

LIBERTY ISLAND ECOLOGICAL RESERVE



LAND MANAGEMENT PLAN

JULY 2015



AECOM



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PREPARED FOR:

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

BAY DELTA REGION
7329 SILVERADO TRAIL
NAPA, CA 94558

CONTACT: RYAN CARROTHERS
ENVIRONMENTAL SCIENTIST
530/757-1813

PREPARED BY:

AECOM
2020 L STREET, SUITE 400
SACRAMENTO, CALIFORNIA 95811

CONTACT: PETRA UNGER
916/414-5800

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AECOM



DRAFT
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Prepared by: AECOM
2020 L Street, Suite 400
Sacramento, CA, 95811

Approved by:



Scott Wilson, Regional Manager



Date

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I. INTRODUCTION

Liberty Island (Island) is a 5,303-acre partially inundated island at the southern end of the Yolo Bypass in the northern Sacramento–San Joaquin Delta (Delta). Originally covered by tidal marsh vegetation, the Island was reclaimed and converted to agriculture in the early 1900s following the construction of levees and drains. The Island was in agricultural production until 1997, when levees protecting the Island failed and the Island flooded. Passive restoration has been occurring since then and open water, emergent marsh, and grassland habitats have become established. Most of the Island is owned and managed by the California Department of Fish and Wildlife (CDFW) as the Liberty Island Ecological Reserve (LIER). The LEIR supports large quantities of wildlife and provides the potential for habitat enhancement, floodplain management, and recovery of endangered species.

This land management plan (LMP) will guide CDFW management of the important resources of LIER in accordance with the laws of the United States and the State of California, incorporating the best available scientific information. It also describes CDFW coordination and cooperation with neighbors, other local interests, and other conservation entities that are active in the Delta.

A. Purpose of Acquisition

As specified in Title 14 of the California Code of Regulations, which describes public use of CDFW lands, the primary reason that CDFW accepted transfer of Liberty Island from the Trust for Public Lands (TPL) was to protect the developing wetlands as habitat for special-status fish species (CDFW 2013). The U.S. Fish and Wildlife Service (USFWS) classified lands including and near Liberty Island as “critical habitat” for the Central Valley Fall-run Chinook Salmon and the Delta Smelt. In addition, the National Marine Fisheries Service (NMFS) has designated the Yolo Bypass lands as critical habitat for the southern Distinct Population Segment of North American Green Sturgeon, which is federally listed as threatened. LIER also provides high-quality habitat for a variety of other special-status and common wildlife species.

Positioned at the downstream end of the Yolo Bypass, LIER is within the statutorily defined flood easement that protects urban Sacramento. The Yolo Bypass was designed with a capacity to pass a runoff event of 490,000 cubic feet per second (cfs). Floodwaters from the Sacramento River, Putah and Cache Creeks, Sutter Bypass, and Knights Landing Ridge Cut are all tributary to Yolo Bypass flood flows. Human-made levees confine flood flows to limit the historic extent of flooding. Confinement increases potential velocities and shear forces of flood flows above the unconfined historic floodplain condition. The current configuration of the Yolo Bypass does not meet all 200-year event criteria defined in the statute.

CDFW recognizes the importance of flood management and acknowledges that LIER habitat management may be constrained by flood management requirements. Flooding is an important ecosystem process that shapes habitat structure and benefits fish and wildlife. CDFW will manage LIER consistent with both flood protection and wildlife needs.

B. Acquisition History

In 1997, the California Bay-Delta Program (CALFED) provided funding to acquire a portion of Liberty Island from Naumachia, Inc. Trust for Public Land (TPL) purchased this portion of Liberty Island (4,308 acres) in 1999 using CALFED Ecosystem Restoration Program grant funds. The funds were originally granted to USFWS and were slated for lands to be included in the proposed North Delta National Wildlife Refuge. Because of delays in adopting a boundary for the proposed refuge, the funds were transferred to TPL for the purchase of Liberty Island. The North Delta Wildlife Refuge was never established.

TPL is a nonprofit organization whose primary purpose is to aid in the acquisition of lands; however, TPL does not undertake long-term management of properties. After managing the property for more than a decade, TPL transferred this portion of Liberty Island to CDFW in January 2011 for long-term management and protection.

CDFW currently owns the southern 4,308 acres of the Island, located in Solano County. The northern portion of the Island, 995 acres of conservation bank land located in Yolo County, is currently owned by Wildlands, Inc. and TPL; however, the northern portion of the property may be transferred to CDFW and become part of LIER at some point in the future.

1. Purpose of this Land Management Plan

The purpose of this LMP is to:

- ▶ guide the adaptive management of habitats, species, and programs described herein to achieve CDFW's mission to protect and enhance wildlife values;
- ▶ serve as a guide for appropriate public uses of LIER;
- ▶ serve as a descriptive inventory of fish, wildlife, and native and nonnative plants and vegetation communities that occur within LIER;
- ▶ provide an overview of the property's planned operation and maintenance activities and of the personnel requirements to implement management goals (this LMP also serves as a budget planning aid for preparation of the annual regional budget); and
- ▶ describe potential and actual environmental impacts and subsequent mitigation measures that may be implemented during management. This LMP contains environmental documentation to comply with federal statutes and regulations.

2. Planning Process

The planning process was guided by the general policy parameters that direct CDFW, including compliance with all federal and state laws. Consideration of CDFW's mission, the purpose of ecological reserves, the purpose and history of the acquisition of LIER, and the purpose of LMPs provided broad direction for the development of this plan.

With this broad guidance, this LMP has been developed from a compilation of the best available data, additional site-specific analyses, and public input. Public input has been obtained through multiple meetings with knowledgeable individuals, agencies, and stakeholders. A summary of public outreach efforts is attached as Appendix A.

The following are the primary management concerns that pertain to LIER:

- ▶ *Endangered Species/Critical Habitats*: To protect, restore, and enhance native habitats and aid the recovery of federally listed and state-listed endangered and threatened species.
- ▶ *Biodiversity*: To protect, manage, and restore the riparian woodlands, tidally influenced wetlands, tidal open water, and nontidal open-water habitats representative of the biological diversity of the Delta.
- ▶ *Connectivity*: To provide habitat linkage and migration corridors to adjacent habitats for wildlife in the Yolo Bypass and Cache Slough Complex.
- ▶ *Cooperative Management*: To coordinate land management activities with federal, state, and local governments and agencies; private conservation organizations; and citizens in support of protecting fish and other wildlife resources that occur at LIER.
- ▶ *Wildlife*: To provide breeding, foraging, migration, and wintering habitat for migratory and resident birds; aquatic habitat for spawning, rearing, and refugia for endangered or threatened native fish such as Longfin Smelt, Delta Smelt, Splittail, Salmon, and other fish; and habitat for mammals such as otters, beavers, and muskrats.
- ▶ *Public Use*: To provide limited, safe, and high-quality opportunities for compatible wildlife-dependent educational and recreational activities that foster public appreciation of the unique natural heritage of the Bay/Delta Ecoregion.
- ▶ *Flood Flow Conveyance*: To facilitate flood flow conveyance and the transportation of additional flows through LIER in a manner that benefits wildlife by managing local LIER conveyance features through nonstructural improvements.

3. Environmental Analysis

An environmental analysis pursuant to the California Environmental Quality Act (CEQA) has been conducted concurrently with development of this LMP to identify the potential environmental impacts of operating LIER under the provisions of this plan. As described in the initial study/negative declaration (IS/ND) prepared for the plan under CEQA, implementing the LMP would not have a significant impact on the environment. The IS/ND is included in Appendix B.

4. Organization of this Land Management Plan

This LMP is organized as follows:

- ▶ **Chapter I, “Introduction,”** summarizes the purpose of the acquisition, acquisition history, purpose of the LMP, and planning process.
- ▶ **Chapter II, “Property Description,”** describes the geographical setting, property boundaries and easements, existing infrastructure, and management setting. This chapter also describes existing resource conditions and serves as the environmental setting of the IS/ND.
- ▶ **Chapter III, “Habitat and Species Descriptions,”** provides a descriptive inventory of habitats and species that are found within or use the property.
- ▶ **Chapter IV, “Management Goals,”** describes the basis for resource management at LIER and identifies management goals and tasks. This chapter serves as the project description necessary for performing environmental review pursuant to CEQA.
- ▶ **Chapter V, “Operations and Maintenance,”** estimates operations and maintenance costs associated with managing the property and identifies potential funding sources. This chapter is intended to guide budget preparation and work plans for the property.
- ▶ **Chapter VI, “Climate Change Strategy,”** describes the projected effects of climate change on resources at LIER and proposed strategies for addressing those effects.
- ▶ **Chapter VII, “Future Revisions of This Plan,”** describes the process by which this LMP would be revised, if needed, so that it would continue to guide management of LIER.
- ▶ **Chapter VIII, “References and Personal Communications,”** lists the sources of information cited throughout this LMP.
- ▶ **Appendix A, “Public Outreach Summary,”** summarizes public outreach efforts, meeting notes, and responses to public comments.
- ▶ **Appendix B, “Environmental Review,”** presents the impact analysis, identifies mitigation measures, and includes other CEQA-required parts of an IS/ND that are not already integrated into other chapters of the LMP.

II. PROPERTY DESCRIPTION

A. Geographical Setting

Liberty Island Ecological Reserve is located at the southern end of the Yolo Bypass in the northern Delta (Exhibit 2-1). The area lies approximately 12 miles southeast of Dixon and 10 miles north of Rio Vista. The 4,308 acre property is entirely within Solano County and is bounded by Liberty Cut, Prospect Slough, Little Holland Tract, and Shag Slough; however, approximately 995 acres of conservation bank land to the north is within Yolo County and is expected to be transferred to CDFW at some point in the future.

LIER is accessible via county roads that intersect State Route 113 in Solano County. To reach LIER from State Route 113, drivers can turn east onto Midway Road, and then travel south on Bulkley Road, east on King Road for a short distance, and then south on Liberty Island Road.

B. Property Boundaries and Easements

LIER consists primarily of open water, with emergent wetland and upland habitats along the northern portion of the property (Exhibit 2-2). Liberty Island was leveed, drained, and used for agricultural production until 1997, when levees protecting the Island failed. Liberty Island belongs to a single reclamation district, Reclamation District 2093 (RD 2093); however, because there is no longer any agricultural activity, the pumps are inoperable, and the levee breach is not slated for repair, the reclamation district could be dissolved in the future. CDFW prefers to leave the Island in its current state. LIER is subject to a flood easement held by the Central Valley Flood Protection Board (CVFPB). This easement grants the State of California the right to inundate lands in the easement area and precludes landowners from building structures or growing vegetation that would substantially obstruct flood flows (USFWS 1999).

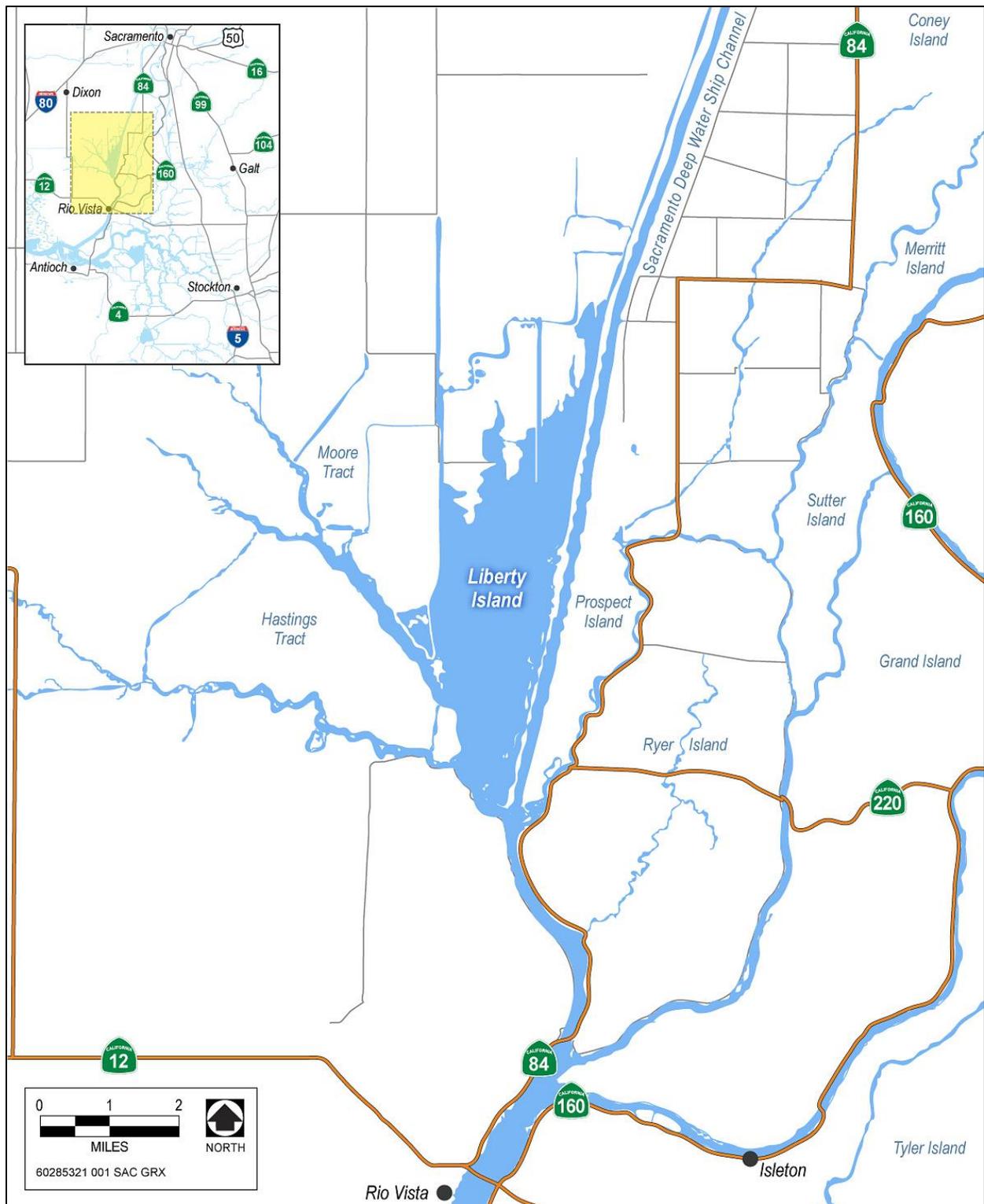
C. Land Uses

The primary land use within LIER is wetland habitat. The northern portion of LIER is primarily emergent wetland habitat. There is also some grassland habitat in the northern portion of LIER. The southern portion of LIER comprises subtidal and open-water habitats. Remnant historic-era levees are located around the perimeter of Liberty Island. Passive restoration has been occurring since the Island flooded in 1997.

D. Adjacent Land Uses

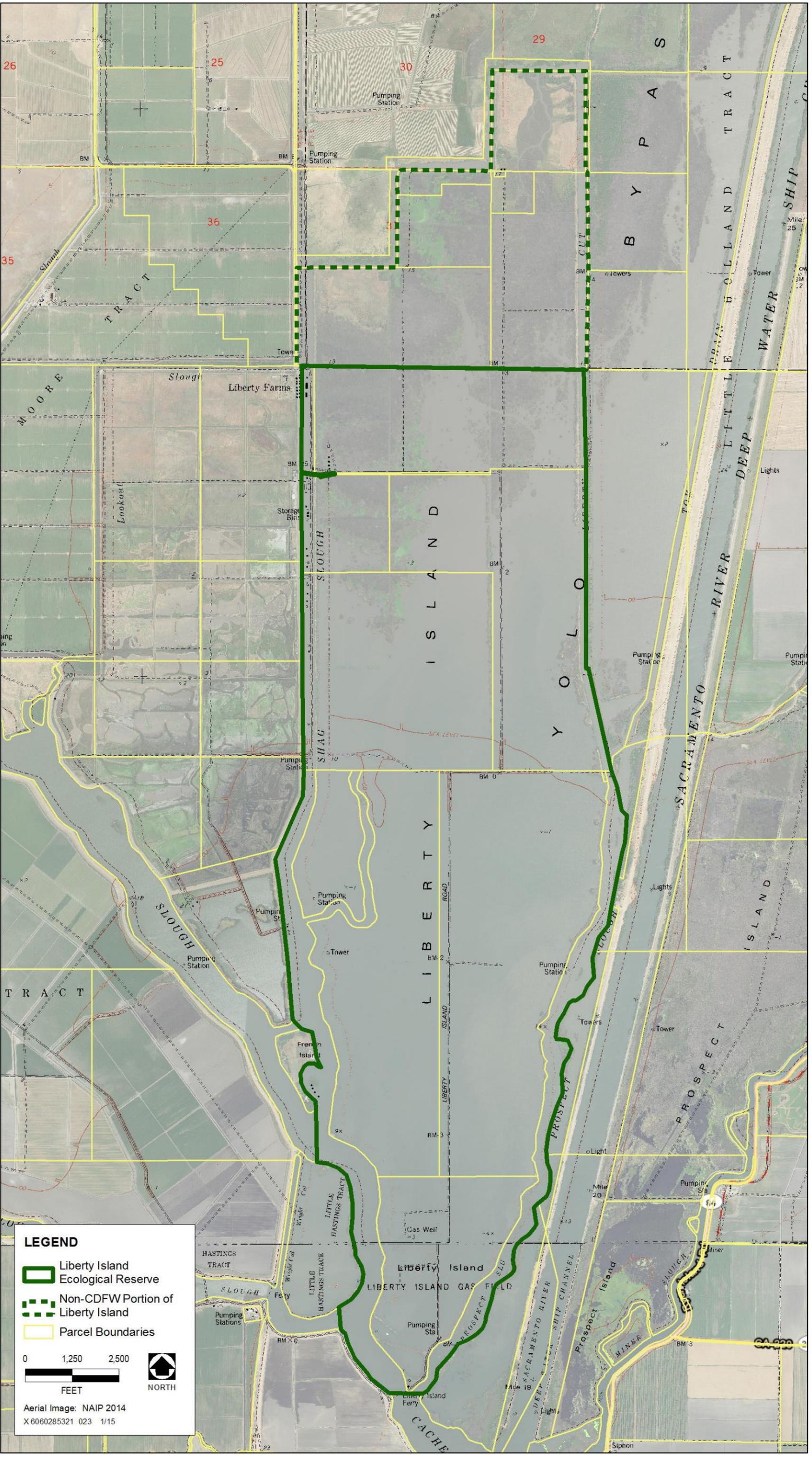
Liberty Island is located in the southern Yolo Bypass, which is a 59,000-acre flood bypass that protects Sacramento and other Central Valley communities from flooding. The Yolo Bypass is characterized by a low-gradient, wide floodplain confined by federal project levees to the east and west.

Land uses surrounding Liberty Island include agricultural lands, proposed and constructed restoration areas, and waterways. The Northern Liberty Island Fish Conservation Bank, which consists of approximately 809 acres (RD 2093 2010) of habitat for native fish, is located immediately to the north. The Liberty Island Conservation Bank and Preserve is also immediately north of LIER. This conservation



Source: CalWaters 2004; CaSIL 2001 layers; data compiled by AECOM in 2013

Exhibit 2-1. Regional Location



Source: Data compiled by AECOM based on information from the National Agriculture Imagery Program

Exhibit 2-2. Location of Liberty Island Ecological Reserve

bank encompasses 186 acres (RD 2093 2009) of fisheries enhancement area constructed in 2010. These lands are currently owned by TPL and Wildlands, Inc., but may be transferred to CDFW at some point in the future.

Farther to the north, the proposed Lower Yolo Restoration Project would include 1,226 acres of perennial emergent marsh and 233 acres of wetland enhancement. Immediately to the east are Prospect Slough and the Sacramento Deep Water Ship Channel. Farther to the east is Prospect Island, which is proposed for restoration of tidal marsh, open water, and riparian habitats. Shag Slough and Liberty Farms are to the west. Liberty Farms is 1,700 acres of enhanced wetlands. Lands in the broader vicinity are primarily in agricultural production.

E. Existing Infrastructure

1. Levees

Before the levee failure in 1997, private levees were maintained around the entire Island. Since the Island flooded, the levees have not been maintained or restored and most are now severely degraded with many breaches. The historic-era levees were constructed in 1917–1918.

2. Roads

Before flooding occurred, paved access roads provided access to the interior of Liberty Island; however, all of these roads are now under water. A submerged road that runs the length of a portion of the Island from north to south is a major hazard for boats. Liberty Island Road, which is an unsubmerged paved road, is the only road that provides access to the northern portion of the Island. Liberty Island Road is a two-lane road that is maintained by Solano County. This road connects to King Road and ends at Liberty Island. The southern portion of the property is accessible only by boat.

3. Utilities

All overhead power lines were removed from the Island and there are no other aboveground utilities within LIER.

4. Agricultural Infrastructure

Liberty Island was in agricultural production at the time the Island flooded, and several pieces of agricultural equipment associated with this use remain on the Island, including pumps and sheds. All agricultural infrastructure remaining on the property is in disrepair and is expected to be removed by CDFW.

F. Public Use

Public use within LIER includes waterfowl hunting, fishing, boating, and wildlife viewing. There are currently no CDFW–owned or maintained recreation facilities on the Island.

1. Waterfowl Hunting

Waterfowl hunting is one of the major uses of LIER from October through February. The area is open to the public and there is no fee for hunting. There is a history of hunters leaving floating duck blinds in place year-round at LIER, which provides the blind owners with preferential access to parts of LIER. There is a need for CDFW to determine whether this informal historic practice should be replaced with a formal system that provides equal opportunity access for all members of the public. Subsection 550(v)(1), Title 14, CA Code of Regulations requires visitors to remove personal belongings from CDFW lands on a daily basis. Waterfowl hunting is the primary form of hunting at LIER, but the California Fish and Game Code specifies that coots, moorhens, pheasants, doves, and rabbits may also be hunted. Hunters typically boat into the northern portion of the Island with specialized boats designed for shallow water, or access the Island via the Shag Slough Bridge. Hunting occurs from both water and land.

2. Fishing

Fishing occurs year round at LIER. Fishing for Striped Bass is most popular in the fall, winter, and spring, coinciding with the fish migration, but also occurs year round. Fishing for White Sturgeon also occurs on the Island, primarily in the winter and early summer.

Most sturgeon fishermen fish from the west bank of the Island into Shag Slough. Fishermen for Striped Bass also fish along Shag Slough and from boats in the Island's interior.



Source: AECOM

3. Boating

Because of its size and geographic position as the outflow of an extensive natural drainage area, the Delta offers a uniquely dependable freshwater-recreation opportunity for boaters. Unlike most of the state's reservoirs, which are subject to drought and fluctuating water levels, the Delta provides fairly consistent water levels through dry and wet years for recreation use year after year. Boaters in the Delta are served by more than 20 large marinas (each with more than 200 berths), and by several dozen smaller marinas, most of which are privately owned.

Boating occurs within the southern portion of LIER; however, even in the deepest parts of the Island, there are boating hazards such as snags, submerged debris, floating objects, old piers and pylons, and remnant submerged structures. Because of its shallow depth, the northern portion of LIER is limited to kayaking, canoeing, and use by small boats during high tide. From the north, boats can be launched from Arrowhead Harbor Marina on Miner Slough. The Rio Vista public boat launch is a popular launching site south of LIER. Kayaks and small specialized boats designed for shallow water can be carried to the water from Liberty Island Road.

4. Wildlife Viewing

LIER provides opportunities for wildlife observation and photography, both from land within the northern portion of the Island and from the water. The significant habitat that LIER provides makes it an ideal place for bird-watching and wildlife viewing.

G. Management Setting/Planning Influences and Considerations

1. Solano County General Plan

State agencies are exempt (as established by *Hall v. City of Taft* [1952] 47 Cal.2d177) from complying with local or county plans, policies, or zoning regulations. Nevertheless, CDFW considers all local plans in its management decisions. State agencies also must comply with state laws and regulations, including CEQA; in doing so, they must minimize environmental effects such as conflicts with local plans and policies intended to protect the environment. For these reasons, CDFW takes local land use policies and regulations into account when making land use planning decisions.

LIER is located in Solano County, so the *Solano County General Plan* was considered in the development of this LMP. The most recent general plan was adopted in 2008. The general plan's land use diagram designates Liberty Island as Agriculture with a Resource Conservation Overlay.

The Agriculture designation is for the practice of agriculture as the primary use, including areas that contribute substantially to the local agricultural economy, and allows for secondary uses that support the economic viability of agriculture. The Resource Conservation Overlay identifies and protects areas of the county with special resource management needs. This designation recognizes the presence of certain important natural resources in the county while maintaining the validity of underlying land use designations. The overlay protects resources by (1) requiring that potential effects be studied if development is proposed in these locations and (2) providing mitigation to support urban development in cities (Solano County 2008).

This LMP does not present any conflicts with the 2008 *Solano County General Plan*.

