buildings could be located on the island floor or on the levee.

Shoreside fishing access could be accommodated on Bouldin Island as well. Use could be focused on those areas where rock levee protection is in place, and where vehicular access would not conflict with levee maintenance or wildlife mitigation operations. Restroom facilities and trash receptacles could be shared by the full range of recreational users. For safety and security, however, it would be best to limit all recreational activities to daylight hours.

Short-term boat docking for shoreline access could be included in the general design for Bouldin Island. Boaters could utilize restroom facilities, picnicking facilities and/or use the docking facilities to access hiking, cycling or interpretative facilities on the island.

Public hunting is compatible with the HMP and could be managed to avoid conflict with non-consumptive recreation on Bouldin Island. Hunting is the main recreational activity proposed under the DW private use and management design. The hunting program would be modeled after that used on existing State Wildlife Management Areas. Hunting during the pheasant season and waterfowl season would be confined to specific areas, would be available to a limited and managed number of users, and would occur only on Wednesdays, Saturdays, and Sundays.

Facilities needed to support a hunting program would include a hunter check-in station (which could be a mobile office building or space at the interpretative center), parking lots, and restrooms. Blinds could be constructed in appropriate areas to both manage hunting activities and to facilitate use of the blinds by disabled hunters.

Holland Tract

As a habitat island under the HMP, Holland Tract could accommodate the same public uses as Bouldin Island. Because of its more difficult road access, and because it is near commercial facilities located at Bethel Island and Franks Tract, limited recreational facilities are suggested for Holland Tract. In any case, facilities could be phased in over time as demand is proven on Bouldin Island, and as use on Bouldin Island approaches design capacity.

Hunting and wildlife observation are the recommended public uses, as each is compatible with the HMP. The seasonal nature of hunting and the institution of a three-day-per-week program would avoid conflicts between consumptive and non-consumptive uses. Facilities would include a hunter check-in station (which could be an office trailer), parking lots, and restroom facilities. Blinds would be placed in appropriate locations to accommodate hunter use and disabled hunter/birdwatcher access. User density would be scaled to provide for a quality experience.

Webb Tract and Bacon Island

Webb Tract and Bacon Island are reservoir islands. As such, water project operations substantially limit the habitat and attraction for wildlife on these islands. Project operations are not predictable, and, therefore, abrupt changes in water depth and surface area could occur. Recreational uses on these island may not be compatible with water project operations.

The reservoir islands lend themselves to levee-bank fishing access and short-term boat docking facilities, however.

Bacon Island

Bacon Island currently supports a substantial amount of levee bank fishing use, which could be enhanced with development of designated areas, trash receptacles, and restroom facilities. The island is accessible via a drawbridge and a county road branching from Highway 4. Short-term boat docking facilities could be located along the existing 5 miles of improved levee road along the eastern side of the island.

Webb Tract

Webb Tract is very lightly used for levee bank fishing. Access is constrained by the necessity of having to use a ferry to reach the tract, as well as having to obtain written permission to enter private property. Under public ownership, fishing access sites could be developed. Because Webb Tract is close to Franks Tract and Bethel Island, both of which are areas of high use for boaters, short-term docking facilities and restrooms would have high levels of use and would serve a currently unmet need.

3.2.5.2 Estimated Costs of Changes Due to Public Ownership

The estimated costs associated with Alternative 1 (public ownership and private management) are based upon the descriptions provided above and are summarized in Table 3-23. It is assumed that all the facilities could be built on the four islands. Operation and maintenance costs are not included.

Table 3-28. Recreation facility construction costs for Delta Wetlands Project - Alternative 1

Facility	Unit	Unit Price ($)	No. Units	Total Price ($)
40-Room Overnight Facility	Overnight Facility	15,000,000	38	570,000,000
40-Car Parking Lot	Parking Lot	110,000	38	4,180,000
Floating Dock With 15 Slips, Waterside	Dock	116,100	38	4,411,800
Floating Dock With 18 Slips, Interior	Dock	139,320	38	5,294,160
				583,885,960
Source: Means 2001				

Revenues from recreation need to be assessed to determine the financial viability of federal/state management. If it proves to be economically infeasible, the DW proposal of private operations driven by public demand may be a reasonable strategy for recreation facility management.