2. Yolo County General Plan

The northern portion of Liberty Island, which is currently owned by TPL and Wildlands, Inc., is located within Yolo County. The *Yolo County General Plan* designates this northern portion of the Island as Agriculture with a Delta Protection Overlay. The Delta Protection Overlay applies to the State of California—designated “primary zone” of the Delta, as defined in the Delta Protection Act. Land uses

consistent with the base designation and the Delta Protection Commission's *Land Use and Resource Management Plan* are allowed (Yolo County 2009).

Principal uses on land designated as Agriculture include cultivated agriculture, such as row crops, orchards, vineyards, dryland farming, livestock grazing, forest products, horticulture, floriculture, apiaries, confined animal facilities, and equestrian facilities. Uses also include agricultural industrial as well as agricultural commercial uses serving rural areas. Agriculture also includes farmworker housing, surface mining, and incidental habitat (Yolo County 2009). Yolo County's zoning classifications for the northern portion of the Island are Agricultural General (i.e., A-1) and Agricultural Preserve (i.e., A-P). The purpose of Zone A-1 is to provide uses on lands best suited for agriculture. The purpose of Zone A-P is to preserve land best suited for agricultural use from the encroachment of nonagricultural uses. This LMP does not present any conflicts with Yolo County's *2030 Countywide General Plan*.

3. Solano Multispecies Habitat Conservation Plan

The draft *Solano Multispecies Habitat Conservation Plan* (HCP) establishes a framework for complying with state and federal endangered species regulations while accommodating future urban growth; developing infrastructure; and conducting ongoing operations and maintenance activities for flood control and irrigation facilities and other public infrastructure undertaken by or under the permitting authority/control of the plan participants within Solano County over the next 30 years.

The HCP has 14 plan participants: Solano County Water Agency, local irrigation districts, and various cities in the planning area. It covers approximately 577,000 acres in Solano County, 8,000 acres in Yolo County, and 37 special-status species (SCWA 2009). LIER is not within the HCP area, and CDFW is not a signatory to the HCP. However, no conflict between this LMP and the HCP is expected to occur.

4. Yolo Natural Heritage Program

The Yolo Natural Heritage Program First Administrative Draft is an HCP and natural communities conservation plan (NCCP) that covers all of Yolo County. The Yolo Natural Heritage Program will conserve the natural open space and agricultural lands that provide habitat for many special-status species in Yolo County. The HCP/NCCP describes measures that will be undertaken to conserve important biological resources, obtain permits for urban growth and public infrastructure projects, and continue Yolo County's agricultural heritage. The NCCP/HCP covers 653,818 acres in Yolo County and 32 special-status species (YNHP 2013). It is planned by a Joint Powers Agency including Yolo County; the cities of Davis, Woodland, West Sacramento, and Winters; and the University of California, Davis. While the HCP/NCCP covers all of Yolo County, CDFW is not part of the Joint Powers Agency and future land use at LIER will not be subject to the HCP/NCCP, even after the plan is adopted. However, no conflict between this LMP and the HCP/NCCP is expected to occur.

5. Yolo Bypass Wildlife Area Land Management Plan

The Yolo Bypass Wildlife Area (YBWA) consists of approximately 16,770 acres of managed wildlife habitat and agricultural land within the Yolo Bypass. The bypass conveys seasonal high flows from the Sacramento River to help control river stage within the Sacramento River during flood conditions and

protect the cities of Sacramento, West Sacramento, and Davis and other local communities, farms, and lands from flooding.

In 2008, CDFW (then the California Department of Fish and Game [DFG]) prepared a LMP for the YBWA, which is located approximately 5.5 miles north of LIER. Because of the close proximity and direct hydrological connection between the YBWA and LIER, many fish, wildlife, and plant species and their habitats either occur or have the potential to occur in both areas. In addition, many of the recreational opportunities offered at the YBWA, such as excellent bird-watching, nature exploration, and waterfowl hunting, are also offered at LIER. Given the similarities between the two areas, and the location of LIER at the receiving ends of flows from the YBWA, the YBWA LMP was an important source of information for developing many of the management goals and tasks for the LIER LMP.

The stated purposes of the YBWA LMP are to:

- ▶ guide management of habitats, species, appropriate public uses, and programs to achieve DFG's mission;
- ▶ direct an ecosystem approach to managing the YBWA in coordination with the objectives of CALFED's Ecosystem Restoration Program;
- ▶ identify and guide appropriate, compatible public-use opportunities within the YBWA;
- ▶ direct the management of the YBWA in a manner that promotes cooperative relationships with adjoining private-property owners;
- ▶ establish a descriptive inventory of the sites and the wildlife and plant resources that occur in the YBWA;
- ▶ provide an overview of the YBWA's operation, maintenance, and personnel requirements to implement management goals, and serve as a planning aid for preparation of the annual budget for the San Francisco Bay–Delta Region (Region 3); and
- ▶ present the environmental documentation necessary for compliance with state and federal statutes and regulations, provide a description of potential and actual environmental impacts that may occur during plan management, and identify mitigation measures to avoid or lessen these impacts.

This LMP is consistent with the YBWA LMP.

6. Implementation Strategy for the Fish Restoration Program Agreement

The Fish Restoration Program Agreement is an agreement between CDFW and the California Department of Water Resources (DWR) that addresses the habitat restoration requirements included in the USFWS and NMFS biological opinions and CDFW California Endangered Species Act authorizations for State Water Project (SWP) and Central Valley Project (CVP) operations. The primary objective of the Fish Restoration Program Agreement is to implement the fish habitat requirements in the Delta, Suisun Marsh, and Yolo Bypass. The restoration focuses on 8,000 acres of intertidal and associated subtidal habitat to

benefit Delta Smelt, Longfin Smelt, and salmonids (DWR 2012a). This LMP is consistent with the Fish Restoration Program Agreement.

7. Central Valley Flood Protection Plan/Sacramento River Flood Control Project

The Central Valley Flood Protection Plan (CVFPP) is intended to guide California’s participation (and influence federal and local participation) in managing flood risk along the Sacramento River and San Joaquin River systems. The CVFPP proposes a systemwide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control, which includes the Sacramento River Flood Control Project. From 2009 through 2011, DWR conducted planning and investigations for the 2012 CVFPP that represented the most comprehensive flood evaluations for the Central Valley. The Central Valley’s flood management system includes levees along the major rivers and streams of the valley floor and around the islands of the Delta, a major bypass system for the Sacramento River and its tributaries, several bypass segments along the San Joaquin River, and reservoirs on almost all major rivers and streams draining to the Central Valley. The regional and system improvements considered in the CVFPP are intended to address several potential physical threats to the existing flood management system. These threats are described in the *Flood Control System Status Report* (DWR 2011). For levees in the system, threats include problems associated with geometry, seepage, structural instability, erosion, settlement, penetrations, vegetation, rodent damage, and encroachments.

The U.S. Army Corps of Engineers (USACE), in conjunction with the State of California, developed a flood control plan for the Sacramento River as part of the Sacramento River Flood Control Project. The plan included levee construction, channel improvements, and reservoir flood storage.

The CVFPB enforces appropriate standards for the construction, maintenance, and protection of flood control facilities in the Central Valley. The CVFPB must review and approve any activity that may affect “project works” or physically change the “designated floodway.” The goal is to ensure that the activity maintains the integrity and safety of flood control project levees and floodways and is consistent with the flood control plans adopted by the CVFPB and the California Legislature. “Project works” are the components of a flood control project within the CVFPB’s jurisdiction that the CVFPB or the Legislature has approved or adopted. Project works include levees, bank protection projects, weirs, pumping plants, floodways, and any other related flood control works or rights-of-way that have been constructed using state or federal funds. Project works also include flood control plans.

Rules promulgated in Title 23 of the California Code of Regulations (Division 1, Article 8 [Sections 111–137]) regulate the modification and construction of levees and floodways to ensure public safety. The flood season for the Sacramento River is November 1 through April 15. The CVFPB enforces appropriate standards for the construction, maintenance, and production of flood control facilities in the Central Valley.

Operation and maintenance of levees and floodways are overseen by DWR, which inspects the levees and issues a biannual report. The report covers the general condition of the levee, vegetation control, rodent control, and flood preparedness. The DWR Division of Flood Management’s Flood Operations Branch is responsible for gathering, analyzing, and disseminating flood- and water-related information and coordinates flood operations of Fremont Weir and Sacramento Weir spills into the Yolo Bypass.

8. Land Use and Resource Management Plan for the Primary Zone of the Delta

The Delta Protection Commission (DPC) was created by the California Legislature in 1992 with the goal of developing regional policies for the Delta to protect and enhance the existing land uses in the Delta's Primary Zone: agriculture, wildlife habitat, and recreation. Working closely with local communities and local governments, DPC adopted its *Land Use and Resource Management Plan for the Primary Zone of the Delta* (Regional Plan) in 1995. In 2000, DPC became a permanent state agency. The policies in the Regional Plan were adopted as regulations in 2000 and approved by the state Office of Administrative Law on May 8, 2001. The Regional Plan was updated in 2010.

LIER is in the Primary Zone. DPC's Regional Plan contains the following policies and recommendations, which may be applicable to LIER (DPC 2010):

- ▶ **Natural Resources Policy P-1.** Preserve and protect the natural resources of the Delta. Promote protection of remnants of riparian and aquatic habitat. Encourage compatibility between agricultural practices, recreational uses, and wildlife habitat.
- ▶ **Natural Resources Policy P-3.** Lands managed primarily for wildlife habitat should be managed to maximize ecological values. Appropriate programs, such as "Coordinated Resource Management and Planning" (Public Resources Code Section 9408[c]) should ensure full participation by local government and property owner representatives.
- ▶ **Natural Resources Policy P-7.** Incorporate, to the maximum extent feasible, suitable and appropriate wildlife protection, restoration and enhancement on publicly owned land as part of a Delta-wide plan for habitat management.
- ▶ **Natural Resources Policy P-8.** Promote ecological, recreational, and agricultural tourism in order to preserve the cultural values and economic vitality that reflect the history, natural heritage, and human resources of the Delta including the establishment of National Heritage Area designations.
- ▶ **Natural Resources Policy P-9.** Protect and restore ecosystems and adaptively manage them to minimize impacts from climate change and other threats and support their ability to adapt in the face of stress.
- ▶ **Recreation and Access Policy P-1.** Ensure appropriate planning, development, and funding for expansion, ongoing maintenance, and supervision of existing public recreation and access areas.
- ▶ **Recreation and Access Policy P-9.** Encourage the development of funding and implementation strategies by appropriate governing bodies for the surrender and/or removal of water-borne debris and dilapidated, unseaworthy, and abandoned vessels from waterways, to minimize navigational and environmental hazards.
- ▶ **Recreation and Access Policy P-10.** Promote and encourage Delta-wide communication, coordination, and collaboration on boating and waterway-related programs including but not limited to marine patrols, removal of debris and abandoned vessels, invasive species control and containment,

clean and safe boating education and enforcement, maintenance of existing anchorage, mooring and berthing areas, and emergency response in the Delta.

This LMP is consistent with these policies and recommendations.

9. Delta Master Recreation Strategy

DPC is also developing a master recreation strategy for the Delta. The purpose of this strategy is to guide decision making regarding development and use of recreation facilities over the next 15 years. The aquatic-related recreation portion of this strategy has been completed and is presented in *Summary Report for the Delta Recreation Master Strategy: Aquatic Resources Focus* (DPC 2005). In the report, the Delta is divided into six zones, and for each, existing facilities are described and additional facilities are proposed. LIER is included in the Bypass zone. Proposed facilities for this zone include the following:

- ▶ nonmotorized trail features located in the vicinity of Lindsey Slough, Cache Slough, and Liberty Island;
- ▶ nonmotorized launch and day-use facility to accompany the trail areas; and
- ▶ a gateway feature at the Interstate 80 (I-80) bypass intersection as an adjunct to the proposed CDFW Pacific Flyway interpretive facility.

10. Delta Plan

The *Delta Plan* was developed by the Delta Stewardship Council. The Delta Stewardship Council was established by the California Legislature in the Delta Protection Act of 2009, Senate Bill X7 1 (Ch. 5, Stats. 09-10, 7th Ext. Sess.). The final plan was adopted by the Delta Stewardship Council in May 2013 and became effective with legally enforceable regulation on September 1, 2013. The *Delta Plan* is intended to be a foundational document that prioritizes actions and strategies in support of key objectives such as the state's requirement to reduce reliance on the Delta to meet future water supply needs. The plan also restricts actions that may cause harm; serves as a guidebook for all plans, projects, and programs that affect the Delta; and calls for further investigation and focused study of specific issues.

Core strategies for the Delta Plan are to:

- ▶ create more natural functional Delta flows,
- ▶ restore habitat,
- ▶ improve water quality to protect the ecosystem,
- ▶ prevent introduction of and manage impacts of nonnative species, and
- ▶ improve hatcheries and harvest management.

11. North American Waterfowl Management Plan

The *North American Waterfowl Management Plan* (NAWMP) is an international agreement that provides a broad framework for waterfowl conservation and management in North America. It identifies population objectives for key species and establishes habitat goals to sustain these populations. In the

United States, the North American Wetlands Conservation Act appropriates funds for implementation of the NAWMP.

The NAWMP seeks to restore and maintain the diversity, abundance, and distribution of waterfowl that existed between 1970 and 1979. The plan identifies population objectives for 20 species of ducks, 18 species or subspecies of geese divided into 27 management populations, and two species of swans. The NAWMP further seeks to ensure that sufficient habitat exists to support 62 million breeding ducks, a fall flight of 100 million ducks, and 6 million wintering geese and swans. The NAWMP is updated at 5-year intervals.

The NAWMP makes broad recommendations for protection, restoration, and enhancement of wetland and upland habitats; duck harvest; management of the overall waterfowl population; subsistence hunting; and research. The major focus, however, is on ducks and their habitat.

Two of the NAWMP's seven habitat objectives relate to the general maintenance or rehabilitation of 34 major waterfowl habitats. Five of the seven priority objectives specifically focus on seven habitat areas (six in the United States, one in Canada) of the highest international priority. These seven areas are the objects of the initial joint ventures, which will receive priority planning and funding. California's Central Valley is one of these seven priority areas. In the priority areas, mallards, northern pintails, and American black ducks receive special attention where appropriate.

The major strategy for implementing the NAWMP is to establish specific habitat joint ventures where agencies and private organizations collectively pool their resources to address waterfowl habitat problems. Each joint venture will develop implementation plans to address specific needs of each area.

12. Water Quality Control Plan for the Sacramento and San Joaquin River Basins

The preparation and adoption of water quality control plans (basin plans) is required by the California Water Code (Section 13240) and supported by the federal Clean Water Act. In California, the regional water quality boards (RWQCBs) prepare and adopt these basin plans. For the waters in a specified area, basin plans designate beneficial uses to be protected, water quality objectives to protect those uses, and a program for achieving those objectives.

LIER is in the area covered by the basin plan for the Sacramento and San Joaquin River basins (Central Valley RWQCB 1998). The management and restoration of marsh and aquatic ecosystems at LIER has the potential to affect attainment of water quality standards. Potential effects on the basin plan's water quality objectives and associated implementation program were considered in the development of this LMP to ensure the LMP's consistency with the basin plan.

An amendment to the Sacramento and San Joaquin River basin plan addresses mercury and methylmercury contamination. In 1990, the Central Valley RWQCB determined that mercury was impairing beneficial uses of the Delta's waters because fish had elevated levels of mercury that posed a risk to the health of humans and wildlife that consumed the fish. Consequently, the Central Valley RWQCB has developed a total maximum daily load (TMDL) for methylmercury and total mercury in the Delta estuary. The total methylmercury load for the Yolo Bypass, which is adjacent to LIER, is 235 grams

per year from all possible sources, including wetlands. This represents a 78% reduction from current estimated loads (Central Valley RWQCB 2010).

13. Past and Ongoing Research

Numerous past and ongoing studies related to fish and aquatic resources have occurred and continue to occur within and around LIER. Outside LIER, the Yolo Bypass and Cache Slough Complex have physical and hydrologic processes similar to those in LIER and/or have hydrological connections that directly link these processes with one another. As a result, studies in these locations are also applicable to those conducted within LIER and are listed and summarized below.

a. Past Studies

The Resilience of Splittail in the Sacramento–San Joaquin Estuary (Sommer et al. 1997): Sacramento Splittail abundance in the Delta was compared between dry and wet years. Abundance was determined by utilizing 8 existing, long-term datasets. A portion of the sampling data came from the Yolo Bypass. Evidence of the resilience of the species was seen when high freshwater outflows in extremely wet years (such as 1982, 1983, 1986, and 1995) resulted in high numbers of juveniles.

Floodplain Rearing of Juvenile Chinook Salmon: Evidence of Enhanced Growth and Survival (Sommer et al. 2001a): Results indicated that the Yolo Bypass provides better rearing and migration habitat for juvenile Chinook Salmon than adjacent river channels. During 1998 and 1999, salmon increased in size substantially faster in the seasonally inundated agricultural floodplain than in the river, suggesting better growth rates. Similarly, coded-wife-tagged juveniles released in the floodplain were significantly larger at recapture and had higher apparent growth rates than those concurrently released in the river. The authors concluded that improved growth rates in the floodplain were in part a result of significantly higher prey consumption, reflecting greater availability of drift invertebrates.

California’s Yolo Bypass: Evidence that Flood Control Can Be Compatible with Fisheries, Wetlands, Wildlife and Agriculture (Sommer et al. 2001b): This study demonstrated that the Yolo Bypass seasonally supports 42 fish species, 15 of which are native. The authors concluded that this floodplain appears to be particularly valuable spawning and rearing habitat for Sacramento Splittail and for juvenile Chinook Salmon, which use the Yolo Bypass as a nursery. Furthermore, the authors theorized that the system may also be an important source to the downstream food web of the San Francisco Estuary as a result of enhanced production of phytoplankton and detrital material. Results suggest that alternative flood control systems can be designed without eliminating floodplain function and processes.

A Framework for the Future: Yolo Bypass Management Strategy (JSA 2001): This management strategy was the product of more than 2 years of meetings held by the Working Group, a collection of landowners, water users, and public agencies having ownership of or responsibility for property and flood conveyance functions in the Yolo Bypass. The Yolo Basin Foundation prepared a proposal to CALFED for the development of a grassroots, stakeholder-driven group that would define its own concept for the future of the Yolo Bypass, a locally based concept that would accommodate a range of land uses and lifestyles. The formation of the Working Group and the preparation of the management strategy were the culmination of that initial goal.

Hydrology and Chemistry of Floodwaters in the Yolo Bypass, Sacramento River System, California during 2000 (Schemel et al. 2002): Discharges to and floodwaters in the Yolo Bypass were sampled during winter and spring 2000. The primary purpose of the study was to link changes in water quality in the Yolo Bypass to inflows from the Sacramento River (over Fremont Weir) and from four local streams that discharge to the west side of the floodplain. Specific conductance, chloride, sulfate, dissolved inorganic nutrients, dissolved organic carbon (DOC), particulate carbon and nitrogen, suspended particulate matter (mass), and selected dissolved metals were measured in most of the samples. After the initial draining of the floodplain, chemical concentrations at sites along the perennial channel showed strong influences of inflows from Cache Creek and Ridge Cut, which are sources of nutrients and contaminants that are potentially hazardous to aquatic resources. Runoff from spring storms increased flow in the perennial channel and flushed accumulated nutrients and organic matter to the tidal river. The authors concluded that releases of freshwater to the perennial channel might be beneficial in maintaining habitat quality for aquatic species during the dry seasons.

Patterns of Adult Fish Use on California's Yolo Bypass Floodplain (Harrell and Sommer 2003): This publication presented initial results from a study to examine adult fish diversity, abundance, and timing of occurrence in the Yolo Bypass. A fyke trap was used to capture adult fish between November 1999 and June 2000. More than 1,600 individuals representing 19 species were observed including federally listed Winter-run and Spring-run Chinook Salmon, Sacramento Splittail, White Sturgeon, Striped Bass, and American Shad. Flow pulses immediately preceding floodplain inundation apparently triggered upstream movement of a suite of native fish including Sacramento Splittail, Sacramento Sucker, Sacramento Pikeminnow, and Sacramento Blackfish (*Orthodon microlepidontus*). The study demonstrated that the Yolo Bypass floodplain represents an important migration corridor and spawning habitat for Delta fish. The authors suggested that restoration of the migration corridor would improve fish passage to upstream tributaries, particularly during low-flow periods.

Hydrologic Variability, Water Chemistry, and Phytoplankton Biomass in a Large Floodplain of the Sacramento River (Schemel et al. 2004): The primary objective of this study was to identify hydrologic conditions and other factors that enhance production of phytoplankton biomass in the waters of the Yolo Bypass. Chlorophyll *a* was used as a measure of phytoplankton biomass in this study. Chlorophyll *a* concentrations were low during inundation by the river when flow through the floodplain was high, but concentrations rapidly increased as river inflow decreased and the floodplain drained. Based on the observation that phytoplankton biomass peaks during drainage events, the authors suggested that phytoplankton production in the floodplain and biomass transport to downstream locations would be higher in years with multiple inundation and draining sequences.

Ecological Patterns of Early Life Stages of Fishes in a Large River-Floodplain of the San Francisco Estuary (Sommer et al. 2004): This study examined assemblage patterns of early life stages of fishes for two major tributaries of the upper San Francisco Estuary: the Sacramento River channel and the Yolo Bypass floodplain. Species abundance was significantly correlated in both systems, suggesting that each assemblage was controlled by similar environmental factors. Species diversity and richness, however, were higher in Yolo Bypass, likely because of a wider variety of habitat types and greater hydrologic variation in the floodplain. Over 4 hydrologically diverse years (1999–2002), the study collected 15 species in Yolo Bypass egg and larval samples, 18 species in Yolo Bypass rotary-screw-trap samples, and 10 species in Sacramento River egg and larval samples. Fishes captured included Delta Smelt,

Sacramento Splittail, American Shad, Striped Bass, Crappie, and Chinook Salmon. As in other regions of the estuary, alien fish comprised a large portion (93% to 99%) of the individuals collected in the Yolo Bypass and the Sacramento River. However, the study noted that the timing of the hydrological cycle in the Yolo Bypass may favor native fish for two reasons: First, the floodplain is typically inundated in winter and early spring, when many native fishes spawn and rear; and second, most alien fishes do not spawn until late spring or early summer, after floodwaters have subsided and warmer perennial water persists. To this degree, the authors conclude that floodplain restoration may be an especially valuable tool to sustain native fishes.

Estimating Sediment Budgets at the Interface between River and Estuaries with Application to the Sacramento–San Joaquin River Delta (Wright and Schoellhamer 2005): This publication presented the results of a detailed sediment budget for the Delta. One of the sampling sites was located in Lindsey Slough, which is adjacent to the southern portion of LIER. The primary regional goal of the study was to measure sediment transport rates and pathways in the Delta in support of ecosystem restoration efforts. In addition to achieving this regional goal, the study has produced general methods to collect, edit, and analyze sediment transport data at the interface of rivers and estuaries. Over the 4 year period of this study, water years 1999–2002, 6.6 ± 0.9 Mt of sediment entered the delta and 2.2 ± 0.7 Mt exited, resulting in 4.4 ± 1.1 Mt ($67 \pm 17\%$) of deposition. The estimated deposition rate corresponding to this mass of sediment compares favorably with measured inorganic sediment accumulation on vegetated wetlands in the delta.

Managing Floodplain Inundation for Native Fish: Production Dynamics of Age-0 Splittail in California's Yolo Bypass (Feyrer et al. 2006): Data were gathered from the Yolo Bypass across 7 hydrologically diverse years (1998–2004) to examine how physical and hydrological characteristics of floodplain habitat influence spawning and patterns of occurrence and production of age-0 Sacramento Splittail. An information-theoretic approach was used to evaluate several factors. The amount of inundated floodplain habitat available during the primary spawning and rearing period of January–June was the most important factor examined in explaining annual production. The results of this study support the flood-pulse concept for cyprinids in regulated temperate river–floodplain systems and demonstrate that floodplain inundation in regulated systems can be managed to benefit native fish.

Floodwater Chemistry in the Yolo Bypass During Winter and Spring 1998 (Schemel and Cox 2007): A preliminary investigation of temporal and spatial variations in floodwater chemistry was conducted during winter and spring 1998 in the Yolo Bypass floodplain. Specific conductance and DOC concentrations along the eastern margin of the Yolo Bypass varied inversely with discharge. The Sacramento River was the greatest source of discharge to the floodplain during major periods of inundation. Increases in specific conductance and DOC concentrations were observed along the eastern margin during periods of lower discharge, when local streams accounted for a significant fraction of the total discharge through the Yolo Bypass. Apparent influences of local stream discharges also were observed in surface waters near the western margin of the floodplain during major inundation periods. Although river and local stream sources of suspended particulate matter appeared important, in-floodplain processes were likely contributors to temporal and spatial variability in concentrations. Values for the C:N ratio of the particulate matter were lowest during periods of decreasing and low discharge through the floodplain, indicating the production of phytoplankton in floodplain waters or a supply to the floodplain from local stream sources.

Phytoplankton Primary Productivity, Respiration, Chlorophyll a, and Species Composition in the Yolo Bypass Floodplain (Lehman et al. 2008): This study compared primary productivity, community respiration, chlorophyll *a* concentration, phytoplankton species composition, and environmental factors in the Yolo Bypass floodplain and in the adjacent Sacramento River. The goal of the comparison was to determine whether passage of the Sacramento River through floodplain habitat enhanced the quantity and quality of phytoplankton carbon available to the aquatic food web, and how environmental conditions during the flood season affected primary productivity and the composition of phytoplankton species in these habitats. The study suggested that the river water passing through a floodplain during the flood season could enhance the quantity and quality of riverine phytoplankton biomass available to the aquatic food web.

Nearshore Areas Used by Fry Chinook Salmon, Oncorhynchus tshawytscha, in the Northwestern Sacramento–San Joaquin Delta (McLain and Castillo 2009): This publication reported the geographic distribution and the densities and catch rates of Chinook Salmon fry in different substrata and nearshore zones in the northwestern Delta. Sample sites included six beach seine sites and eight electrofishing sites during winter 2001 along the Sacramento River, Steamboat Slough, Miner Slough, Prospect Island Marsh, Prospect Slough, and Liberty Island. Overall, fry densities were higher on the Sacramento River and Steamboat Slough and lower in Liberty Island and Prospect Island marshes. Chinook fry were significantly larger in the Sacramento River than in Steamboat Slough during March. Densities of Chinook Salmon fry were higher in shallow beaches than in riprap nearshore zones. Fry densities also increased with Secchi depth and richness of nonnative species, suggesting increased predation risk. Shallow nearshore environments in conveyance channels such as Steamboat Slough and the Sacramento River seem important for rearing Chinook Salmon fry. Conversely, riprap in these channels was less used by fry. The authors concluded that evaluating potential impacts of habitat quality on growth and survival of fry seems key to successful conservation and restoration efforts in the Delta.

The Freshwater Tidal Wetland Liberty Island, CA was Both a Source and Sink of Inorganic and Organic Material to the San Francisco Estuary (Lehman et al. 2010): The production and export of material by Liberty Island were measured and compared using discrete monthly and continuous (15-minute) measurements of a suite of inorganic and organic materials and flow between 2004 and 2005. Seasonal material flux was estimated from monthly discrete data for inorganic nutrients, suspended solids and salts, organic carbon and nitrogen and phytoplankton and zooplankton group carbon, and chlorophyll *a* and pheophytin pigment. The study indicated that tidal flow rather than river discharge was responsible for 90% or more of the material flux in the wetland, and that freshwater tidal wetlands can be a source of inorganic and organic material, but that the export of material is highly variable spatially and temporally and varies most closely with tidal flow.

Spatial Perspective for Delta Smelt: A Summary of Contemporary Survey Data (Merz et al. 2011): This study utilized data from the 20-millimeter (mm) Tow-Net and Spring Kodiak Trawl, together with other Interagency Ecological Program (IEP) programs and regional monitoring programs, to comprehensively describe the range and temporal and geographic distribution of Delta Smelt by life stage within the San Francisco Estuary, including the Yolo Bypass. Delta Smelt were observed more frequently and at higher densities (at all life stages) near the center of their range, from Suisun Marsh down through Grizzly Bay and east Suisun Bay through the confluence to the Lower Sacramento region, and into the Cache Slough region. This comprehensive review provides managers and scientists an improved

depiction of the spatial and temporal extent of the Delta Smelt throughout its range and lends itself to future analysis of Delta Smelt population assessment and restoration planning.

The Spawning Migration of Delta Smelt in the Upper San Francisco Estuary (Sommer et al. 2011):

The primary objective of this study was to characterize, at least generally, the spawning migration of Delta Smelt, including the periods immediately before and after upstream movement. The study utilized fall midwater trawl, spring Kodiak trawl, 20-mm survey, SWP salvage, and summer townet survey data. Overall, Delta Smelt fit the pattern of a diadromous species that is a seasonal reproductive migrant. Emerging data suggest that there is variability in the migration behavior of Delta Smelt, a pattern contrary to the reigning viewpoint that all smelt migrate in winter.

A Place to Call Home: A Synthesis of Delta Smelt Habitat in the Upper San Francisco Estuary

(Sommer and Mejia 2013): This study used a combination of published literature and field survey data to synthesize the available information about habitat use by Delta Smelt. The study reported that Delta Smelt habitat ranges from San Pablo and Suisun Bays to their freshwater tributaries, including the Sacramento and San Joaquin Rivers. In recent years, substantial numbers of Delta Smelt have colonized habitat in Liberty Island. The authors recommended restoration of multiple geographical regions and habitats, coupled with extensive monitoring and adaptive management. An overall emphasis on ecosystem processes rather than specific habitat features was suggested as likely to be most effective for recovery of the species.

Suspended-Sediment Flux and Retention in a Backwater Tidal Slough Complex near the Landward Boundary of an Estuary (Morgan-King and Schoellhamer 2013):

This study characterized the turbidity around Liberty Island by measuring suspended-sediment flux at four locations from July 2008 through December 2010. An estuarine turbidity maximum in the backwater Cache Slough complex is created by tidal asymmetry, a limited tidal excursion, and wind-wave resuspension. During the study, there was a net export of sediment, although sediment accumulates in the region from landward tidal transport during the dry season. Sediment is continually resuspended by both wind waves and flood-tide currents. The suspended-sediment mass oscillates in the region until winter freshwater flow pulses flush it seaward. The hydrodynamic characteristics in the backwater region, such as low freshwater flow during the dry season, flood tide dominance, and a limited tidal excursion, favor retention of sediment.

Effects of Turbidity and an Invasive Waterweed on Predation by Introduced Largemouth Bass

(Ferrari et al. 2014): This study tested how changes in turbidity and the recent invasion of an aquatic macrophyte, *Egeria densa*, may have changed the predation pressure by introduced Largemouth Bass on juvenile Striped Bass and Delta Smelt. In a series of mesocosm experiments, it was demonstrated that increases in vegetation density decreased the predation success of Largemouth Bass. When placed in an environment with both open water and vegetated areas, and given a choice to forage on prey associated with either of these habitats, Largemouth Bass preyed mainly on open-water species as opposed to vegetation-associated species, such as juvenile Largemouth Bass, Bluegill, or Red Swamp Crayfish. Turbidity served as cover to open-water species and increased the survival of Delta Smelt; open-water prey tend not to seek refuge in the vegetation cover, even in the presence of an imminent predation threat. The results of this study provide the beginning of a mechanistic framework to explain how decreases in turbidity and increases in vegetation cover correlate with a decline of open-water species in the Delta.

b. Ongoing Studies

Breach III Study: Evaluating and Predicting Restoration Thresholds in Evolving Freshwater-Tidal Marshes (CALFED 2011): LIER has been the site of several CALFED-sponsored and other research projects in recent years because the Island provides a unique opportunity to study passive restoration and biological conditions and processes in the Delta. The largest of these studies, the Breach III Study, is an interdisciplinary study that is evaluating hydrologic and geomorphic changes and the ecological response to passive wetland restoration at the landscape scale. An objective of this research is to develop a measurement and predictive tool to guide future restoration to successful outcomes. The Cache Slough Complex, and the Island in particular, has been recognized by the IEP, CALFED, the BDCP, and others as potential refugia for Delta Smelt, Sacramento Splittail, salmon species, and other native fish species and for its hydrodynamic influence within the north Delta region. During 2002–2005, USFWS was able to collect various life stages of Delta Smelt within the Island on regular time intervals. Based on those data and current monitoring efforts at Liberty Island, it appears that Delta Smelt are utilizing the nearshore habitats of the Island not only during the spawning season, but on a year-round basis. Because of these findings, resource managers and regional planners have touted the Island as a model for tidal marsh restoration.

Interagency Ecological Program Cache Slough Studies (DWR 2010b): The IEP is currently examining the hydrodynamic footprint of Liberty Island. Preliminary, unpublished results suggest three findings: (1) turbidity in this area seems to be controlled by big inflow events and wind; (2) seasonally, big inflow events such as the flooding of the Yolo Bypass bring big sediment pulses into the region; and (3) the region is remarkably turbid because of windy conditions that stir up large amounts of sediment. This is important because turbidity has been dropping in the Delta because of reduced sediment inputs from upstream and the filtering effect of expanding beds of aquatic plants, yet pelagic native fish like Delta Smelt need turbid water. A working hypothesis is that the high turbidity in the Island (and the broader region) is a key reason why the area has become a hot spot for Delta Smelt. The study also found that zooplankton densities are relatively high in the Cache Slough region compared to many other parts of the Delta. Phytoplankton levels are not remarkably high in the Island itself, but are at impressive levels in the smaller sloughs that surround the Island. The Cache Slough complex (including Liberty Island and the Sacramento Deep Water Ship Channel) seems to provide suitable habitat for Delta Smelt and other fishes because it is turbid and has more food.

Delta Juvenile Fish Monitoring Program, USFWS, Stockton, California: In 2000 CALFED provided funding to the USFWS Delta Juvenile Fish Monitoring Program (DJFMP) to conduct a 2-year pilot study within Liberty Island. The goals of the study were to (1) summarize the passive restoration that had occurred since the island flooded (2) develop aquatic monitoring protocols; and (3) document baseline conditions for fish and wildlife occupancy, vegetation, bathymetry, water quality, phytoplankton, zooplankton, benthic conditions, and organic carbon before any restoration activities. The DJFMP participated in the Interagency Monitoring Group, composed of CDFW and DWR, to complete the pilot project during the 2003 through 2005 field seasons. The DJFMP was specifically tasked with fish sampling to determine the habitat use of Sacramento Splittail, Delta Smelt, and Chinook Salmon within the Island. In 2009, the DJFMP submitted a proposal to the IEP Management Team to reinstate fish monitoring at Liberty Island. The additional effort was proposed to complement ongoing studies in the region including BREACH III. As a result, larval fish trawls and beach seine sampling at the Island were

reinitiated in 2010, and these sampling elements continue today as part of the baseline monitoring program. In addition, zooplankton sampling in conjunction with the larval trawls has been incorporated into the 2013 DJFMP work plan.

Sediment and Turbidity Studies in the Cache Slough Complex, U.S. Geological Survey (USGS): As part of the IEP, USGS has conducted studies on sediment process and turbidities favoring endangered fish and their connection to pelagic organism decline in the Cache Slough Complex. These ongoing studies began in 2008. The results show that Liberty Island acts as a sink for sediment coming out of the Yolo Bypass or as a source of sediment from seasonal winds that promote resuspension, or both. Additional studies compared the diet of fish species across a wetland vegetation gradient during different seasons to help determine how to restore favorable wetland habitats for native fish.

H. Geology, Soils, and Topography

1. Geology

LIER is located in the Great Valley Geomorphic Province of California, a large northwest-trending valley bounded by the Sierra Nevada to the east and south, the Coast Ranges to the west, and the Klamath Mountains to the north. The Great Valley is drained by the Sacramento and San Joaquin Rivers, which join and flow out of the province through San Francisco Bay. This geomorphic province is an asymmetric trough approximately 400 miles long and 50 miles wide, filled with a thick sequence of sediments ranging from Jurassic (180 million years Before Present [B.P.]) to recent age. The sediments in the Great Valley vary from 3 to 6 miles in thickness and were derived primarily from erosion of the Sierra Nevada to the east, with lesser amounts of material from the Coast Ranges to the west.

Liberty Island is located approximately 12 miles southeast of Dixon in the northern reaches of the Delta. Most of the sediments in the Delta were deposited between 175 million and 25 million years B.P. and were accumulated in marine environments. Younger deposits (25 million years B.P. to recent) are generally described as nonmarine; however, some of the younger deposits may have formed as marine deposits in shallow seas and estuaries. The depositional history of the Delta during the late Quaternary period (the last 1 million years) probably was controlled by several cycles related to fluctuations in regional and global climate, with each cycle consisting of a period of deposition followed by a period of nondeposition and erosion. Thus, the Delta during the late Quaternary period had stages of wetlands and floodplain creation as tidewaters rose in the valley from the west; areas of erosion when tidewaters receded; deposition of alluvial fans that were reworked by wind to create extensive sand dunes; and alluvial fan deposition from streams emanating from the adjacent mountain ranges.

From 70,000 to 11,700 years B.P., sea level may have been as much as 365 feet below the present level. During this time, the Delta was a fluvial and alluvial system, where fast-moving rivers deposited coarse-grained sediments in alluvial fans and channels. During the Holocene (11,700 years B.P. to present day), sea levels rose, flooding the area known today as San Francisco Bay and the Delta. In the initial flood stages, fine-grained silty sands and clayey silts were deposited in shallow bays. As conditions in the Delta became conducive to plant growth over time, organic sediments composed mainly of peat began to accumulate above the silt that previously had been deposited. Once the plants became established, their growth and decay led to repeated cycles of peat deposition. The thickest deposits likely occurred at the sites of major Pleistocene-age drainage ways. Over thousands of years, the process of peat deposition led

to the formation of peat islands, with river channels and sloughs around the islands. During flood events, rivers would flow over their banks and form natural levees of sand and silt along the edges of the islands. Many of the present-day levees in the Delta are located at the sites of these older, natural levees (Roger Foott Associates Inc. 1991).

Geologic mapping provided by Atwater (1982) indicates that the primary geologic formation exposed at the surface of LIER consists of Holocene-age flood basin deposits (Exhibit 2-3). Holocene intertidal deposits composed of soft mud and peat are present in the southern portion of the Island.

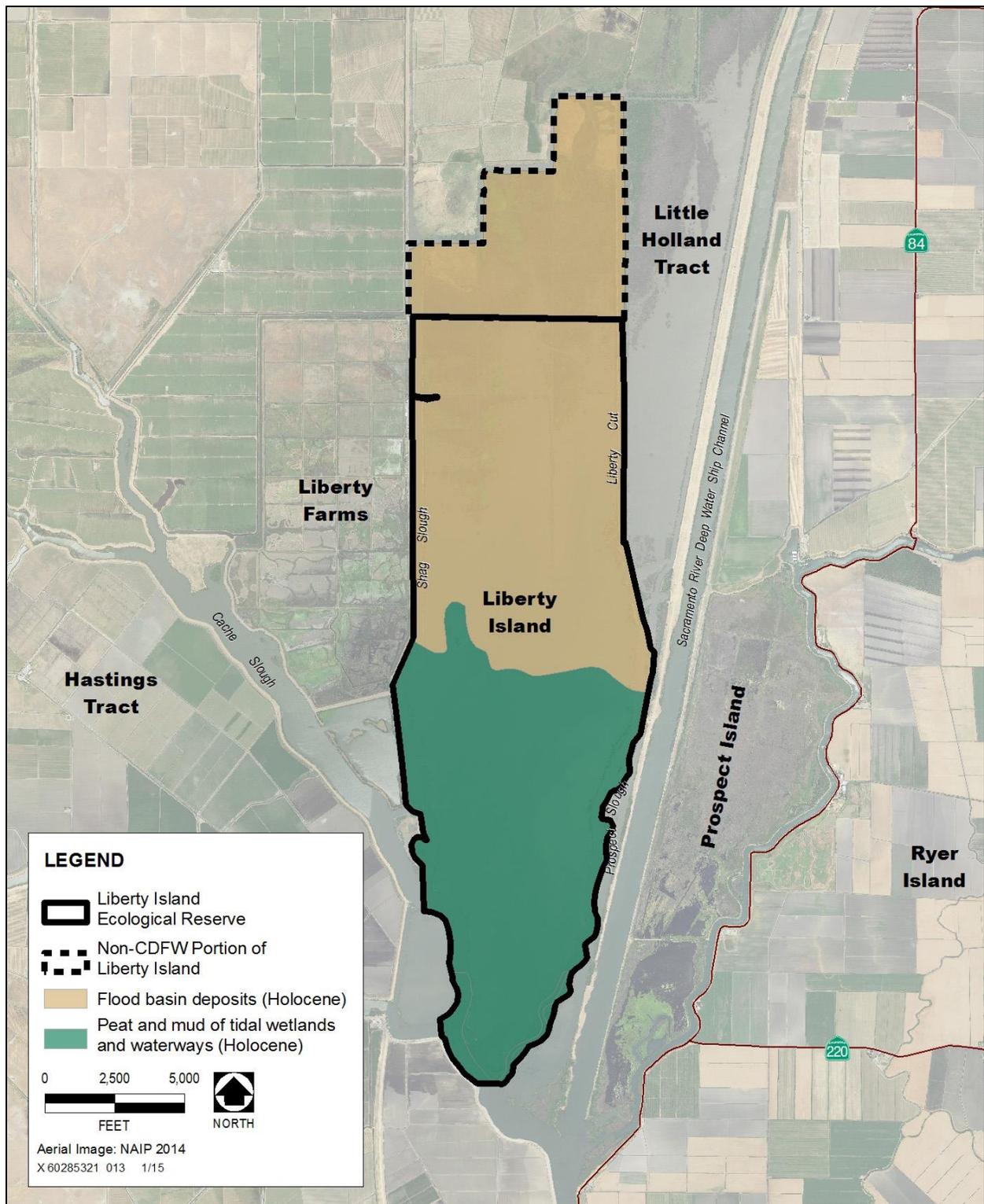
LIER is located in the USGS Liberty Island and Rio Vista 7.5-minute quadrangles. Most of the Island has been submerged since 1997 and is therefore topographically below sea level. North Liberty Island is flat and is located at an approximate elevation of 0–5 feet above mean sea level.

2. Seismicity

No active faults have been mapped within or adjacent to LIER by the California Geological Survey (CGS) or USGS (Jennings 1994), and Liberty Island is not located in an Alquist-Priolo earthquake fault zone (CGS 2012).

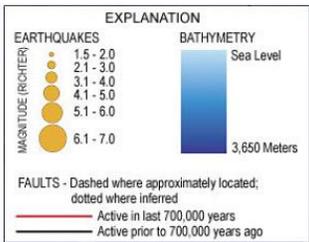
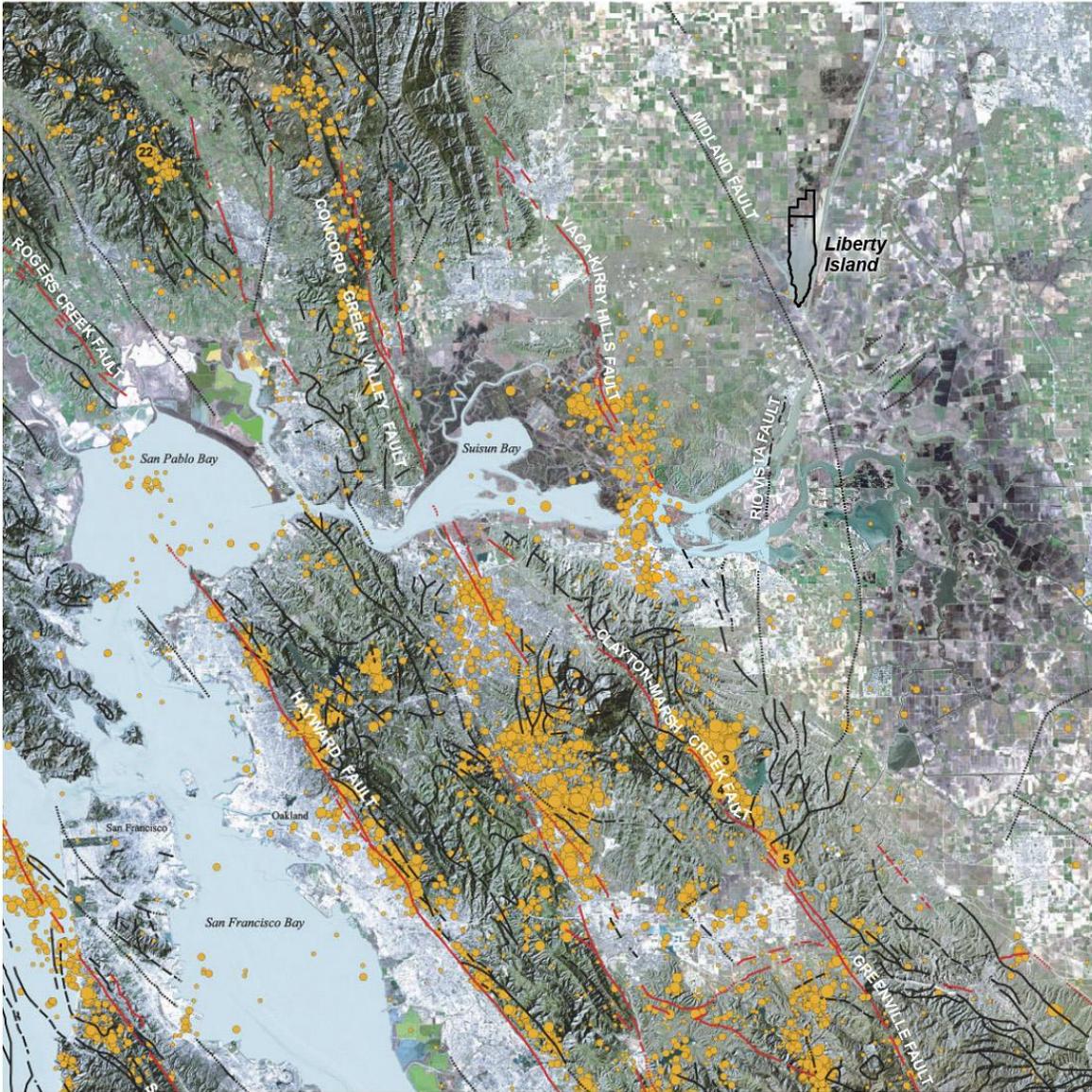
As shown in Exhibit 2-4, the Midland Fault is located approximately 2 miles west of the Island and is oriented north/south; however, the Midland Fault has not been active in the last 1.6 million years (Jennings 1994). The Rio Vista Fault is located approximately 5 miles south of the Island. It is classified as an undivided quaternary fault that has shown evidence of activity during the last 1.6 million years, but not during the last 200 years (Jennings 1994). The Vaca–Kirby Hills Fault is located approximately 12 miles west of the Island. Although it is not classified as active fault by CGS or USGS, numerous microearthquakes as large as magnitude 3.7 have been associated with the Vaca–Kirby Hills Fault over the past 32 years (Myer et al. 2010), indicating that this fault is active. The known active faults (as classified by CGS) closest to LIER are listed in Table 2-1, which also shows each fault’s approximate distance from the Island and the projected maximum moment magnitude and slip rate.

Seismic hazards that may result from a nearby moderate to major earthquake generally can be classified as primary and secondary. The primary effect is fault ground rupture, also called surface faulting. Because no active faults have been mapped in the project area, and the area is not located within an Alquist-Priolo earthquake fault zone, fault ground rupture is unlikely. Common secondary seismic hazards include ground shaking, liquefaction, subsidence, and seiches. These hazards are discussed briefly below.



Source: cbec 2012a

Exhibit 2-3. Geologic Formations at Liberty Island Ecological Reserve



60285321 002 SAC GRX

Source: USGS 2012

Exhibit 2-4. Regional Faults

Table 2-1. Faults in the Project Region Classified as Active by the California Geological Survey			
Fault Name	Approximate Distance from Liberty Island (miles)	Maximum Moment Magnitude	Slip Rate (mm/yr)
Greenville Fault Zone (Clayton section)	15	6.6	2.0
Concord–Green Valley	20	6.2	4.0
Rodgers Creek Fault	28	7.0	9.0
Hayward Fault (Northern section)	32	6.4	9.0
San Andreas Fault (Peninsula section)	55	7.1	17.0

Note: mm/yr = millimeters per year
Sources: Cao et al. 2003, Jennings 1994, data compiled by AECOM in 2014

Ground shaking. Seismic ground shaking refers to ground motion that results from the release of stored energy during an earthquake. The intensity of ground shaking depends on the distance of the site from the earthquake’s epicenter, the magnitude of the earthquake, site soil conditions, and the character and duration of the ground motion. Ground shaking can result in damage to or collapse of buildings and other structures.

Ground failure/liquefaction. Liquefaction is a process by which water-saturated materials (including soil, sediment, and certain types of volcanic deposits) lose strength and may fail during strong ground shaking, when granular materials are transformed from a solid state into a liquefied state as a result of increased pore-water pressure. Structures on the ground that undergo liquefaction may settle or suffer major structural damage. Liquefaction is most likely to occur in low-lying areas, where the substrate consists of poorly consolidated to unconsolidated, water-saturated younger sediments, or of similar deposits of artificial fill. The islands in the Delta are generally composed of peat and mud deposits, which have high liquefaction potential.

Subsidence and settlement. Subsidence is the gradual settling or sudden sinking of the ground surface that results from subsurface movement of earth materials. Seismically induced settlement refers to the compaction of soils and alluvium caused by ground shaking. Fine-grained soils are subject to seismic settlement and differential settlement. Areas underlain by low-density silts and clays associated with fluvial depositional environments are susceptible to seismically induced settlement. These environments include old lakes, sloughs, swamps, and streambeds. The amount of settlement may range from a few inches to several feet.