3.2.5.3 Additional Permitting Required for Changes Proposed Due to Public Ownership

Recreation impacts will generally be subject to the same regulations, procedures, and guidelines for other similar development projects in the Delta. These include the ESA of 1973 (as amended), the CESA of

1985, the CWA (as amended 1977) and the California Fish and Game Code (Section 2081). Biological information is required to evaluate the significance of project impacts, to support formal and informal consultations with resource agencies regarding impact findings and mitigation strategies, and to prepare permitting documents.

The project is also subject to the CEQA, and the National Environmental Policy Act (NEPA). DWR would be the lead agency for CEQA. Corps is the federal lead agency overseeing the issuance of the Section 404 Permit and the required NEPA documentation. Reclamation could become the federal lead agency for NEPA under federal or joint state/federal ownership.

Permits required for this project include:

- Nationwide Army Corps of Engineers Section 404 Permit
- Regional Water Quality Control Board Section 401 Water Quality Waiver or Certification (if impacted wetlands features are determined to be waters of the U.S.)
- California Department of Fish and Game Section 1601 Streambed Alteration Agreement
- Consultation as required for a DFG Section 2081 and/or USFWS Section 7/Section 10 Incidental Take Permit

The procedural guidelines of Section 106 of the National Historic Preservation Act must be followed, due to identification of 16 significant resources eligible for listing on the *National Register of Historic Places*. This will include consultation with the State Historic Preservation Officer (SHPO), and the concerns of Native American and other interested parties during the cultural resources inventory process (DWR 2001b). See Section 3.2.4 for a complete discussion on laws governing cultural resources protection.

Permits or compliance already obtained include:

- SWRCB Water Rights Permit
- Regional Water Quality Control Board Section 401 Water Quality Certification
- USFWS and NMFS “No Jeopardy” biological opinions
- DFG Section 2081 Agreement under the CESA

Under public ownership the probable changes to the recreational facilities could require amended biological opinions with the USFWS and NMFS and an amended Section 2081 Agreement under the CESA. The existing opinions and agreement were based on the very vague descriptions of conceptual recreational facilities in the DW project documents.

The permits for the DW project include terms and conditions contained in agreements reached between DW Properties, DWR, and Reclamation, that will protect water supplies and senior water rights holders in the Delta. Such agreements preclude diversion to storage when surplus water is not available (per state and federal project needs). The DW project is also subject to an array of terms established in agreements reached with EBMUD, Contra Costa Water District (CCWD), California Urban Water Agencies (CUWA), PG&E, the City of Stockton, Amador County, and the North Delta Water Agency.

3.2.6 Hazardous Materials

Numerous areas of observed or potential sources of hazardous materials contamination were identified in section *3.1.6.3 Basic Issues and Impacts*. The recommendation of a Phase II ESA was made. The purpose of a Phase II ESA as defined by American Society of Testing and Materials Designation E 1903-97, is to:

> “…evaluate the recognized environmental conditions identified in the Phase I ESA for the purpose of providing sufficient information regarding the nature and extent of contamination to assist in making informed business decisions about the property; and

> where applicable, providing the level of knowledge necessary to satisfy the innocent purchaser defense under [the Comprehensive Environmental Response, Compensation and Liability Act.]"

Once a Phase II ESA investigation has identified the nature and extent of contamination at the Site, a Phase III Site Remediation plan and cost estimate can then be created. Remediation plans based on speculation as to the nature and extent of contamination could potentially produce grossly inaccurate cost estimates. Therefore, time and cost estimates are provided below only for the Phase II ESA investigation.

3.2.6.1 Schedule for Phase II Environmental Site Assessment

The draft Phase II ESA schedule is based on previous Phase II assessments performed by Site Assessment staff (Table 3-29). Since the schedule is reflective of previous projects, conditions at this specific Site may require alteration of the time estimates provided.

3.2.6.2 Cost Estimate for Phase II Environmental Site Assessment

The draft Phase II ESA cost estimate is based on previous Phase II assessments performed by Site Assessment staff (Table 3-30). Since these estimates are based on previous projects, conditions at this specific Site may require alteration of the charges provided.

Table 3-29. Draft schedule for Phase II Environmental Site Assessment for the Delta Wetlands Project

Draft Schedule
Phase II Environmental Site Assessment

ACTIVITY	JAN. 2002				FEB. 2002				MAR. 2002				APR. 2002				
	7	14	21	28	4	11	18	25	4	11	18	25	1	8	15	22	29
Sample Plan / Site Safety Plan																	
Sample Collection																	
Sample Analysis																	
Data Analysis																	
Final Report																	