Seismic seiches. A seiche is an earthquake-induced wave within an enclosed or restricted body of water, such as a lake, reservoir, or channel. Seiches can cause a body of water to overtop and to damage levees and dams, and may lead to inundation of surrounding areas.

3. Soils

The 4,308-acre LIER is located in Solano County, while the 995-acre North Liberty Island is located in Yolo County. A review of soil survey data published by the U.S. Natural Resources Conservation Service (NRCS 2013), which include both counties, indicates that the Island consists of five different soil types (Exhibit 2-5).

a. Soil Characteristics

As shown in Table 2-2, all of the LIER soils are composed primarily of silts and clays, with small amounts of sand. The soils are generally nonsaline, are poorly drained, and have low to moderate water and wind epto hydrologic Group C or D. Group C soils exhibit medium to high runoff potential and a low to moderate infiltration rate, while Group D soils have high runoff potential and a low infiltration rate. (Hydrologic soil groups apply only to surface layers.) The soil pH ranges from moderately acidic to slightly basic. All of the LIER soils originated from mixed alluvium. They are suitable for crop production and were used in that capacity from 1918 until the levee breach in 1997.

b. Subsidence from Peat Oxidation

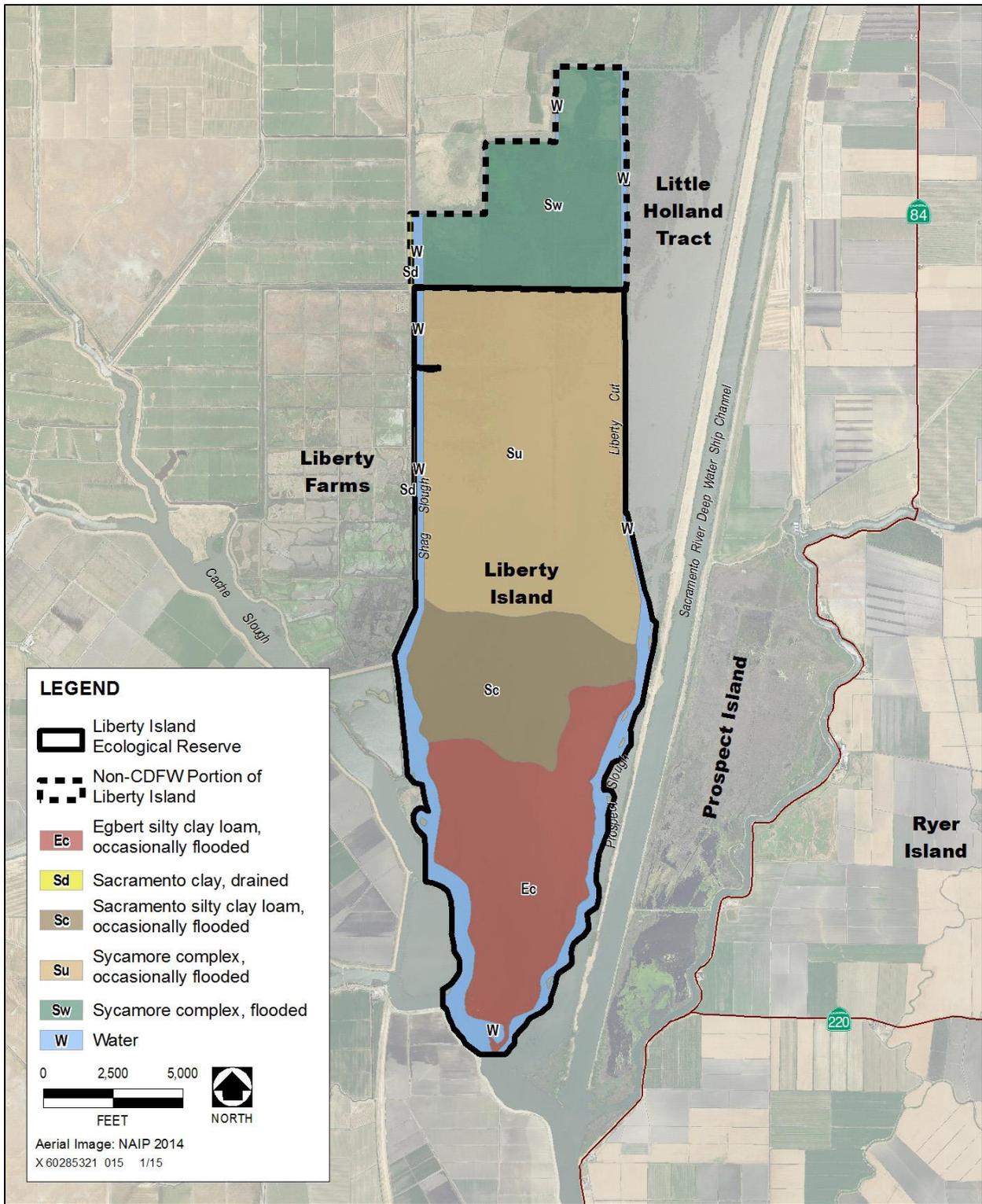
Subsidence of land in the Delta from the oxidation of peat soils is an ongoing process. Delta islands, including Liberty Island, were reclaimed for agricultural use because of their fertile soils by constructing levees and drains. Substantial reclamation of Delta islands was accomplished between 1880 and 1920. Reclamation at Liberty Island occurred in 1917–1918 with the construction of levees approximately 11 feet high. Dickman (1981) notes that “Prior to this time, the island had been a favored sport center with abundant ducks and black bass sheltered by tules 10–20 feet high.”

After reclamation, the drained Delta lands began to subside. “Subsidence,” as it relates to Delta islands, refers to the falling level of the land surface, primarily from the oxidation of peat soil. This oxidation occurs because microbes decompose organic matter in the presence of oxygen. Once the water is drained from Delta soils, oxygen levels increase. Because organic matter (from marsh plants) accounts for a large portion of the volume of peat soils, this consumption of organic matter by microbes reduces soil volume.

c. Minerals

Liberty Island does not lie within an area that has been classified for aggregate mineral resources under the California Surface Mining and Reclamation Act mineral land classification project. Because the materials underlying the surface consist of mud, organic soil, peat, and imported fill material, LIER does not contain valuable aggregate resources.

However, the Liberty Island gas field is located at the southern end of LIER (Exhibit 2-2). The gas field was discovered in 1960 and was producing approximately 3,900 million cubic feet per day (California Division of Oil and Gas 1982). Drilling and maintenance pads for the gas wells were interspersed among the agricultural fields. However, there are currently no active or inactive gas wells within the Island.



Source: cbec 2012b

Exhibit 2-5. Liberty Island Ecological Reserve Soils

Table 2-2. Soil Characteristics in the Liberty Island Ecological Reserve and North Liberty Island											
Soil Map Unit Name	Soil Composition (%)				Permeability ¹	Salinity ² (EC)	pH	Drainage	Hydrologic Soil Group	Water Erosion Hazard ³	Wind Erosion Hazard ⁴
	Sand	Silt	Clay	Organic Matter							
Liberty Island Ecological Reserve											
Egbert silty clay loam, occasionally flooded	17.8	44.5	37.7	1.94	Moderately high	Nonsaline	6.1	Poorly drained	C	Low	7
Sacramento clay, drained	11.1	25.0	63.9	2.09	Moderately low	Nonsaline	6.7	Poorly drained	D	Low	4
Sacramento silty clay loam, occasionally flooded	12.0	30.5	57.5	2.00	Moderately low	Nonsaline	7.4	Moderately well drained	D	Moderate	7
Sycamore complex, occasionally flooded	11.4	55.4	33.1	0.74	Moderately high	Very slightly saline	7.3	Somewhat poorly drained	C	Moderate	5
North Liberty Island											
Sacramento clay, drained	11.1	25.0	65.0	2.09	Moderately low	Nonsaline	6.7	Poorly drained	D	Low	4
Sycamore complex, flooded	7.1	59.5	33.4	0.91	Moderately high	Nonsaline	7.1	Somewhat poorly drained	C	Moderate	7
<p>Notes: EC = electrical conductivity</p> <p>¹ Based on standard U.S. Natural Resource Conservation Service saturated hydraulic conductivity (Ksat) class limits; Ksat refers to the ease with which pores in a saturated soil transmit water.</p> <p>² Based on the electrical conductivity of the soil, which is measured as deciSiemens per meter at 25 degrees Celsius.</p> <p>³ Based on the erosion factor "Kw whole soil," which is a measurement of relative soil susceptibility to sheet and rill erosion by water.</p> <p>⁴ Soils assigned to Group 1 are the most susceptible to wind erosion, and those assigned to Group 8 are the least susceptible.</p> <p>Source: NRCS 2013</p>											

I. Geomorphology, Hydrology, Water Quality, and Climate

1. Geomorphology

a. Yolo Bypass

Historic Conditions

The Yolo Bypass is located in the general area of the historic Yolo Basin, the larger of the north Delta's two major flood basins bordering the Sacramento River (Exhibit 2-6). The formation of the Yolo Basin and other basins in the area was a product of the sediment-rich flood flows of the Sacramento River and the valley's relatively low-gradient topography. During California's wet season (the winter and spring), heavy flows would spill out of the Sacramento River into the Yolo Basin and move parallel to the river before rejoining it nearly 40 miles downstream. The basin was several miles wide, started near Knights Landing Ridge, and drained mostly into the mouth of Cache Slough at its downstream end. Separating the Yolo Basin from the Sacramento River were large, gradually sloping, forested levees composed of sand and silt that were deposited over time during flood events that overtopped the levees. To its west, the basin was bordered by the valley's slopes and large alluvial fans of incoming tributaries (Whipple et al. 2012). In some cases, the vegetation types have been mapped to the association level, which captures the variety of species composition and structure that may be found by considering multiple plant layers within an alliance, not just the primary layer.

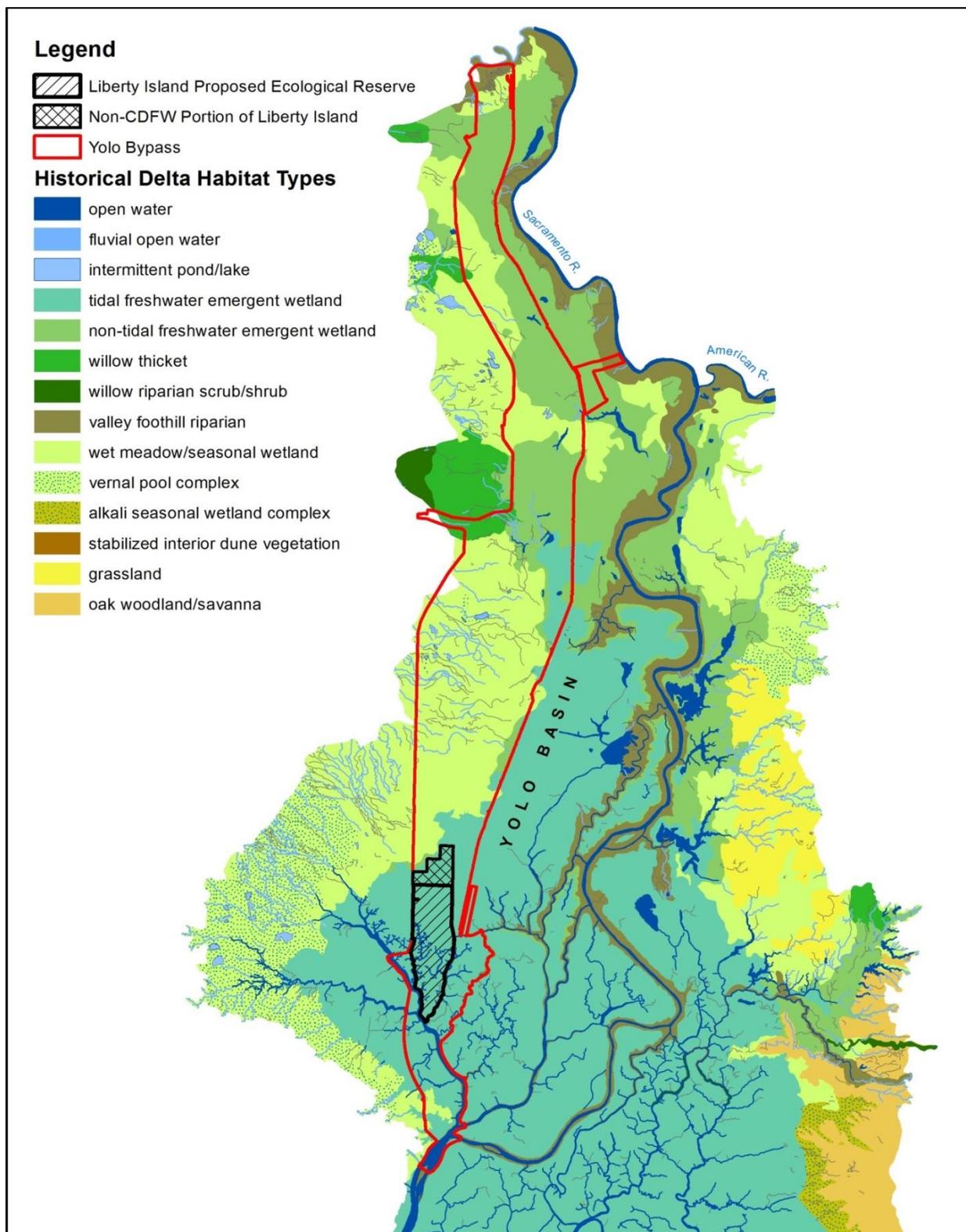
The Delta basins were so large that they often carried more water during flood events than the river channel itself. During floods, flows moving through the basin could be several feet deep, and often the basin would remain wet in many areas for weeks or months after flood events had passed. Consequently, the Yolo Basin was dominated by wetland vegetation, particularly nontidal, freshwater emergent wetland in the north. These seasonal wetlands transitioned through tule marsh, backwater ponds, and willow thickets to tidal wetlands in the south (DFG 2008). More than 50% of the Yolo Basin's 73,000 acres were tidally influenced. This part of the basin was affected by both the fluvial processes of Sacramento River flooding and tidal processes of the San Francisco Estuary (Whipple et al. 2012).

Geomorphic Modifications

During the 19th and 20th centuries, the Yolo Basin was transformed from its natural form to its current state as a highly modified flood control bypass. As portions of the Delta were converted to agricultural land, large-scale flood control projects were implemented to protect farmers and crops (DFG 2008). The Sacramento River was physically predisposed to flood more frequently than other large river systems because its channel was only large enough to carry a small fraction of river flows (Whipple et al. 2012).

Flood frequencies and magnitudes were intensified by the widespread use of hydraulic gold mining, which filled river beds with excess sediment, in a process known as bed aggradation (James and Singer 2008).

In 1911, the State Reclamation Board began valleywide flood control efforts that included construction of the Yolo Bypass. The bypass was designed to carry flood flows of 500,000 cfs, which is five times the capacity of the Sacramento River. Construction of the levees along the bypass was completed in 1948; the position of those levees has remained fairly constant since the alignment of the Sacramento Deep Water Ship Channel in the mid-1940s (DFG 2008).



Source: SFEI-ASC 2012; mapping data provided by San Francisco Estuary Institute and adapted by cbec in 2014

Exhibit 2-6. Historical Delta Environment with Current Yolo Bypass Location

In addition to the changes in the physical form of the Yolo Basin, the incoming supply of sediment to the Sacramento River and Yolo Bypass has changed dramatically over the past two centuries. Starting in the 1850s, the widespread practice of hydraulic gold mining in Northern California resulted in the production of enormous quantities of coarse sediment (nearly 1.1 billion cubic meters by 1905) in the mountain tributaries of the Sacramento River and other Central Valley rivers. This sediment was mobilized during heavy rains, transported down from the mountains east of the valley, and typically deposited along the beds of these rivers. This process of river bed aggradation reduced the flood conveyance capacity of the Sacramento River and resulted in more frequent and higher magnitude floods (James and Singer 2008).

However, since the end of hydraulic gold mining in the late 1800s, most of the Sacramento River has experienced bed lowering or degradation. Recent analysis also shows that sediment transport in the river has been consistent for the past several decades (Hall et al. 2010). Additionally, sediment supply to San Francisco Bay from the Sacramento River declined by roughly 50% between 1957 and 2001 (Wright and Schoellhamer 2004). This decline can be attributed to a combination of factors, including:

- ▶ construction of several dams in the Sacramento River watershed, which capture and store sediment in reservoirs;
- ▶ a reduction in easily erodible sediment remaining from hydraulic gold mining practices;
- ▶ sediment deposition in flood bypasses (such as the Sutter and Yolo Bypasses);
- ▶ bank protection measures along the Sacramento River and its tributaries; and
- ▶ land use change throughout the Sacramento River watershed (e.g., urbanization and agriculture).

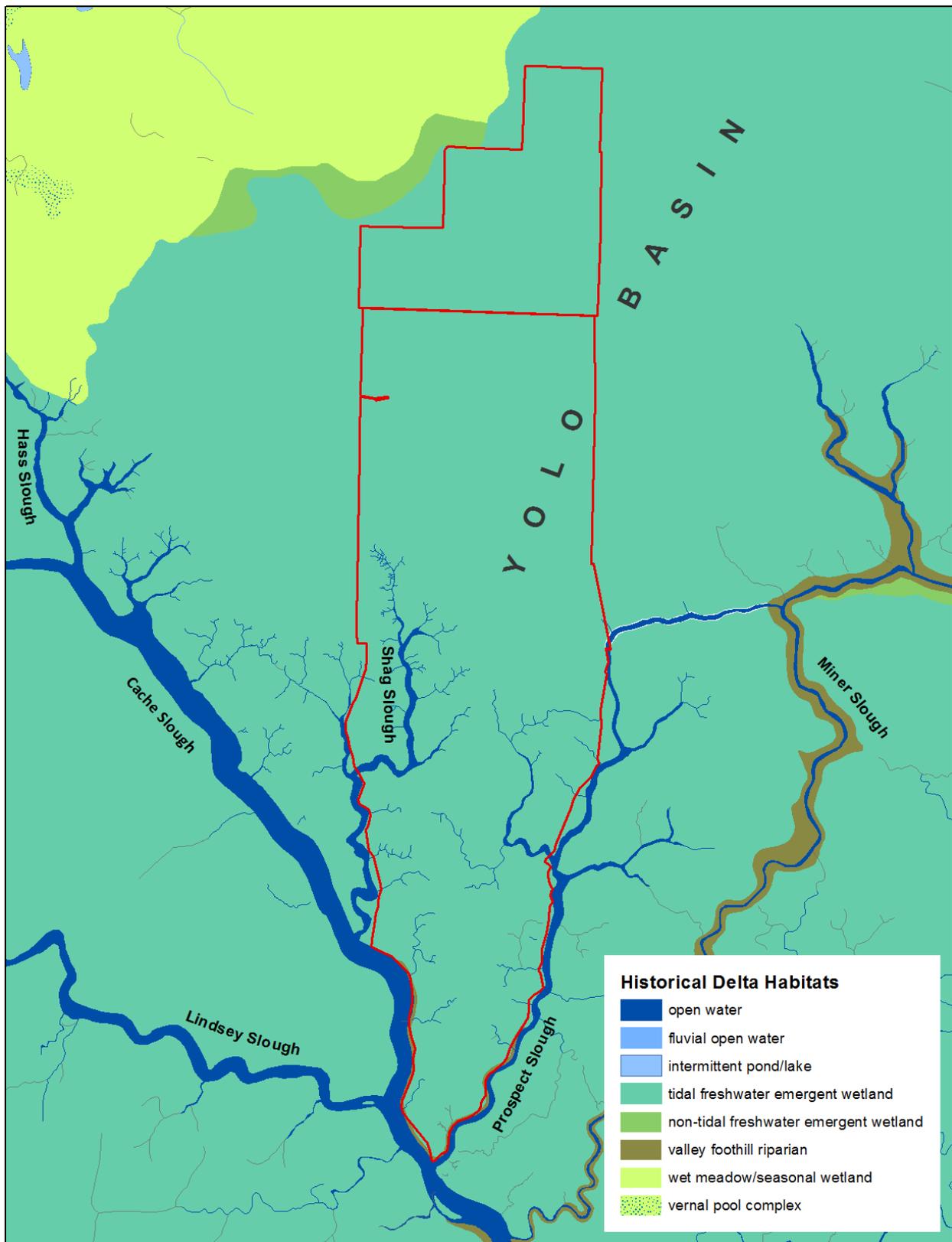
b. Liberty Island

Historic Conditions and Geomorphic Modifications

In the Delta's presettlement conditions, Liberty Island was an expanse of tidally influenced, freshwater tule marsh habitat in a larger mosaic of wetland vegetation and sloughs (Exhibit 2-7). Given its location in the Delta and Yolo Basin, Liberty Island and its surrounding landscape was a product of both fluvial and tidal processes.

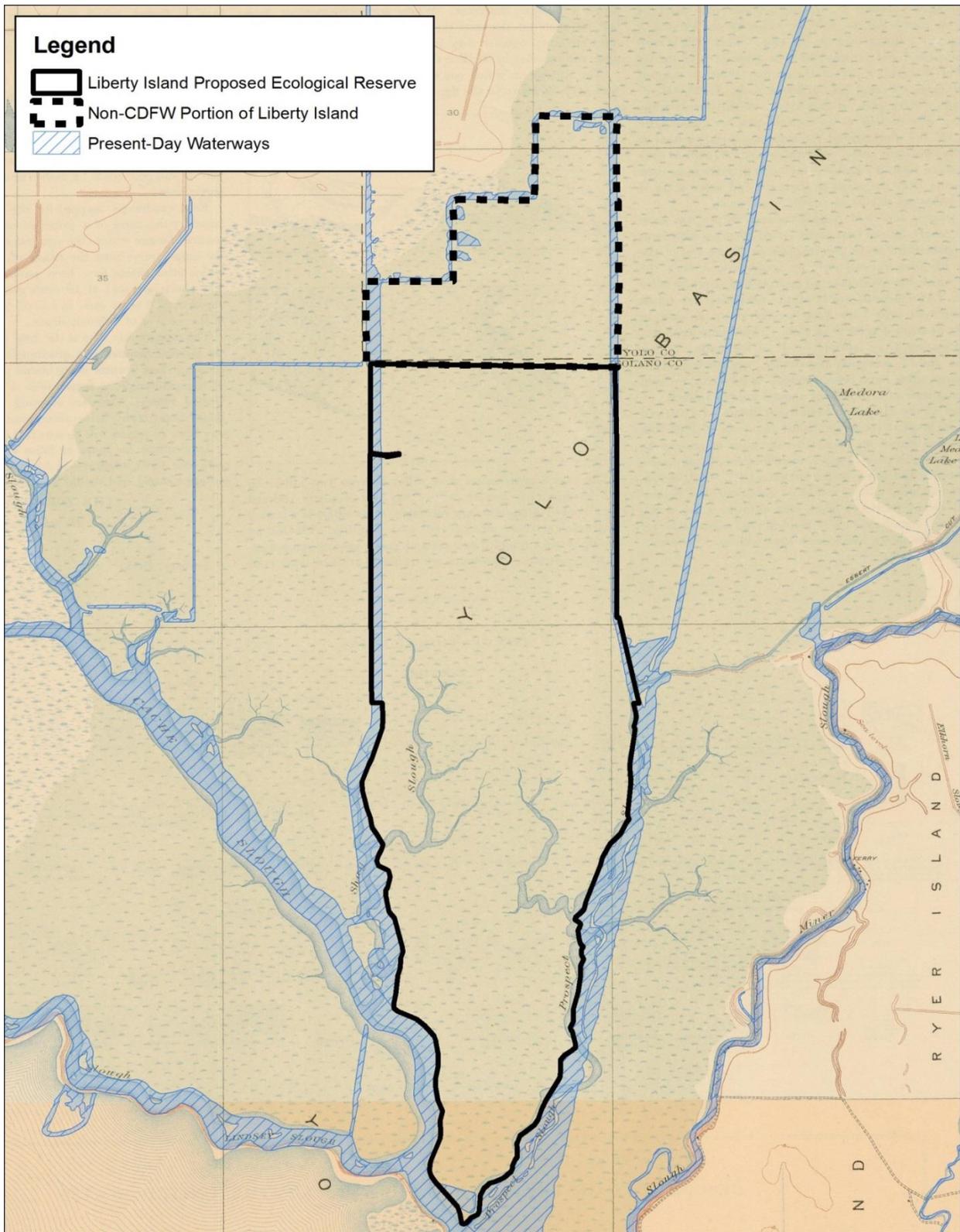
During the late 1800s and early 1900s, much of the Delta and the areas within the Yolo Basin were converted to agriculture. In the late 1910s, the reclamation of Liberty Island, which was one of the last islands to be converted to farming, began when the area was purchased by the Liberty Farms Company.

At this time, the Island was surrounded by Prospect Slough to the east and Cache Slough along the western and southern boundaries (Exhibit 2-8). Under the direction of Robert Malcolm, the president of the Liberty Farms Company, floating dredges were used to construct more than 20 miles of levees around the Island's boundaries. Additionally, two canals were cut in the north-south direction in the interior of the Island to promote drainage. This was followed by the removal of the tule marsh within the Island and the construction of more than 120 miles of lateral ditches that drained into the main drainage canals.



Source: SFEI-ASC 2012; mapping data provided by San Francisco Estuary Institute and adapted by cbec in 2014

Exhibit 2-7. Historic Mapping by the San Francisco Estuary Institute



Source: SFEI-ASC 2012; USGS Cache Slough 1916 and Rio Vista 1910 quadrangle maps, adapted by cbec in 2014.

Exhibit 2-8. U.S. Geological Survey Quadrangle Map Overlain with Present-Day Hydrography

Large pumps were installed at the southern end of the canals to keep the Island's interior dry. In the late 1920s, the road bed within the Island's interior was heightened and the levee tops were flattened to serve as additional roads.

As with many of the agricultural areas in the Yolo Bypass, Liberty Island was subject to periodic flooding during the winter and spring. It was typical for the levees to be overtopped or fail during large flood events, and the Island flooded on 27 occasions between 1918 and 1973. After each flood, the Island's levees were repaired with dredges and sometimes enhanced in size or position. Flooding of Liberty Island became more frequent after the construction of the Sacramento Deep Water Ship Channel was completed in 1963. The alignment of the ship channel substantially altered the southern end of the Yolo Bypass, constricting flows through a smaller area and thus increasing the likelihood of flooding at Liberty Island. It was also during this time that spoil from construction of the Sacramento Deep Water Ship Channel was placed in Shag Slough to provide additional agricultural land (Dickman 1981).

The cycle of farming interrupted by floods continued at Liberty Island until 1997, when a flood event caused extensive damage to the Island's levees and the current owner chose not to repair them. Since that time, the Island has remained inundated.

Over time, the ground surface of Liberty Island subsided because of the draining of the soils and decomposition of the organic material present in the soil. However, subsidence at the Island was much less than in other parts of the Delta because of the higher mineral component of soils in the Liberty Island area (DWR and CDFW 2013).

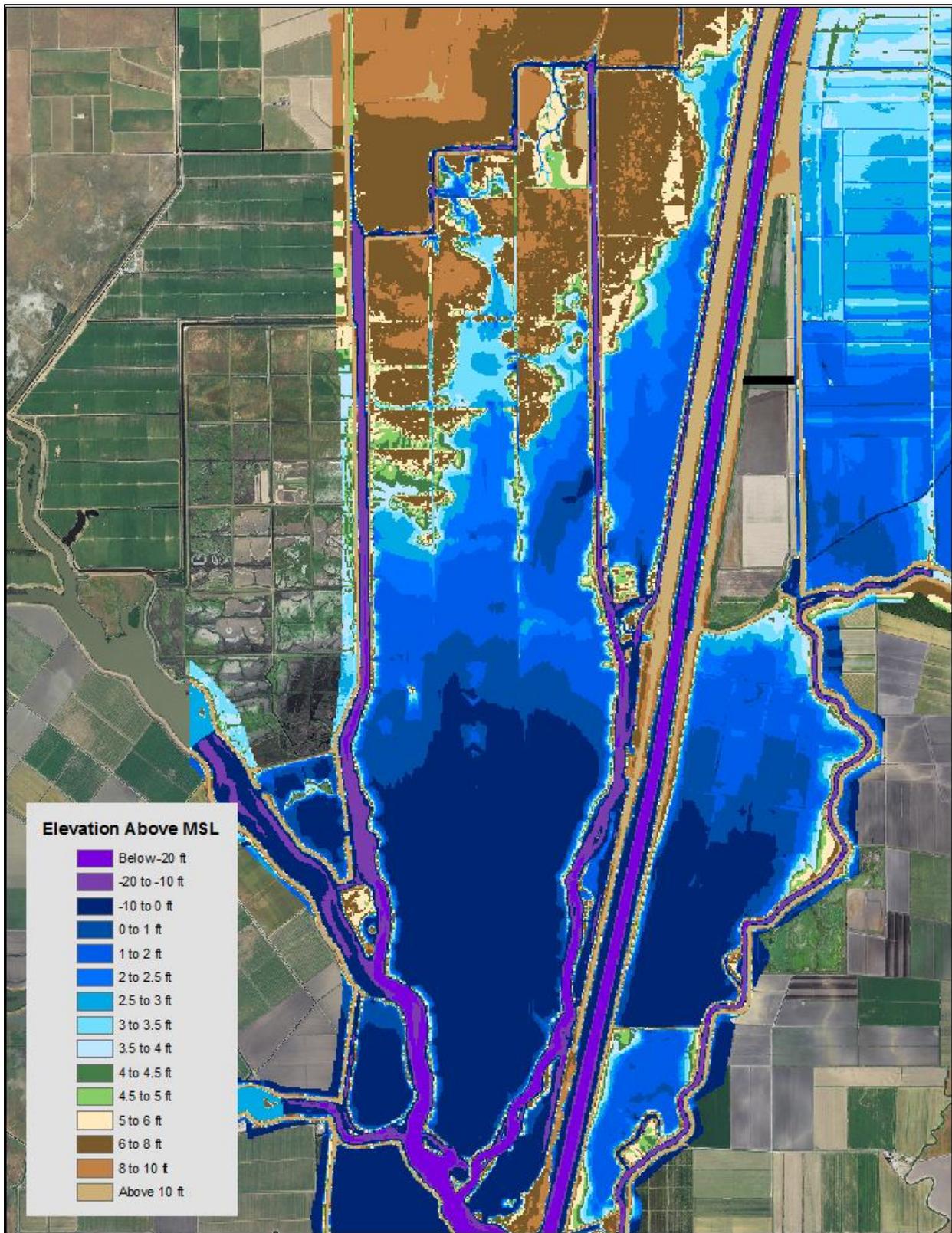
Overview of Existing Conditions

Today, Liberty Island is a tidally influenced, flooded, former agricultural area bordered by eroding restricted-height levees. The Island has a down-valley gradient from north to south, and its central and southern sections consist of a continuous expanse of open water. The deepest sections of the Island, located at its southern tip, are approximately 40 feet below sea level. The northern extent of the Island is made up largely of upland areas that transition to tule marsh habitat as the elevation decreases as one moves southward. Along the northern edge of the Island is a system of "stair-step" levees and canals, with a few sections of wetlands created by levee breaches and restoration projects. The levees surrounding the Island have failed or completely eroded in numerous sections, resulting in tidal connections with the surrounding Delta slough system. There are also two canals and a road bed running from north to south that are presently under water, but partially exposed during low tide.

Exhibit 2-9 depicts the topography of Liberty Island and differentiates upland, tidal, and subtidal areas of the Island. Elevations are drawn from a combination of Central Valley Floodplain Evaluation and Delineation Light Detection and Ranging (LiDAR) data (DWR 2008) and recent bathymetry (EDS 2009; DWR 2010a).

Wind and Waves

Depending on the season and weather conditions, the dominant drivers of geomorphic processes at Liberty Island vary among tidal, fluvial (riverine), and wind-wave processes. Wind patterns and the geometry of Liberty Island combine to create large waves in the open-water areas. Wave-induced erosion plays an important role in the Island's geomorphology, particularly in open-water areas and along levees.



Source: cbec 2011

Exhibit 2-9. Present-Day Topography of Liberty Island

On an annual basis, the largest source of wave power is the sea breeze, because of its moderate strength and near-daily frequency from May through August. This wind climatology, which is driven by temperature differences between the Bay Area and Central Valley, produces afternoon winds from the southwest at 15–20 miles per hour (Exhibit 2-10). During the winter, the wind climate includes forcing by Pacific storms and polar fronts that drive intermittent winds from both the north and south that can exceed 30 miles per hour (Exhibit 2-10).

Waves generated by the sea breeze interact with Liberty Island's geometry to elevate bed shear stress over large areas of the northern intertidal mudflats. Because of the Island's alignment, winds from the southwest generate waves over nearly a 4-mile fetch of open water. At the north end of the Island, waves encounter shallow depths or the water's edge, depending on the tide. In these shallow conditions, waves transmit their energy to the mudflats as bed shear stress. Exhibit 2-11 shows the monthly variation of the time that wave-induced bed shear stress exceeds the critical erosion shear stress. From May through August, the wave-induced bed shear stress is erosive more than 25% of the time in a large fraction of the northern mudflats. The wave-induced bed shear stress ends abruptly at the vegetation because it rapidly damps waves and shelters the bed from elevated shear stress. In addition to eroding the bed, waves erode the Island's surrounding levees.

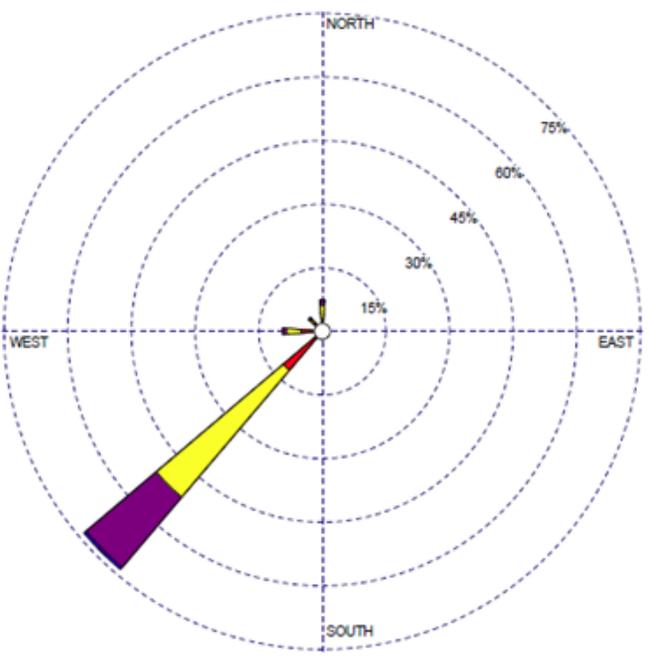
Sediment Sources

The Sacramento River is the primary source of sediment for the Delta (Wright and Schoellhamer 2004), and Liberty Island is well-positioned to accumulate a fraction of this sediment supply. Small to moderate flows in the Sacramento River valley are contained within the river's main channel and Delta distributaries. Several of these distributaries (Miner, Sutter, and Steamboat Sloughs) pass by or through lower Cache Slough, and reversing tides bring their sediment-laden riverine discharge into Liberty Island. At higher discharges that flood the Yolo Bypass, sediment-rich waters from the Sacramento River and Yolo Bypass tributaries flow directly across Liberty Island on their way through the bypass (Exhibit 2-12). These tributaries, which include Cache Creek, Knights Landing Ridge Cut, and Putah Creek, enter the bypass upstream of Liberty Island and yield small quantities of sediment to Liberty Island.

An ongoing analysis program by USGS characterizes regional sediment fluxes to the Cache Slough region, which includes Liberty Island (Morgan-King et al. 2013). The Yolo Bypass dominates sediment supply to the Cache Slough region, providing approximately three-quarters of the sediment flux. Most of the remaining fraction enters the region through the Sacramento River distributary, Miner Slough. Almost half of the sediment flux into Cache Slough is deposited each year. In terms of the fraction deposited, the Cache Slough region is an exception to the northern Delta, which sees less than 10% of its incoming sediment flux deposited. This larger deposition rate in the Cache Slough region occurs during high flows in the Yolo Bypass, a time when concurrent high discharge in the Sacramento River delivers large sediment loads through the north Delta. In the Sacramento River, discharge is so energized by flooding that minimal deposition occurs.

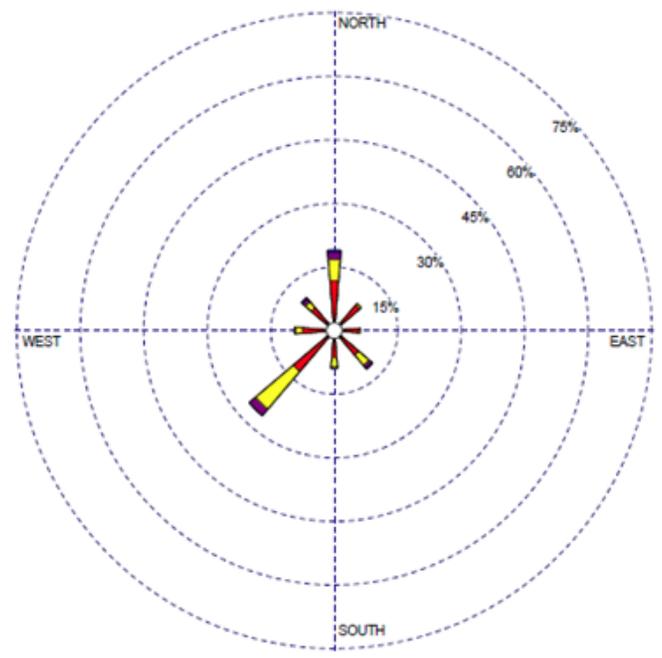
Local sediment supply originating within Liberty Island is limited. In the open-water areas, the bed is largely unchanged from the pre-breach agricultural surface. The exceptions are sites near levee breaches that scoured in the first few years immediately after breaching, but remained stable over the last decade. Local variations in topography, such as agricultural furrows, drainage ditches, and areas behind berms,

a) April to September



Source: CIMIS Station #122, Hastings Tract

b) October to March

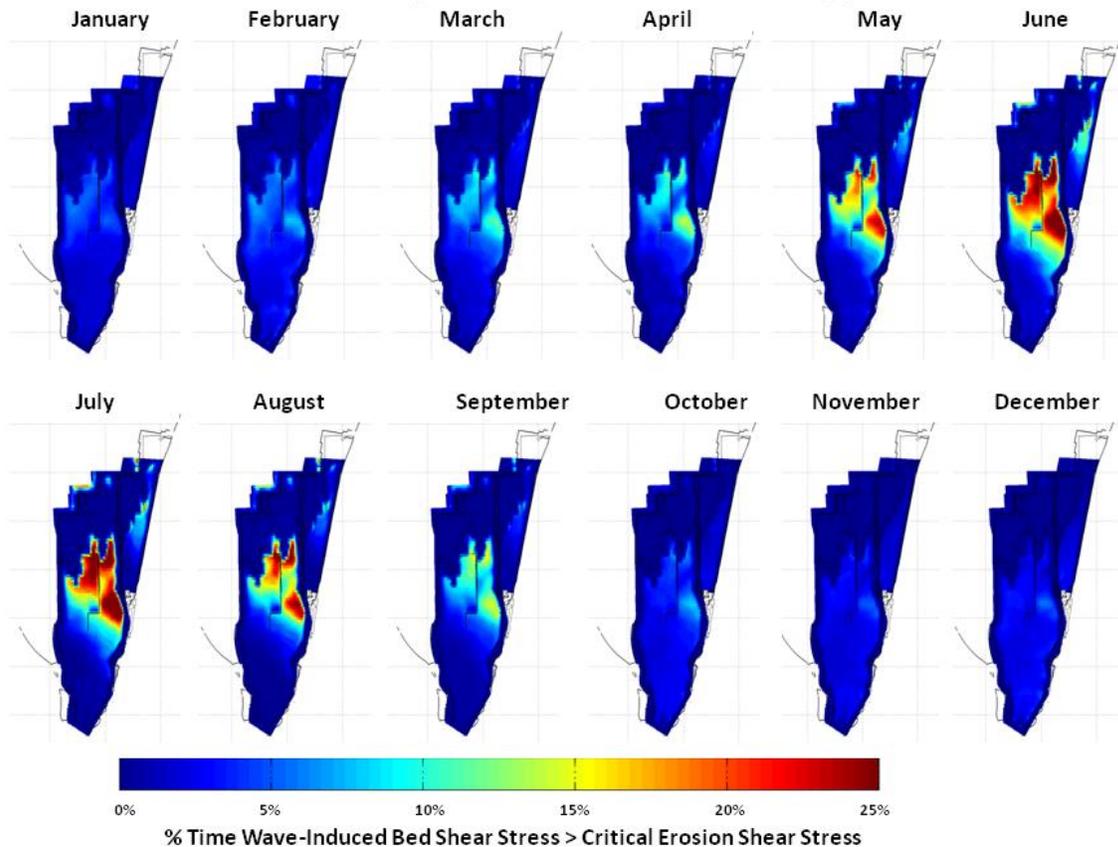


WIND SPEED (m/s)
 >= 20.0
 15.0 - 20.0
 10.0 - 15.0
 5.0 - 10.0
 0.0 - 5.0
 Calms: 0.00%

Source: ESA PWA 2013

Exhibit 2-10. Wind Direction and Magnitude

Liberty Island Wave Climatology



Source: ESA PWA 2013

Exhibit 2-11. Wave Climatology

likely provide sediment storage that fluctuates with the short-term and seasonal variations of other sources and bed shear stress. Degrading levees may also provide minor contributions, but those contributions are smaller than those of riverine supply. The rates of accumulation within marsh habitat suggest that once sediment deposits in these vegetated areas, it is typically protected from resuspension.

Sediment Flux and Accretion

Given the complexity of Liberty Island, modeling of hydrodynamic and sediment transport currently provides the strongest understanding of sediment dynamics. Models created by ESA PWA predict the influences of tides, riverine discharge, and waves on seasonal patterns of sediment fluxes and accretion on Liberty Island (ESA PWA 2013). This work simulated four periods between July 2010 and March 2011, which included a winter with above-average runoff. The modeling integrated observed tides, discharge, and suspended-sediment fluxes at the boundaries of the modeling domain. The initial conditions for the bed sediments were configured through a combination of observations and model iterations. The model's predictions were calibrated and validated to observed concentrations of suspended sediment within the modeling domain. The predicted deposition and erosion rates and patterns were consistent with spot measurements of erosion and deposition rates (Reed et al. 2012) as well as an Island-wide survey of the bed (EDS 2010).

Yolo Bypass Flow with Sediment



Source: Sommer et al. 2008 (contrast enhancements by ESA PWA 2013)

Exhibit 2-12. Yolo Bypass Color Banding

The periods modeled suggest a seasonal cycle to Liberty Island's suspended-sediment field. Sediment is supplied primarily by the Sacramento River, with particularly favorable delivery from the Yolo Bypass. These riverine sediments are sequestered in marsh vegetation and temporarily deposited on mudflats, probably in local areas associated with small-scale topographic features. After floodwaters and riverine inputs recede in late spring or early summer, the nearly daily sea breezes generate waves that resuspend sediment. The wave-induced sediment resuspension occurs predominantly in the northern mudflats. This resuspended sediment is often advected to nearby vegetated areas and deposited, where it contributes to long-term accretion. The mudflats are also hydrologically distant from the rest of the Delta, as indicated by the long residence time of the resuspended sediment in this portion of the Island, which slows the dispersal of wave resuspended sediments. In the fall, when winds have receded and relatively little local sediment is being supplied, concentrations of suspended sediment are lowest. The cycle begins again with the arrival of the first flush from winter runoff.

Geomorphic Evolution

Approximately two-thirds of Liberty Island is open water, with tidal marsh vegetation composing another quarter of the Island. The remaining fraction of the Island is uplands and levees. In most of the open water, which includes both intertidal mudflats and shallow subtidal regions, there has been only a negligible change in the bed surface.

Limited deposition can be found in sheltered bed depressions and along the west levee, where forcing by tides, riverine discharge, and waves is reduced. These local deposition points likely serve as reservoirs for seasonal sediment storage and resuspension. Change to open water occurs as tule vegetation expands laterally. Existing tule plants extend runners to colonize adjacent mudflats at a rate of approximately 3 feet per year (Hester et al. 2013). This rate is altered by the duration of inundation, soil conditions, and waves. In newly vegetated areas, waves and currents are dampened, enabling deposition of sediment to occur at a rate of nearly 1 inch per year (Reed et al. 2012). In areas that have been vegetated for several years or more, the accumulated sediment platform built on top of the former agricultural surface reaches depths of 1 foot or more.

Observation on Liberty Island and elsewhere in the Delta indicates that tule can occupy areas that are somewhat below mean lower low water (Hester et al. 2013), which include wide expanses of the Island's intertidal mudflat and shallow subtidal open water. Assuming that current conditions persist into the future, the tule marsh is expected to continue its expansion. However, at 3 feet per year, this expansion would add only a narrow buffer approximately 150 feet wide to the existing marsh in the next 50 years. At the scale of Liberty Island, where marsh stretches for several thousand feet and open water stretches for miles, this additional buffer would result in a relatively small change to the Island's habitat distribution and could be significantly outpaced by changes resulting from sea level rise (see discussion of Future Conditions in Section II.I.4, "Climate," below).

Waves have degraded Liberty Island's levees, eroding the inboard side of the eastern levee. Once the levee crest's elevation drops into the tidal range, tidal currents overtop the crest and contribute to the degradation. This degradation is likely to continue along portions of the levee. However, once the elevation of the levee drops below mean lower low water, the degradation rate appears to slow. Further erosion is limited because the wave-induced erosion at the bed decreases with depth. This decreasing erosion establishes a new equilibrium between the wave and current-induced erosion and the consolidated soils forming the levee. The result is a subtidal bench, in some places completely replacing the levee and in others fronting the remaining levee. Patches of tule have been established and expanded onto these degraded levee benches. This unaided tule expansion suggests that management to facilitate tule growth on the degraded levee benches could minimize further degradation. The tule would reduce wave transmission onto adjacent property, while still allowing tidal exchange in sections without a remaining levee. Sea-level rise would enable waves to reach higher on the levees and may facilitate ongoing degradation.

Since the initial response to breaching, the evolution of the channels has been limited. Most of the channels are associated with topographic features such as breaches in external levees and internal berms, as well as pre-breach drainage ditches. The constriction of flow through breaches in levees and berms has scoured channels near the breach; but once past the constriction, the flow disperses and there is negligible channel signature in the planar, pre-breach surface. As a result, the marsh and intertidal mudflat have not developed the dendritic channel network observed on natural marshes and mudflats. Assuming that current trends persist, the existing channels are likely to remain fairly static because they appear to be nearly in equilibrium with the existing tidal prism.

In addition to the current processes that are causing geomorphic change at Liberty Island, others may change in the future and affect the evolution of the Island. Additional factors that could influence Liberty

Island's geomorphology include the riverine sediment supply, Yolo Bypass modifications, nonnative vegetation, and restoration of adjacent areas.

2. Hydrology

a. Yolo Bypass

Historic Conditions and Shifts in Yolo Basin Hydrology

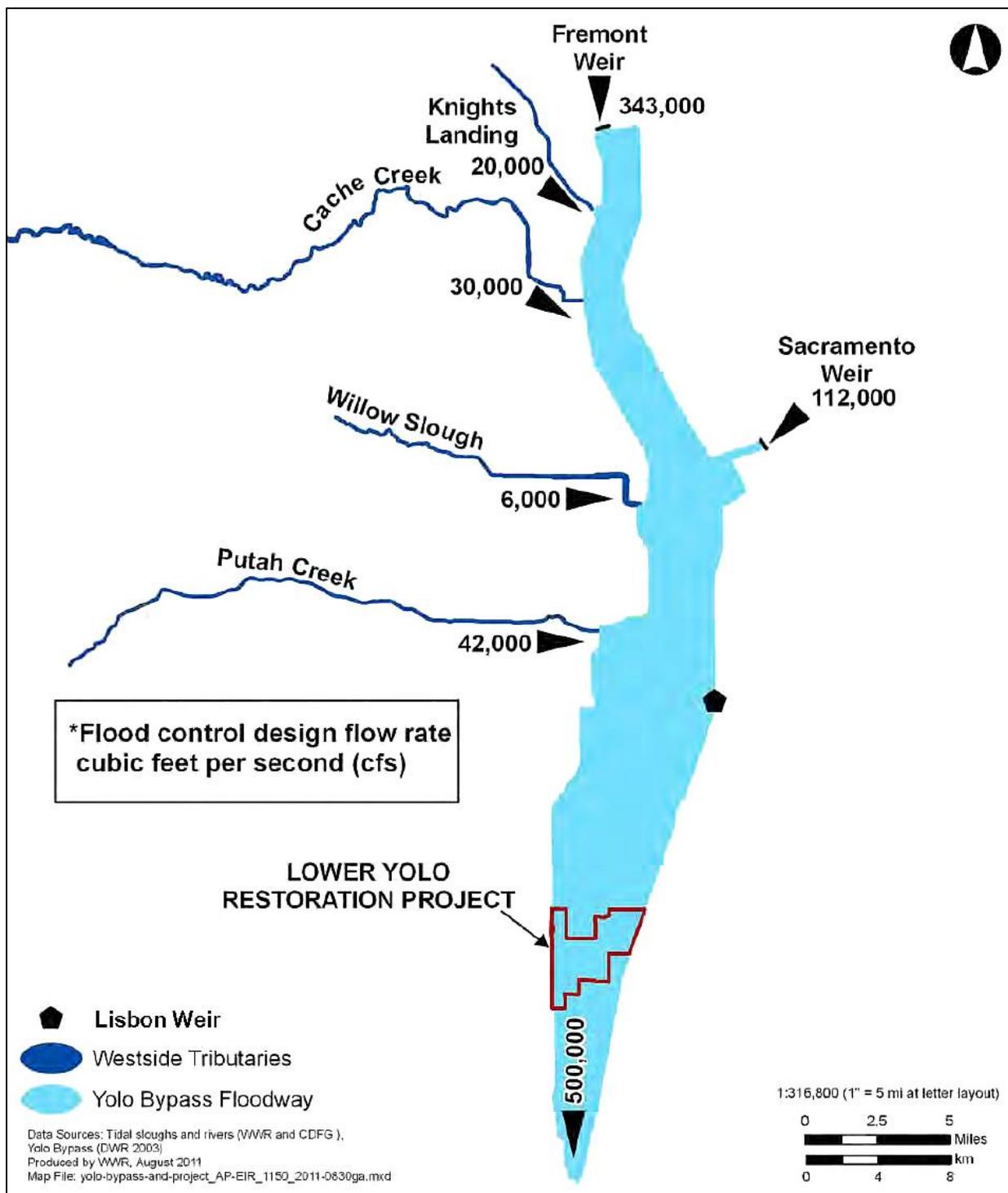
As described in Section II.I.1, "Geomorphology," the historic Yolo Basin carried a large portion of the Sacramento River's peak flood flows for its roughly 40-mile length. Water from the Sacramento River would enter the basin primarily at its northern end (near the present-day Fremont Weir) and would flow south through the basin until it reached Cache Slough. Along the way, western tributaries draining coastal mountain ranges would contribute additional flows. These tributaries, particularly Cache and Putah Creeks, often contributed a large portion of the annual flows in the Yolo Basin. At times, flows in the Sacramento River's flood basins exceeded those in the river channel itself, creating a vast inundated area in the Central Valley often referred to as an "inland sea." It was estimated that the Yolo Basin carried 185,000 cfs during the 1881 flood, compared to the Sacramento River's maximum discharge capacity of 110,000 cfs. The Yolo Basin, and other flood basins of the Central Valley, also served to attenuate the peak winter flood flows by delaying their downstream arrival. Sacramento River flooding into the Yolo Basin typically occurred between December and April, with inundation of the Yolo Basin sometimes reaching depths up to 15 feet. Depending on weather and flood conditions, it would often take several months for most of the basin to dry out, while some parts of the basin, particularly those farther south (and near Liberty Island), would remain inundated year round (Whipple et al. 2012).

Current Conditions

Flood Flows

The Yolo Bypass is California's largest flood control bypass, protecting Sacramento and nearby population centers and farmland by diverting water from the Sacramento River at a point north of the city and returning it to the river via Cache Slough just north of Rio Vista. The bypass was designed to handle flood flows ranging from 343,000 cfs at its northern end to 500,000 cfs at its southern end, which is up to five times the flow capacity of the Sacramento River to its east (Exhibit 2-13).

Floodwaters enter the Yolo Bypass primarily through the Fremont Weir when the Sacramento River's stage exceeds 32.8 feet North American Vertical Datum of 1988 (NAVD88) (corresponding to a flow rate of 56,000 cfs at Verona). The Fremont Weir, located along the Sacramento River's right bank, is a passive structure consisting of approximately 2 miles of earthen berm topped by a concrete sill with the primary purpose of releasing overflow waters of the Sacramento River, Sutter Bypass, and Feather River into the Yolo Bypass. The other major entrance to the Yolo Bypass is the Sacramento Weir, which is usually opened once the Sacramento River stage reaches 30.0 feet NAVD88 at the I Street Bridge (corresponding to 98,000 cfs). As many gates as necessary are opened to so that stage at I Street does not exceed 31.5 feet NAVD88. The primary purpose is to protect the city of Sacramento by limiting flood stages. The weir has a design capacity of 100,000 cfs. Additional flows enter the Yolo Bypass from tributaries to the west, which include Knights Landing Ridge Cut (19,000 cfs), Cache Creek (15,000 cfs), Willow Slough Bypass (3,000 cfs), and Putah Creek (10,000 cfs).



Sources: SFCWA 2013; 1957 design flow information provided by Central Valley Flood Protection Board and adapted by cbec in 2014

Exhibit 2-13. Design Flows from U.S. Army Corps of Engineers Yolo Bypass Model

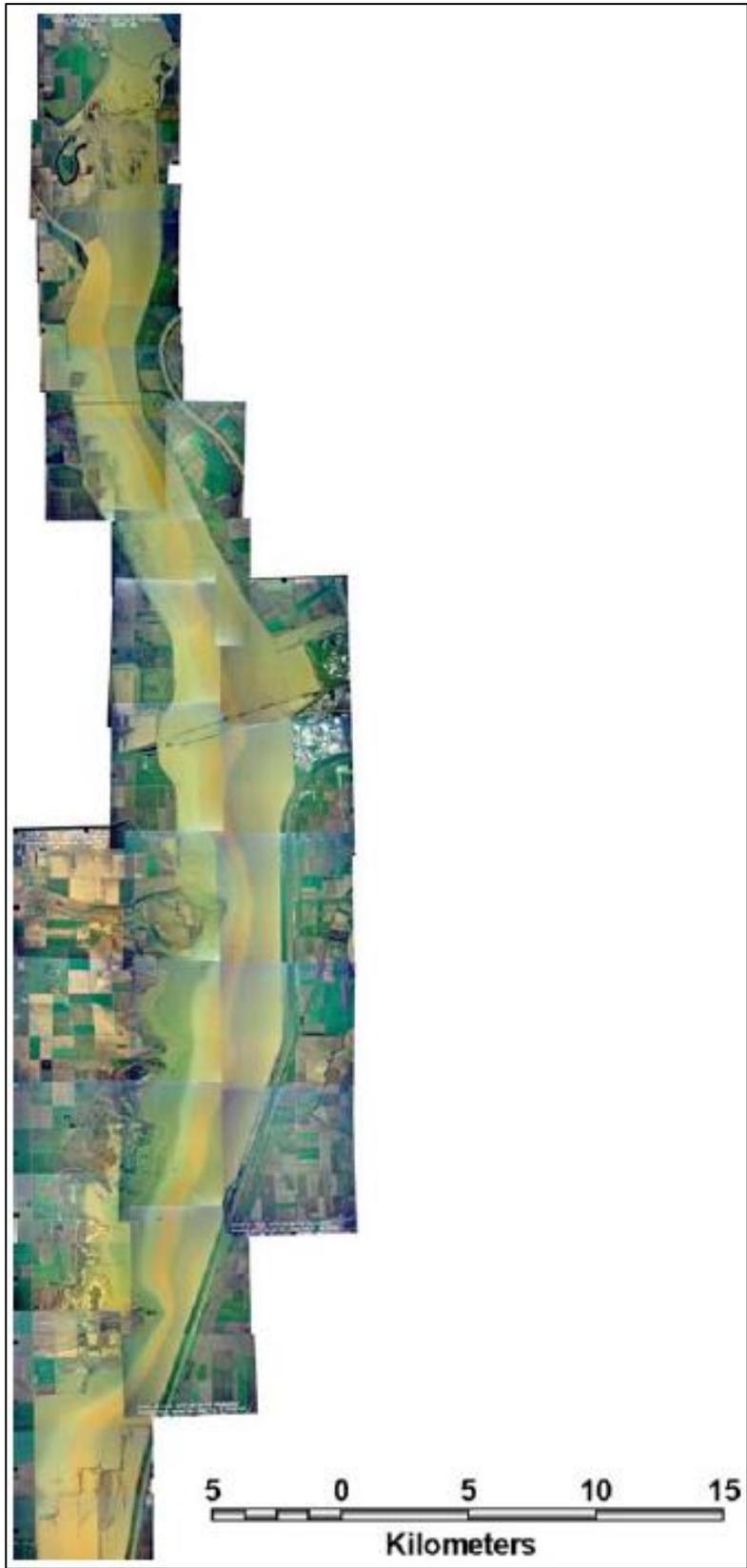
The Yolo Bypass generally slopes from west to east, so flood flows initially coalesce in the Tule Canal and Toe Drain channels, which run alongside the eastern project levee of the Yolo Bypass north and south, respectively, of the I-80 causeway. As flood levels rise, the entire bypass is inundated and flows move more uniformly from north to south between the project levees. A portion of the western extent of the Yolo Bypass is not bounded by a levee south of Putah Creek. Water exits the bypass just south of Liberty Island, where flows enter Cache Slough and can overtop the restricted-height levees bounding Prospect Island and Egbert Tract.

An unusual characteristic of the Yolo Bypass is its very limited mixing of the flood flows contributed by its four major inflows (the Sacramento River, Knights Landing Ridge Cut, Cache Creek, and Putah Creek) despite the presence of several constrictions in flow area and long wind fetch lengths across the bypass (Exhibits 2-14 and 2-15). Aerial imagery of flooding in the Yolo Bypass routinely shows persistent hydrologic banding from north to south, which can be attributed partly to the wide, shallow nature of flooding in most of the bypass (Sommer et al. 2008).

This physical phenomenon has important consequences for water quality and habitat. The lack of lateral mixing of floodwaters results in unequal distribution of various chemical, physical, and biological constituents. Cache Creek, which serves as the most significant source of mercury to the San Francisco Estuary, may create higher concentrations of mercury and methylmercury where its flows tend to remain concentrated. Hydrologic banding in the bypass may also be important to Chinook Salmon and Steelhead, for upstream migration of returning adults and rearing habitat for juveniles (Sommer et al. 2008). This is the case because during sexual maturation, olfactory sensitivity increases and strong imprinting to chemical cues in the natal river is established (Havey 2008). Sequential imprinting is thought to also occur during emigration downstream, so salmon returning as adults can detect the distinct odor or cues moving upstream in search of their natal river and spawning grounds. Therefore, hydrologic banding can help adults avoid straying and genetic introgression, which leads to a greater number of adults successfully spawning and greater overall fitness and survival in the species. Varying temperature, water chemistry, sediment transport and turbidity, and food resources within each distinct band also play important roles in the survival of these species.

Inundation Records

Stage data from the Lisbon Weir, which has been in operation since 1935, can be used to quantify the historical inundation regime for the Yolo Bypass. The Lisbon Weir is located on the Toe Drain south of I-80 and begins to overtop once flows reach 11.5 feet or 3,500 cfs at Lisbon Weir. Exhibit 2-16 shows the duration of inundation in the Yolo Bypass at the Lisbon Weir for water years 1935 to 2012 relative to water year types. Inundation can happen as early as late November and extend through May and is often broken into multiple inundation events of variable duration. Exhibit 2-16 demonstrates that inundation of the Yolo Bypass is typically absent in times of drought, typically lasts for less than 21 days in below-normal water years, and often continues for several weeks to a few months in above-normal and wet years. These data demonstrate the tremendous variability in bypass flooding on an annual basis. It is uncertain how this variability will change in the presence of climate change and future reservoir reoperations.



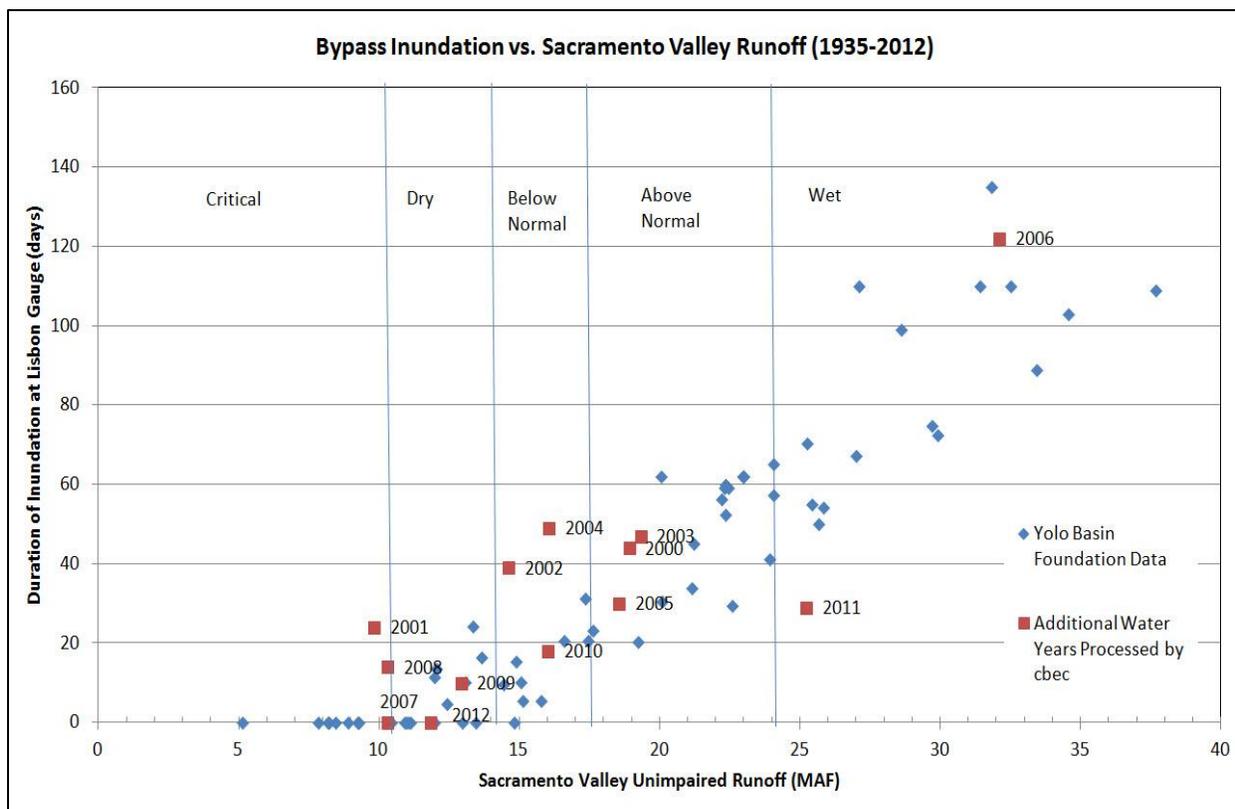
Source: Sommer et al. 2008

Exhibit 2-14. Hydrologic Banding in the Full Yolo Bypass



Source: Sommer et al. 2008

Exhibit 2-15. Hydrologic Banding in the Yolo Bypass



Source: Yolo Basin Foundation 2001 (blue diamond markers); data adapted by cbec in 2014 (red squares)

Exhibit 2-16. Inundation vs. Water Year Type

Seasonal Changes to Hydrology

The Yolo Bypass experiences substantial seasonal changes in its hydrology. Foremost, the bypass tends to flood between the late fall and early spring when Northern California experiences its wet weather and heavy rains before being relatively dry the rest of the year. Additionally, agricultural activities in and around the bypass use irrigation water from various surface water and groundwater sources inside and outside the bypass during the summer months and early fall. The Yolo Bypass also receives tail water drainage from various sources inside and outside the bypass. A significant irrigation feature in the bypass is the Lisbon Weir, which allows for tidal pumping of the Toe Drain upstream of the weir for agricultural uses. During drier water years, there can be a net flux of water up the Toe Drain because of reduced upstream water supply and continued agricultural demand. These seasonal changes in bypass flows and hydrology also affect the upstream limits of tidal influence in the bypass, which extend upstream of the Lisbon Weir to I-80 during low flows during the summer and winter.

Regional Groundwater Hydrology

The Yolo Bypass is located in the Yolo and Solano groundwater subbasins, both of which are part of the larger Sacramento Valley Groundwater Basin. Much of the northern portions of the bypass’s hydrogeologic formations are characterized by low-permeability basin deposits overlain in places by more recent, high-permeability stream deposits. Farther south in the Delta, soils have a considerable peat component because of historical inundation and the presence of wetlands for the last several thousand years. However, many of the agricultural islands in the Delta have experienced substantial subsidence

because of the rapid decomposition of drained peat soils. In the Solano subbasin, in which Liberty Island is located, subsurface flows are generally in the northwest-to-southeast direction.

Tidal Influences

The Yolo Bypass experiences considerable tidal influence throughout its southern portion because of its hydrologic connectivity with the San Francisco Estuary. During low-flow conditions, muted tidal effects can extend to I-80. In addition to its effects on bypass hydrology and flow direction, the tidal range in the bypass, which is typically 4 feet at its southern end, allows for tidal surcharging at places like Lisbon Weir for irrigation purposes.

b. Liberty Island

Historic Conditions

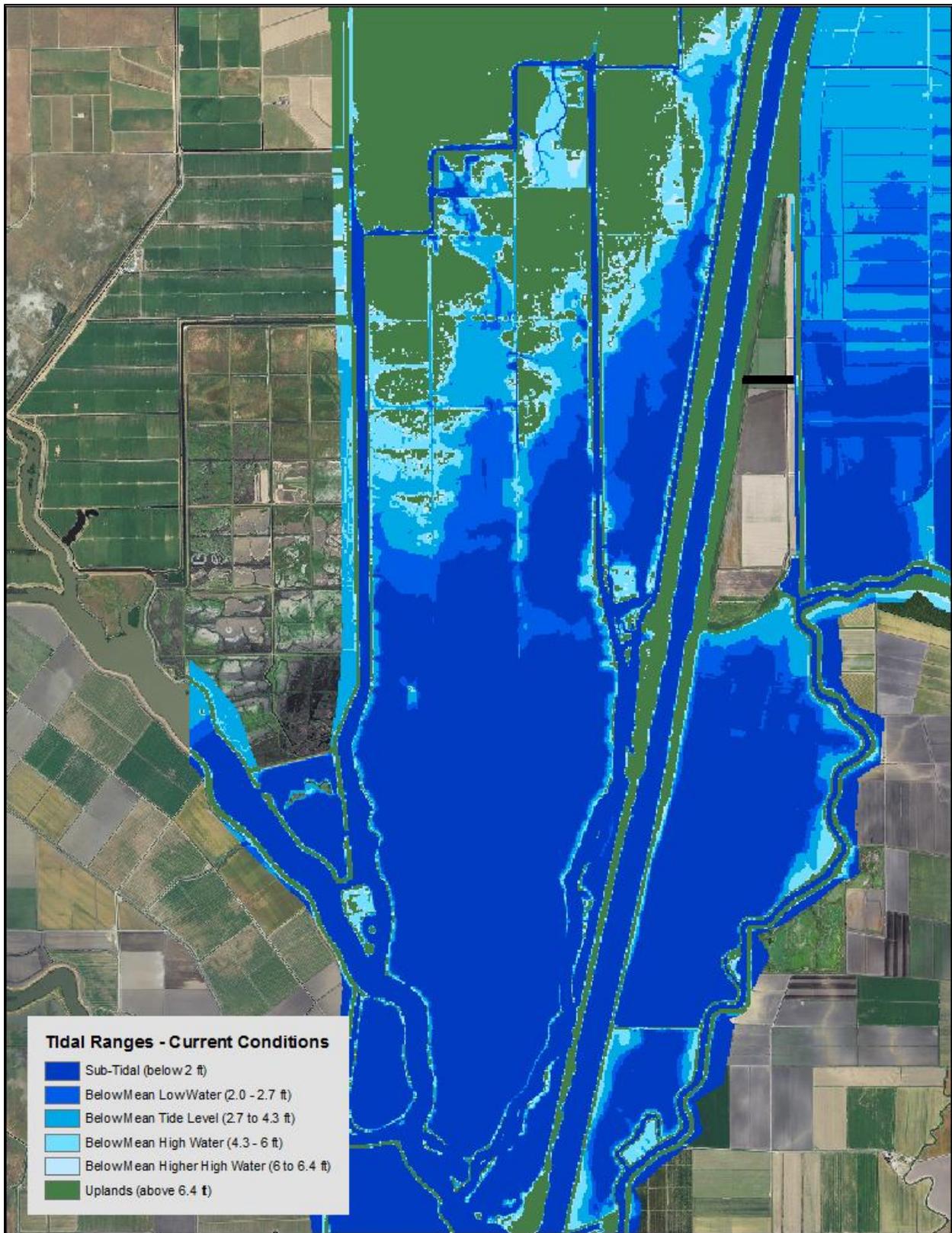
As discussed in Section II.I.1, “Geomorphology,” Liberty Island was historically a large expanse of tidally influenced tule marsh near the southern end of the Yolo Basin with a truncated slough network (Exhibit 2-7). During the summer and fall, tidal processes were the dominant drivers of hydrology at the Island. During the winter and spring months and other periods of heavy rain, flood flows would travel down the Yolo Basin, typically inundating the Island and nearby areas with sediment-laden floodwaters for weeks or months. These flood flows would also provide a flushing effect on the system, moving sediment and nutrients to the San Francisco Estuary.

Tidal Regime

Liberty Island, with its low elevation, proximity to the San Francisco Estuary, and significant hydrologic connectivity to the surrounding Delta sloughs, experiences a tidal range of approximately 4 feet. The estuary exhibits a mixed semidiurnal tide, so Liberty Island has two low tides and two high tides of unequal height each day.

Assessments of the local tidal regime have been conducted in nearby areas. As part of this work, tidal levels were measured in various locations in the Toe Drain, Prospect Slough, Liberty Cut, Shag Slough, and stair step along Liberty Island’s northern boundary, and within the Island itself. These data were used to calculate tidal data (cbec n.d.) in accordance with the National Ocean Service’s methodology (NOAA 2003) for the Lower Yolo Restoration Project. These tidal data provide an established elevation defined by a certain phase of a tide (e.g., mean high water, mean lower low water) relative to a geodetic (earth surface) datum.

Liberty Island has a large spectrum of elevations, ranging from approximately 40 feet below sea level at its southern entrance to Cache Slough to nearly 20 feet above sea level along levee ridges at its northern boundary. Although more than half of the Island is open water that remains inundated at lower low tide, a large amount of its area is also within the intertidal zone. Exhibit 2-17 displays a map of the various tidal zones of Liberty Island based on Central Valley Floodplain Evaluation and Delineation LiDAR data (DWR 2008), EDS (2009) and DWR (2010a) bathymetry data, and the tidal data presented in Table 2-3. Marsh habitat, which requires tidal conditions, is present through much of Liberty Island’s northern extent as well as along the edges of eroding levees surrounding the Island.



Sources: cbec 2011; SFCWA 2013

Exhibit 2-17. Tidal Data

Tidal Datum	Elevation (feet NAVD88)
Mean higher high water	6.2
Mean high water	5.8
Mean tide level	4.22
Mean low water	2.6
Mean lower low water	2.0

Note: NAVD88 = North American Vertical Datum of 1988
Source: Data provided by cbec n.d.

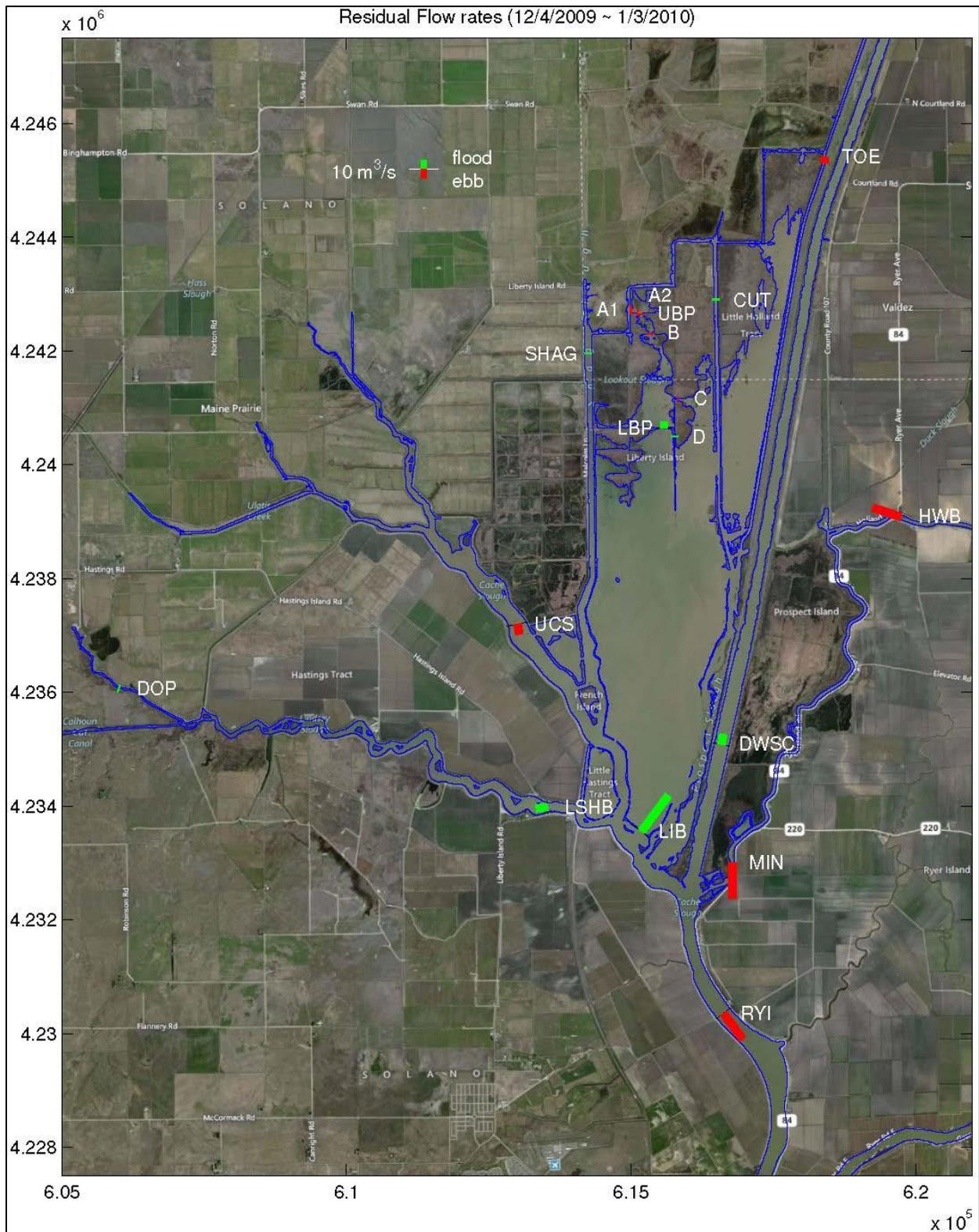
Additionally, the tidal cycles at Liberty Island are a critical component of marsh habitat hydrology. Marsh habitat is fairly abundant at the Island, present along most of the eroding levees encircling the area and in the more shallow-water and transition areas in the northern part of the Island. Particularly relevant to management are the interactions of tidal cycles with sea level rise, water quality (e.g., net export of dissolved organic matter), and habitat management efforts. These topics are discussed in more detail in the sea-level rise, water quality, and management sections of this report.

Circulation and Residence Time

Circulation within Liberty Island is dominated by the tides when the Sacramento River and the Yolo Bypass are not in flood stage. These patterns differ between the northern and southern portions of the

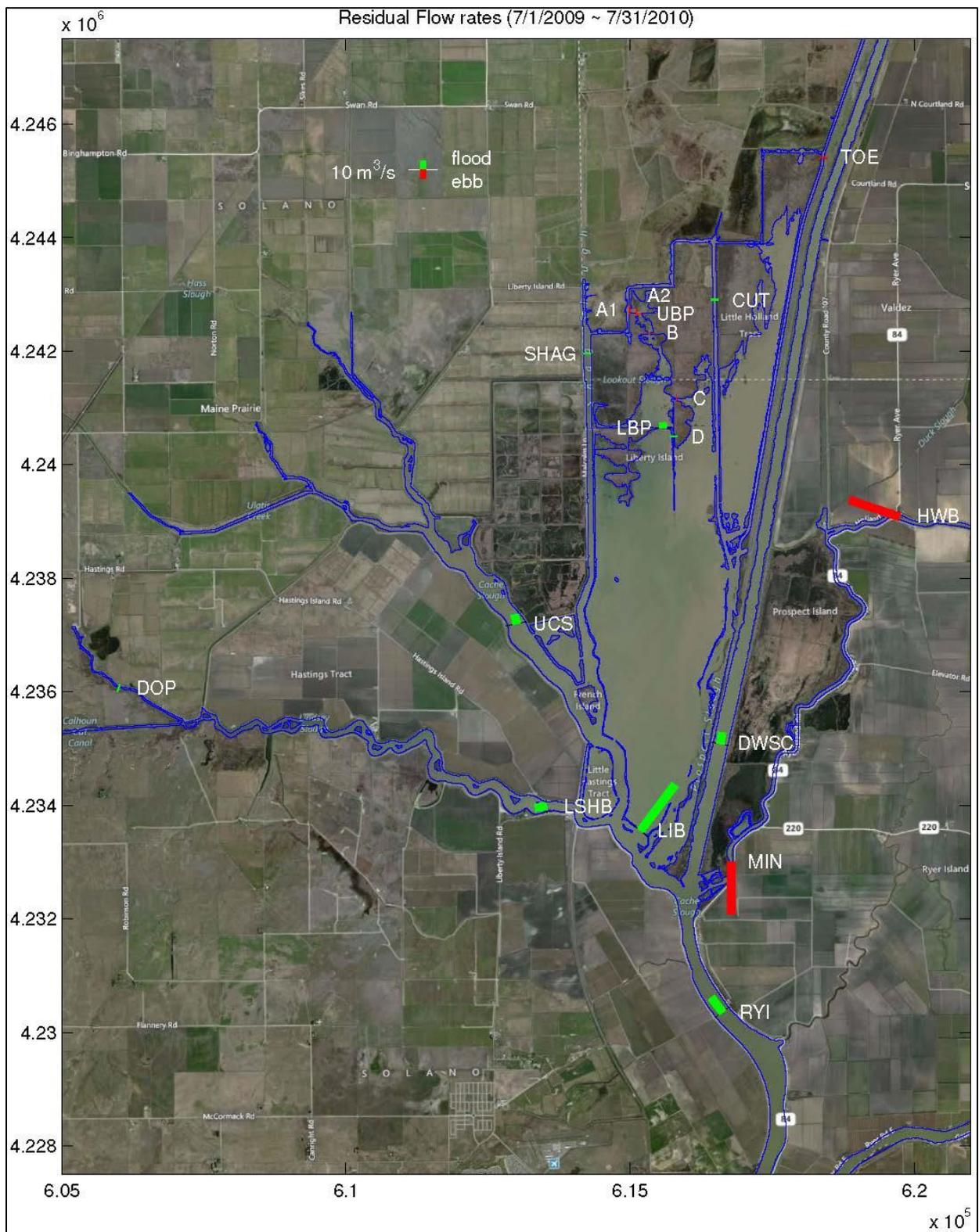
Island and by season. As shown by Exhibits 2-18a and 2-18b, Exhibits 2-19a and 2-19b, and Table 2-4, circulation within southern Liberty Island is controlled by exchange into the Island through the southern breach and exchange out of the Island to Prospect Slough, and ultimately Cache Slough, through the breaches and substantially degraded levees on the east side of the Island. Depending on the season, water exiting southern Liberty Island can disperse south into the surrounding Delta during the winter or can be recirculated during the summer, given the residual net northerly flows on Cache Slough related to agricultural and municipal abstractions. Circulation within northern Liberty Island is controlled by exchange through the stair-step breaches into the Island, as supported by northerly residual tidal flows on Shag Slough and Liberty Cut. These local circulation patterns mean that much of the water exiting the Island typically returns on a subsequent tide.

As a result of differences in tidal circulation and because the distance traveled by a water parcel during each phase of the tide is less than the entire length of Liberty Island, there is a broad range in residence times for water starting within Liberty Island. As shown in Exhibit 2-20, residence times range from less than 5 days within the southern end of the Island to more than 25 days within the northern end of the Island. Because the east levees are more degraded, the shorter residence times extend farther north on the east side of the Island. This tidally driven exchange of water strongly influences the physical, biological, and chemical conditions of Liberty Island.



Source: Gauge data from U.S. Geological Survey, U.S. Bureau of Reclamation, California Department of Water Resources, and Solano County Water Agency adapted by cbec in 2014

Exhibit 2-18b. December 2009 Circulation (Residual Flow Rates)



Source: Gauge data from U.S. Geological Survey, U.S. Bureau of Reclamation, California Department of Water Resources, and Solano County Water Agency adapted by cbec in 2014

Exhibit 2-19b. July 2010 Circulation (Residual Flow Rates)

Location	Discharge Levels (m ³ /s)					
	December 2009			July 2010		
	Flood	Ebb	Residual*	Flood	Ebb	Residual*
RYI	1,429.2	1,466.3	37.1	1,463.7	1,442.0	-21.7
HWB	20.2	54.8	34.5	5.3	67.0	61.7
LSHB	64.8	51.3	-13.5	66.0	52.4	-13.6
UCS	54.7	66.6	11.9	62.7	51.5	-11.2
SHAG	16.1	14.8	-1.4	15.9	15.5	-0.4
CUT	21.9	20.2	-1.7	24.3	22.1	-2.2
TOE	11.9	19.0	7.2	15.8	16.9	1.1
DOP	2.7	1.9	-0.9	3.6	2.8	-0.8
DWSC	318.0	306.1	-11.9	317.5	304.2	-13.3
LIB	343.6	291.2	-52.3	351.1	284.1	-67.0
MIN	28.5	70.3	41.8	12.6	73.6	61.0
A1	7.1	8.5	1.4	7.9	8.7	0.8
A2	3.2	3.9	0.8	3.3	4.0	0.7
B	1.8	2.9	1.1	2.7	3.1	0.4
C	1.4	1.7	0.2	1.6	2.0	0.4
D	3.9	2.8	-1.2	4.0	3.2	-0.8
LBP	24.4	17.3	-7.1	27.0	20.1	-6.9
UBP	2.6	3.4	0.8	3.1	3.5	0.5

Notes: m³/s = cubic meters per second
* Positive residual flow occurs on ebb, negative on flood.
Source: Gauge data from U.S. Geological Survey, U.S. Bureau of Reclamation, California Department of Water Resources, and Solano County Water Agency adapted by cbec in 2014

Flood Hydraulics

As flood levels rise and the Yolo Bypass becomes active, moderate floodwaters reach Liberty Island after flowing down the eastern side of the bypass. Just north of the stair steps is a minor natural ridge that causes flows to concentrate along the eastern side of the bypass. This flow concentration, and the downstream widening of the flow area, is depicted by the color bands present in aerial imagery of Yolo Bypass flood events (Exhibit 2-11). However, during large flood events such as those approaching the capacity of the bypass, this upstream constriction of flows north of Liberty Island becomes less pronounced and floodwaters move more generally from north to south through the southern section of the bypass. As flow levels become high enough, the restricted-height levees at the northern edge of Liberty Island (e.g., stair-step levee) are overtopped.

As discussed in the description of Yolo Bypass hydrology (see “Flood Flows” in the discussion of current conditions in Section II.I.a, above), the flood flows from different sources to the bypass can exhibit unusually low amounts of lateral mixing (Exhibit 2-15). Thus, the signature color band from each tributary often can still be seen in aerial imagery as far south as Liberty Island. The persistence of these flow bands has important implications for water quality and the distribution of sediment, because certain

sections of Liberty Island may be exposed to floodwaters from only one or two of these tributaries. Liberty Island's location at the southern end of the Yolo Bypass also has important implications for flood velocities and conditions. The width of the overall bypass narrows considerably from Liberty Island's northern end to its southern end because of the construction of the Sacramento Deep Water Ship Channel within the Yolo Bypass. As shown by Exhibit 2-20, flow depths and velocities during large floods, such as the design flood, show flow depths ranging from 15 feet deep in the north to 30 feet deep in the south, with a streamlined flow field where flow velocities increase from 2 feet per second in the north to 3.5 feet per second in the south as the bypass constricts near Egbert Tract.

3. Water Quality

a. Overview

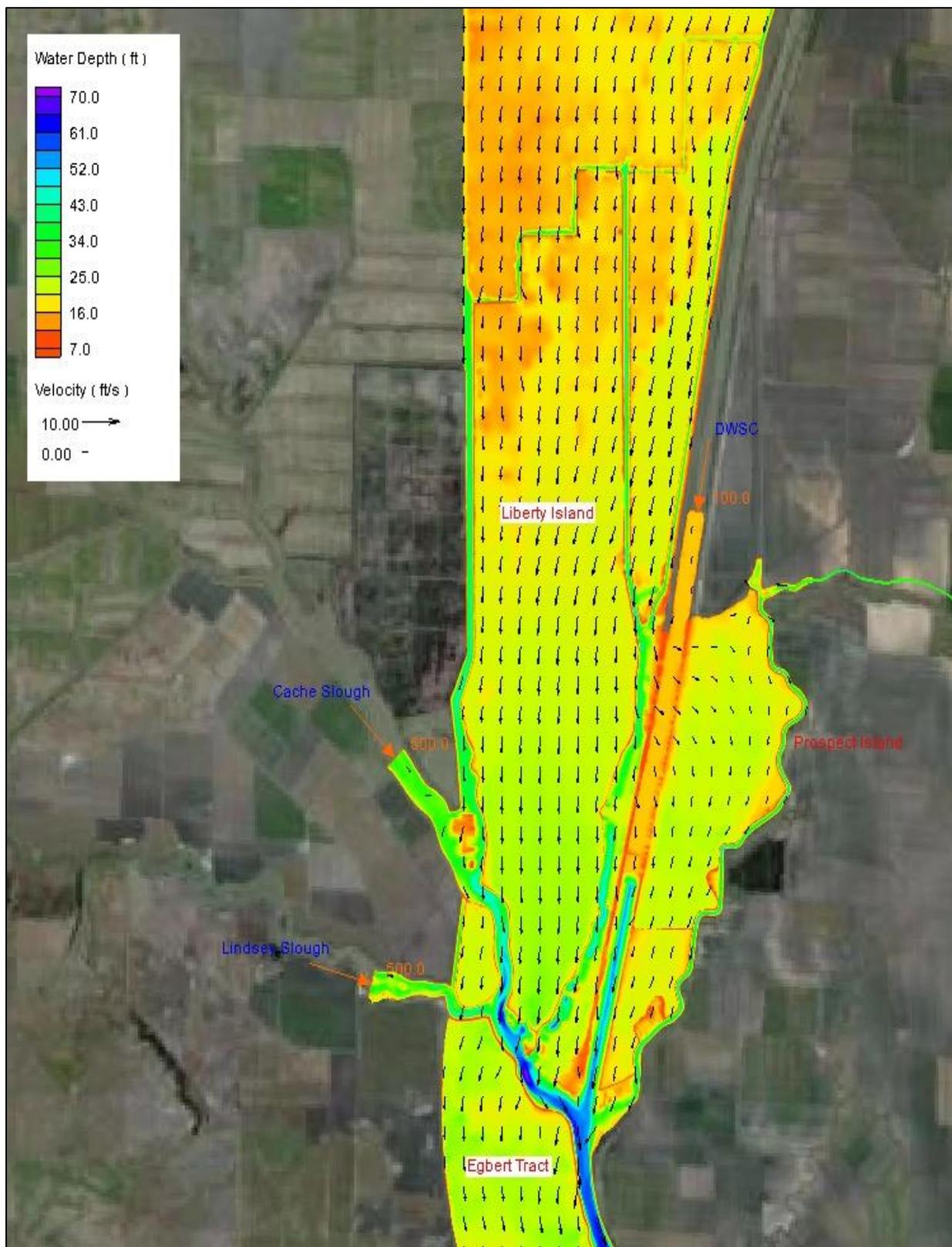
Sources of water to Liberty Island include flows moving through the Yolo Bypass and the Cache Slough Complex. As discussed in Section II.I.2, "Hydrology," the relative contributions from these sources vary both seasonally and during flood events. At base-flow conditions, much of this water consists of agricultural drainage mixed with water from the Sacramento River that travels down distributaries to Cache Slough. During flood events, this water comes from the entire Sacramento River watershed and is a mixture of agricultural runoff, urban stormwater, discharge from natural areas, and other sources. In addition, the wide range of residence times for water in Liberty Island (Exhibit 2-21) results in a variety of turn-over times for water quality constituents that depend on the water's starting position. These varying hydrologic conditions, coupled with seasonal changes to ecological processes in Liberty Island, result in significant temporal and spatial variability of water quality conditions at Liberty Island.

b. Beneficial Uses/Total Maximum Daily Load

The Delta has the following identified beneficial uses:

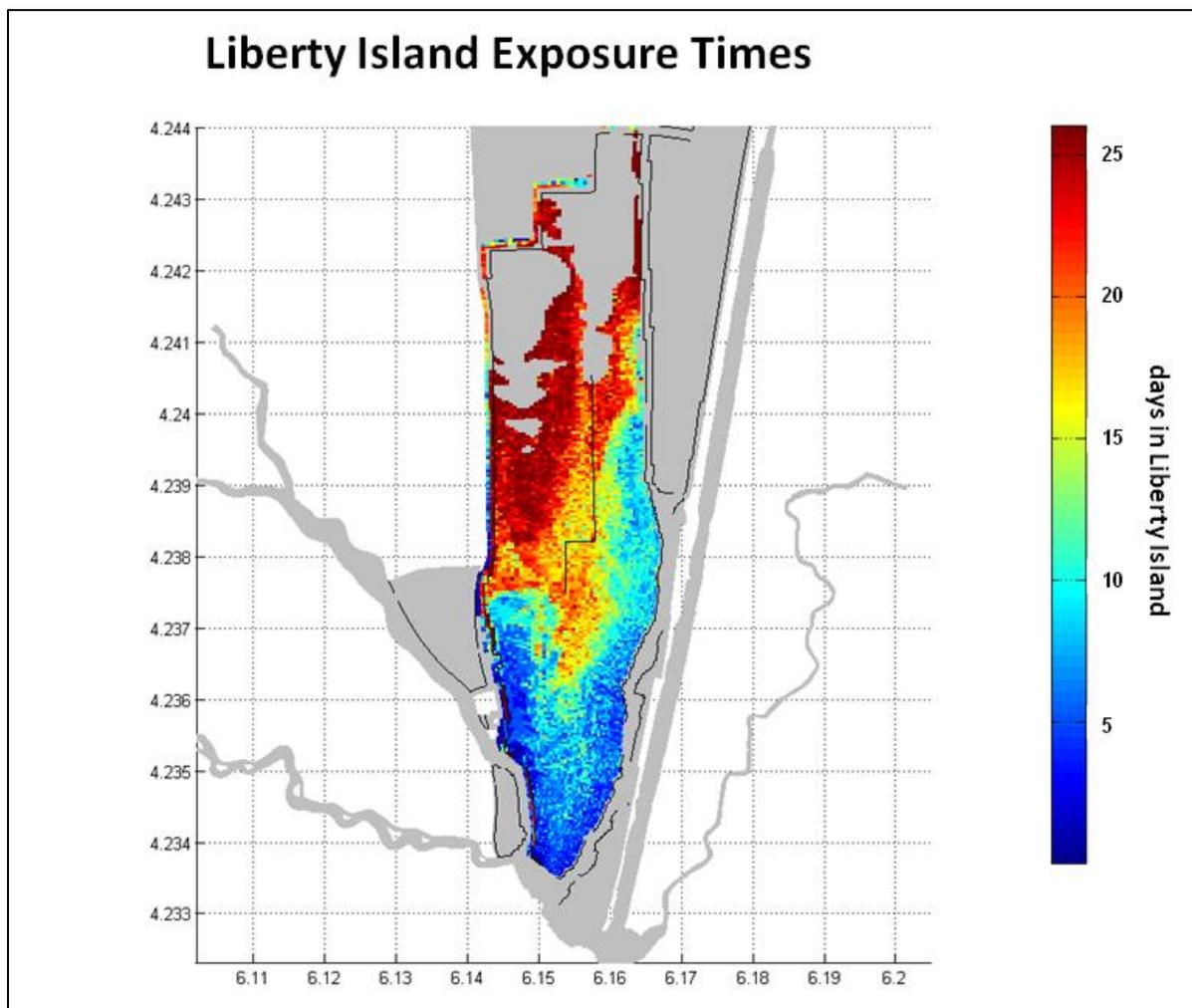
- ▶ Municipal and Domestic Supply
- ▶ Industrial Service Supply
- ▶ Industrial Process Supply
- ▶ Agricultural Supply
- ▶ Groundwater Recharge
- ▶ Navigation
- ▶ Water Contact Recreation
- ▶ Noncontact Water Recreation
- ▶ Shellfish Harvesting
- ▶ Commercial and Sport Fishing
- ▶ Warm Freshwater Habitat
- ▶ Cold Freshwater Habitat
- ▶ Migration of Aquatic Organisms

Possible sources of contamination that can affect water quality include turbidity; pesticides and fertilizers from agricultural runoff; water temperature exceedances; and toxic heavy metals, such as mercury, copper, zinc, and cadmium from acid mine drainage.



Source: cbec 2012c

Exhibit 2-20. Prospect Existing Design Flood Outputs



Source: ESA PWA 2013

Exhibit 2-21. Residence Times

In California, the State Water Resources Control Board develops the list of water quality–limited segments; the U.S. Environmental Protection Agency approves each state’s list. Waters on the list of water quality–limited segments do not meet water quality standards, even after point sources of pollution have installed required pollution control technology. Section 303(d) of the federal Clean Water Act also establishes the TMDL process to improve water quality in listed waterways.

TMDLs have been developed or are being developed for the following constituents for the Delta:

- ▶ Diazinon
- ▶ Chlorpyrifos
- ▶ Dichlorodiphenyltrichloroethane (DDT)
- ▶ Electrical conductivity
- ▶ Invasive species
- ▶ Group A pesticides
- ▶ Mercury
- ▶ Unknown toxicity

c. **Effects of Physical Processes on Water Quality**

Disparate, complex, and interrelated physical, chemical, and biological processes affect water quality within a tidal wetland. The following concepts are summarized below:

- ▶ Diurnal tidal fluctuation
- ▶ Circulation and residence time
- ▶ Sediment flux/accretion
- ▶ Reoxygenation of water

Diurnal Tidal Fluctuation

Tidal cycles provide semi-diurnal oscillations in water levels, exposing a large portion of the Island to both submerged (inundated) and atmospheric conditions. Within the Island, net northern flows (and Island inundation) are on the rising tide and net southern flows (Island water export) are on the receding tide. For the shallower areas at the northern end of the Island, some areas become inundated and then water levels recede before reinundation. There is potential in these areas (and other areas of the wetland where rising and falling water occurs) for chemical oxidation-reduction reactions to occur as a result of fluctuations in water levels. Mottling of the soil column will show evidence of oxic/anoxic conditions in the soil column over time. Water levels vary daily and seasonally as a result of the depth of inundation. The following constituents are affected by this physical process:

- ▶ *Nutrients*: Under oxidizing conditions, inorganic nitrogen will cycle into nitrate, which is the most mobile and soluble form of nitrogen. Under persistent reducing conditions, nitrate could be converted to ammonia, which is toxic to aquatic life in small concentrations. Organic forms of nitrogen are more stable and bound to sediment.
- ▶ *Mercury*: Under reducing conditions, methylmercury can be formed from inorganic mercury by the action of anaerobic organisms that live in aquatic systems. This methylation process converts inorganic mercury to methylmercury in the natural environment via bacteria.
- ▶ *Trace Metals*: Under reducing conditions, trace metals will become more mobile. Under oxidizing conditions, metals will sorb to sediment and will be less mobile.

Circulation and Residence Time

Circulation and residence time in the Island is described above in detail. This process is related to diurnal fluctuation, and relates mainly to the amount of time that a particular volume of water remains in the Island. As stated in Exhibit 2-20 in Section II.I.2, "Hydrology," there is substantial spatial variability in the mean residence time of water within Liberty Island. This means that the exchange and mixing of water and water quality constituents with the surrounding sloughs varies considerably throughout the Island.

Increased residence or detention time within the Island indicates that plants have more time for intake of nutrients and metals, and bacteria have more time to degrade toxic constituents that may be present. However, hydrophytic plants will degrade over time, releasing the constituents that they removed from the water column back into it. The following constituents are affected by this physical process:

- ▶ *Sediment/Turbidity*: Under quiescent conditions, sediment will settle from the water column, reducing turbidity and concentrations of total suspended solids.
- ▶ *DOC*: Degrading plant tissue can result in increased DOC.
- ▶ *Trace Metals/Nutrients*: With increased residence time in the wetland, trace metals and nutrients (especially as ammonium or nitrate) will be taken up and incorporated into plant tissue; over time, however, these constituents will be released back into the environment upon plant mortality.
- ▶ *Mercury*: Increased residence time may result in mercury methylation under certain conditions.
- ▶ *Pesticides*: Increased residence time may result in further degradation of labile (readily degradable) constituents, but more recalcitrant pesticides like DDT will persist in the environment.

Sediment Flux/Accretion

Sediment flux/accretion on the Island is described in detail earlier in this document. Although both fluvial and tidal processes influence the exchange and export of materials from the Island, research indicates that tidal processes are responsible for more than 90% of material flux from the Island's wetlands (Lehman et al. 2010).

Constant sediment flux into/from the Island results in consistent and localized increases in turbidity and total suspended solids associated with sediment movement. In quiescent settling conditions, particulate matter settles out and ultimately improves the water quality of the water leaving the Island. However, advancing and receding tides cause a more chaotically turbulent environment from a hydraulic perspective, resulting in sediment resuspension. Additional constituents can be transported via sorption to sediment, including metals and pesticides. The following constituents are affected by this physical process:

- ▶ *Sediment/Turbidity*: Resuspension and accretion of sediment can increase turbidity and total suspended solids in the water column.
- ▶ *Dissolved Oxygen (DO)*: Suspended sediment can reduce localized DO concentrations
- ▶ *DOC*: Suspended sediment can increase localized DOC concentrations
- ▶ *Metals/Pesticides*: Sediment resuspension can result in remobilizing constituents (metals, pesticides) that are sorbed to sediment.
- ▶ *Mercury*: Sediment accretion may result in mercury methylation under certain conditions.

Reoxygenation of Water

Water in the Island can be reoxygenated via wind or hydrophytic plants, or through tidal flushing. Because of the expanse of open water in the project area, the potential exists for a large wind fetch to increase the transfer of oxygen into the water. The presence of hydrophytic plants in the vegetated areas transports oxygen from the air to the water column, hence increasing localized DO concentrations. The

movement/replenishment of water into and from the Island can result in increased DO. This physical process affects the amount of DO in the water column. The increase of DO is beneficial for aquatic life and degradation of labile constituents via biological processes.

d. Sediment and Turbidity

Turbidity is a measure of the cloudiness or clarity of water, and is proportional to the concentration of suspended sediment in the water column. The units for turbidity measurements are nephelometric turbidity units (NTU). Turbidity is an important water quality constituent of the Delta and Liberty Island, particularly because it is a key habitat component for Delta Smelt. Delta Smelt prefer waters with turbidity values greater than 12 NTU because they provide cover from predators. Turbidity values at Liberty Island have considerable spatial and temporal variability, as discussed in Section II.I.1, “Geomorphology.” During a year of water quality monitoring between 2004 and 2005, suspended sediment concentrations ranged from roughly 40 to 200 parts per million (Lehman et al. 2010), although higher concentrations may occur during major flood events.

Current sediment and turbidity levels are understood to be lower and less variable than historical levels, largely because of the deposition of sediment behind numerous dams in the Sacramento River watershed. As a result, there are now monitoring requirements for turbidity in the Delta to ensure that turbidity levels are high enough to support sensitive species such as Delta Smelt (Frantzich 2012; DWR and CDFW 2013). These efforts to maintain turbidity values are contrary to the objectives of municipal and industrial water usage. High levels of suspended solids can cause problems for filtration and disinfection of water diverted from locations such as the Barker Slough Pumping Plant (DWR and CDFW 2013).

e. Salinity

Liberty Island is generally characterized as freshwater, with salinity concentrations rarely exceeding 0.00000025 (2.5e-7) parts per million (USGS gauge 11455350; Lehman et al. 2010). However, with its connection to the San Francisco Estuary, Liberty Island does have salt concentrations slightly higher than typical freshwater environments.

The Delta’s salinity exhibits a decreasing gradient moving inland from the San Francisco Estuary. Salinity in the Delta and Yolo Bypass also varies seasonally, as river and agricultural discharges fluctuate. During dry periods, saline waters extend farther upstream, while during wet periods, waters move toward San Francisco Bay.

Because salinity affects many species (such as Delta Smelt and Longfin Smelt) and the usability of Delta water diverted for agricultural and municipal uses, salinity is an important criterion in Delta water management. Freshwater releases from upstream reservoirs and decreases in water exports from the Delta are used to prevent the upstream migration of salinity, particularly during dry conditions. These actions typically focus on keeping the freshwater-saltwater boundary as far downstream as practically possible (DWR and CDFW 2013).

Salinity levels in the Delta and Yolo Bypass may also be affected on a finer scale by agricultural drainage or high rates of evaporation from shallow, poorly mixed areas. For Liberty Island, agricultural drainage returns from the Toe Drain or the Reclamation District 2068 outfall at the northern end of Shag Slough

may cause increased salinity within Liberty Island, particularly during the summer. It is also important to note that sea-level rise will likely cause increased salinity intrusion in the Delta and Liberty Island. This topic is discussed in more detail in Chapter VI, “Climate Change Strategies.”

f. Nutrients and Dissolved Organic Carbon

Detailed studies of the flux of inorganic and organic materials from Liberty Island were conducted between 2004 and 2005, using both discrete sampling and continuous measurements of water quality. The subsequent findings demonstrated that the flux of organic and inorganic materials at Liberty Island undergoes tremendous seasonal variation in both magnitude and direction. On an annual basis, Liberty Island provides a net export of total phosphorous, soluble phosphorous, total nitrogen, and total suspended solids. On the same annual time scale, the Island serves as a sink for nitrate, ammonium, chloride, and bromide salts (Lehman et al. 2010).

On a seasonal basis, these trends vary by compound. For example, nitrate and ammonium exports occurred during the summer and accumulated in the fall and winter. However, total nitrogen was exported during the winter. Organic material was largely exported from Liberty Island during the summer, fall, and winter while storage occurred in the spring. An exception to this was total organic carbon, which was exported in all seasons (Lehman et al. 2010).

It is also important to note that these findings (Lehman et al. 2010) may not be consistent with conditions at Liberty Island at all times. Given the highly variable flooding regime for the Yolo Bypass, the flux of organic and inorganic materials (particularly those that are biologically relevant) may vary considerably from year to year depending on physical conditions at the Island.

Agricultural drainage to the Yolo Bypass and Sacramento River watershed can increase the concentration of dissolved nutrients and organic compounds present at Liberty Island. Located near the Island is the Ulatis Canal, which contributes large amounts of agricultural discharge to Upper Cache Slough that contain elevated levels of DOC and other organic constituents during the winter months. These anthropogenic sources of nitrogen and phosphorous-containing compounds can fuel algal growth, which can cause water quality conditions for other organisms to deteriorate. However, little research is available regarding the effect of nutrient concentrations on algal growth in Liberty Island.

The Barker Slough Pumping Plant, located several miles west of Liberty Island, has been affected by elevated concentrations of DOC, which creates harmful byproducts during disinfection processes. Restoration activities have the potential to increase DOC concentrations in the Cache Slough Complex that could adversely affect the Barker Slough Pumping Plant.

g. Dissolved Oxygen

Adequate DO levels are necessary for fish and aquatic invertebrate species. Continuous water-quality monitoring performed between 2004 and 2005 at the southern end of Liberty Island showed DO concentrations ranging between 7.5 and 13 milligrams per liter (Lehman et al. 2010). DO concentrations vary substantially by season and are driven largely by changes in water temperature; as water temperature increases, its saturation capacity for DO decreases. Other factors influencing DO levels are mixing at the water surface (i.e., aeration), salinity and abundance of bacteria, algae, and organic matter. Excess

nutrient concentrations can drive uncontrolled growth in algae populations, which can lead to very low DO levels. Although the data available from 2004 and 2005 (Lehman et al. 2010) do not indicate this as an issue, the Yolo Bypass and the Cache Slough Complex can receive substantial drainage from agricultural operations. This drainage can contain elevated nutrient concentrations that could result in low DO levels, particularly during periods of intense summer heat (DWR and CDFW 2013). Additionally, DO concentrations during the period of study from 2004 to 2005 may have been lower in parts of Liberty Island farther to the north that are shallower and have less mixing.

The DO objective for Liberty Island as specified in the basin plan for the Sacramento and San Joaquin River basins is 5 milligrams per liter. This requirement is low relative to the DO requirements for many other non-Delta water bodies (which are typically 7 milligrams per liter), and it may not support all relevant fish species through their life cycles. However, this lower threshold indicates that this area is likely viewed as a warm-water aquatic habitat (and thus has a lesser capacity for holding DO) (DWR and CDFW 2013).

h. Temperature

Water temperature is an important component of healthy habitat conditions for the Delta and San Francisco Estuary. It strongly influences many chemical and biological processes and determines the saturation capacity of DO in water. Water temperature fluctuates daily and seasonally in the Delta. Delta wetlands are subject to more variable temperatures than Central Valley rivers because of their greater surface area for sunlight exposure and heat transfer with the atmosphere. Between June 2004 and June 2005, water temperatures in the southern end of Liberty Island ranged from roughly 45 to 80 degrees Fahrenheit (°F) (Lehman et al. 2010). However, given the limited hydrologic connectivity and shallow water depths in ponds at the northern end of Liberty Island, it is likely that water temperatures there exhibited a wider range.

Temperature regimes in the Delta have shifted because of land development and water management practices, which have influenced native species that are adapted to particular temperature ranges. Several actions have been taken to limit unnatural temperatures and temperature fluctuations. These actions include establishing water quality objectives in the current basin plan for the Sacramento and San Joaquin River basins and banning activities or discharges that increase temperatures in receiving waters by more than 5°F (DWR and CDFW 2013).

i. Toxic Chemicals

Methylmercury

Methylmercury, which is scientifically known as monomethylmercury (MeHg), is a toxic pollutant present in much of the Sacramento River watershed and the Delta. The region's primary sources of mercury are early mercury and gold-mining practices in the Coast Ranges and Sierra Nevada, respectively. These mining practices released inorganic mercury in the form of mercury sulfide (HgS), which was discharged and continues to be discharged to the Delta via upstream tributaries. Anaerobic bacteria, present mostly in wetland, river, and estuary sediments, perform methylation of inorganic mercury, converting it to the more problematic form, methylmercury. The production of methylmercury is greatest in areas that have frequent wetting and drying cycles (e.g., riparian areas and tidal wetlands) and

ample supplies of organic carbon (DWR and CDFW 2013). These conditions are found in many parts of Liberty Island.

When present in high concentrations, methylmercury can act as both a neurotoxin and a teratogen. It is of particular concern for both humans and wildlife, given its capacity for bioaccumulation. Human exposure occurs primarily when people eat fish containing methylmercury. Although there is still much unknown about the formation and effects of methylmercury, its high concentrations in many parts of the Delta and San Francisco Estuary have resulted in regulatory actions. Particularly relevant to Liberty Island is the listing of the Cache Slough Complex as impaired on the Clean Water Act's 303(d) list for elevated mercury concentrations in resident fish species. Additionally, RWQCBs have implemented TMDLs for methylmercury for the Delta and San Francisco Bay. Studies are being conducted to determine the methylmercury contributions from different land types in the Delta; upon completion in 2020, these studies may result in more specific actions for land management (DWR and CDFW 2013).

Trace Metals

Several trace metals are found in the Delta and Central Valley waterways: copper, aluminum, cadmium, chromium, arsenic, selenium, and lead. Although many of these metals are essential for life in low quantities, at elevated concentrations they can be highly toxic to wildlife and humans. These metals originate from both human activities and natural sources. Historical mining practices in the Cascade Mountains and Sierra Nevada are one of the more important, persistent sources of several of these metals to the Central Valley. Other anthropogenic sources include runoff from roads, industrial pollution, marine equipment, and domestic activities. However, concentrations of these trace metals in sediment and waterways in the Cache Slough Complex are currently unknown (DWR and CDFW 2013; DFG 2008).

Ammonia

Ammonia is a nitrogen-based compound that is frequently found in aquatic environments. Ammonia was naturally present at low levels in the pre-settlement Delta; however, concentrations have increased substantially because of the discharge of sewage treatment plant effluent, agricultural drainage, and atmospheric deposition. Effluent from the Sacramento Regional Wastewater Treatment Plant is known to contribute 90% of the ammonia found in the Sacramento River south of Sacramento.

Ammonia can occur in two forms in water: ionized ammonia (NH_4^+) and un-ionized ammonia (NH_3). Un-ionized ammonia can cause both acute toxicity and chronic toxicity in aquatic organisms, depending on the concentration and the duration of exposure. Concentrations in the Sacramento River and Yolo Bypass have not been found at levels high enough to cause mortality of pelagic fish species, but chronic toxicity from ammonia has been observed in Delta Smelt. Additionally, ammonia has been observed to cause mortality of other aquatic organisms, such as the copepod *Eurytemora affinis*, in parts of the north Delta (Werner et al. 2009 and Teh et al. 2009, both cited in DWR and CDFW 2013).

Pesticides

Pesticides and herbicides are present in the waterways and sediment of the Yolo Bypass and Cache Slough Complex. The dominant source of these chemicals is agricultural runoff. The use of more persistent organochlorine pesticides (e.g., DDT and chlordane) has largely been replaced by less

persistent organophosphate pesticides (e.g., diazinon and chlorpyrifos). Still, both classes of chemicals are found in the Yolo Bypass. These chemicals are acutely toxic to aquatic and terrestrial organisms, and their continued application to agricultural areas in the bypass may cause occasional toxicity in the Cache Slough Complex and Liberty Island area (DWR and CDFW 2013; DFG 2008).

4. Climate

a. Current Conditions

Climate and Weather Patterns

The climate of the Central Valley and Delta can be described as Mediterranean. This climate type is characterized by hot, dry summers and mild, wet winters. Summer temperatures typically reach 90°F during the day and can exceed 115°F during heat waves. Wintertime temperatures sometimes drop below freezing, but snowfall in the Delta is uncommon. Average annual precipitation is typically around 20 inches, with most rainfall occurring between November and March (DWR 2013; Reclamation 2011; SFCWA 2013:317).

Wind patterns for the area vary with the seasons, although the prevailing pattern consists of westerly winds. As the Central Valley warms during the summer compared to the San Francisco Bay Area and Pacific Ocean, strong westerly winds frequently reach the Delta. Cool, humid breezes from the Pacific Ocean can reduce temperatures in the Delta by as much as 7°F. At other times, northerly winds from the Great Basin result in summer heat waves and periods of mild winter temperatures (Reclamation 2011; SFCWA 2013:317; DWR 2013; WRCC 2013; Pierce and Gaushell 2005).

Interannual climate variability is strongly driven by patterns in the Pacific Ocean, particularly the El Niño Southern Oscillation, and by the presence of a semipermanent high-pressure area in the northern Pacific Ocean. During the summer, this pressure center moves northward, typically pushing storm tracks far north of California. During the winter, this pressure center migrates south and encourages storm systems into California, delivering moderate precipitation to the region. When changes to circulation patterns occur, such as those driven by the El Niño Southern Oscillation, storm systems from the southwest can bring heavy rainfall into the Central Valley and other parts of California (Reclamation 2011; WRCC 2013).

b. Future Conditions

Changes to Climate and Weather

Although projections of future climate and weather patterns driven by climate change are very uncertain, there is some consensus about potential changes for Northern California. Air temperatures are expected to increase, as will the proportion of precipitation that falls as rain rather than snow. Precipitation amounts are likely to change, but projections and models differ as to whether it will increase or decrease.

California is expected to maintain a Mediterranean climate of hot, dry summers and mild, wet winters; however, the frequency and intensity of droughts and floods is expected to increase (Lund et al. 2003; DWR et al. 2013).

Sea-Level Rise

Observed

In recent decades, sea level along California's coast has risen at a rate of 6.7 to 7.9 inches per century, which is consistent with the global average of 6.7 inches over the 20th century. Gauges near the mouth of San Francisco Bay have measured the rate of sea-level rise at 8.0 inches per century. Sea-level rise is attributed to increased freshwater inputs from melting ice and snowpack, as well as thermal expansion of ocean water (IPCC 2007 and Cayan et al. 2009, both cited in DWR 2013; NOAA 2008).

Projected

Sea-level rise is projected to continue at an accelerating rate because of thermal expansion of ocean water and increased melting of land and sea ice. In 2007, the Intergovernmental Panel on Climate Change released its fourth report that estimated sea-level rise by 2100 to be between 0.6 foot and 1.9 feet. This estimate is now considered to be fairly conservative. More recent science and modeling efforts predict sea-level rise by 2100 to be in the range of 1.6 to 4.6 feet and some estimates exceed 5 feet (Cayan et al. 2012; DWR 2013; Knowles 2010).

Numerous state agencies, science boards, and planning commissions use a prediction of 4.6 feet (55 inches) of sea-level rise by 2100. This prediction is based on the work of Rahmstorf (2007), which employs a semi-empirical approach in predicting rates of sea-level rise. This method uses future projections of global temperatures under various greenhouse gas emissions scenarios outlined by the Intergovernmental Panel on Climate Change. The temperature projections from each scenario can be used to estimate rates of thermal expansion of sea water and melting of land and sea ice, both of which contribute to sea-level rise. The various greenhouse gas emission scenarios result in a spread of sea-level rise predictions for 2100 that range from 1.6 to 4.6 feet (CALFED Independent Science Board 2007).

The Delta Reform Act of 2009 required that the associated environmental impact report address the potential impacts of sea-level rise up to 55 inches (4.6 feet) by 2100. Similarly, the San Francisco Bay Conservation and Development Commission, DWR, and several other agencies have adopted this projection. Given the widespread adoption of this sea-level rise prediction by state agencies and organizations, this LMP similarly employs a sea-level rise projection of 4.6 feet by 2100.

Impacts on Liberty Island

Projected rates of sea-level rise will have dramatic impacts on Liberty Island. These impacts are best illustrated by Exhibits 2-22 and 2-23, which demonstrate the changes in tidal ranges for the Island under 1.33 and 4.6 feet of sea-level rise by 2050 and 2100, respectively. Large areas that are now in the tidal range, particularly in the northern part of the Island, will become subtidal. Additionally, much of the area that is now characterized as uplands will become tidally influenced. This shift is particularly striking for 2100, because most of LIER will be either subtidal or tidal. As discussed above under "Geomorphologic Evolution" in Section II.I.1.b, marsh plants will likely struggle to keep pace with sea-level rise. Just 1 foot of sea-level rise can translate to a shift of the lower boundary of potential marsh habitat by several thousand feet. As a result, significant areas of potential marsh habitat may be converted to subtidal open water too deep to support marsh vegetation before expansion of natural vegetation could transform these areas into marsh. Similarly, large areas of existing marsh habitat would be converted to open water. Sea-

level rise will also result in increases in salinity at Liberty Island and, if high enough, could shift freshwater conditions to slightly brackish.

J. Cultural Resources

Liberty Island has a long cultural history, from the earliest Native American inhabitants to people farming and residing there in recent times. This section characterizes the prehistoric, ethnographic, and historic settings; describes previous cultural resource investigations for the property and surrounding vicinity; and identifies the resources that have been documented and recorded on Liberty Island. The following text was developed through a cultural records search and a review of literature and existing data sources.

1. Ethnographic Setting

Liberty Island is within the ethnographic territory of the River Patwin, a southern division of the Wintun people, who belong to the Penutian language family. Use of the Patwin language extended southward to the Delta system, and included numerous dialects (Hill, River, Cache Creek, Lake, Tebti, Dahcini, and Suisun) (ShIPLEY 1978). Kroeber (1932) arranged the groups along two linguistic-political lines, Hill (southwest) and River (southeast and southern). The word “Patwin” translates as “man” or “people” in the native tongue. Although native people did not identify themselves as Patwin, this name is used to describe the linguistically and culturally related groups that occupied their traditional tribal territory. The southern group, or Poewin, claimed the Yolo Basin; however, no known ethnographic village locales are within this area.

The nearest documented ethnographic village sites are Liwai, which is located along Ulatis Creek west of Dixon, and Tolenas, which is located near Suisun Bay (Johnson 1978:350).

The Patwin were politically organized into tribelets that consisted of a primary village with several outlying settlements. Each tribelet maintained its own autonomy and sense of territoriality. Structures within these villages were usually earthen covered, and semisubterranean elliptical (River Patwin) or circular (Hill Patwin) in form (Kroeber 1932). All except the individual family dwellings were built with the assistance of everyone in the village. Ethnographic accounts indicate that one’s paternal relatives built single-family homes within the settlements (Johnson 1978). The Patwin used a wide variety of resources, both the natural materials available within their range and those obtained by trading with other tribes for obsidian and other nonlocal materials. Netting and cordage made from wild hemp (*Apocynum cannabinum*) and from milkweed (*Asclepias* sp.) provided fibers for the production of fishing nets and lines. Anadromous fish such as Sturgeon (*Acipenser* spp.) and Chinook Salmon (*Oncorhynchus tshawytscha*) were part of the staple Patwin diet (Johnson 1978:355) and were typically caught in large numbers using stone and wood weirs and cordage nets. Smaller fish were also caught with nets, and mussels were collected from the river bottom. Fishing spots were considered “owned” and one had to seek permission before fishing at a particular location (Johnson 1978:355).

The Patwin territory supported a wide variety of animal life including tule elk, deer, antelope, bear, and various species of duck, geese, turtles, and other small animals (Johnson 1978:355). Hunting and fishing were important subsistence activities among the Patwin, as with many Native American groups throughout the region; however, their primary staple food was the valley oak (*Quercus lobata*) acorn. The oak groves themselves were considered to be “owned” communally by the particular tribelet. Various

seeds such as sunflower (*Helianthus* spp.), clover (*Melilotus* spp.), bunchgrass (*Festuca* spp.), and wild oat (*Avena fatua*) were also gathered and ground into coarse flours. As with the oak groves, particularly fruitful tracts of seed-bearing lands were controlled by individual families or the tribelets (Powers 1877; Kroeber 1932).

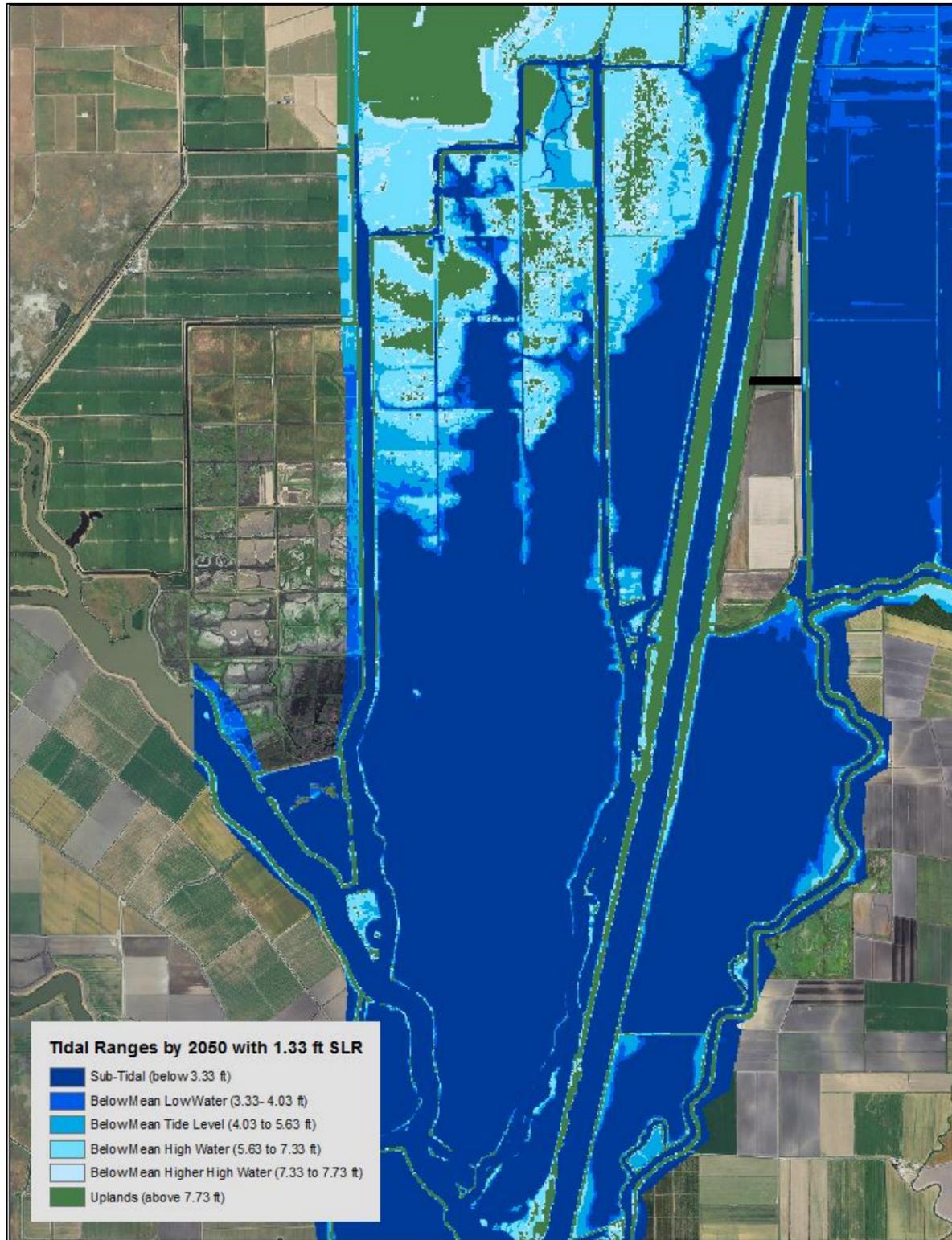
2. Historic Land Use

a. Early Exploration and Settlement

In the 1700s, various Spanish explorers led expeditions into the Central Valley searching for sites for inland missions. Expeditions were also conducted in the early 1800s and included those of Gabriel Moraga, Jose Antonio Sanchez, and Father Narciso Duran. These explorers were followed by trappers of the Hudson Bay Company, beginning with Jedidiah Strong Smith in the late 1820s and Joseph Walker and Ewing Young in the 1830s (Hoover et al. 1990:533).

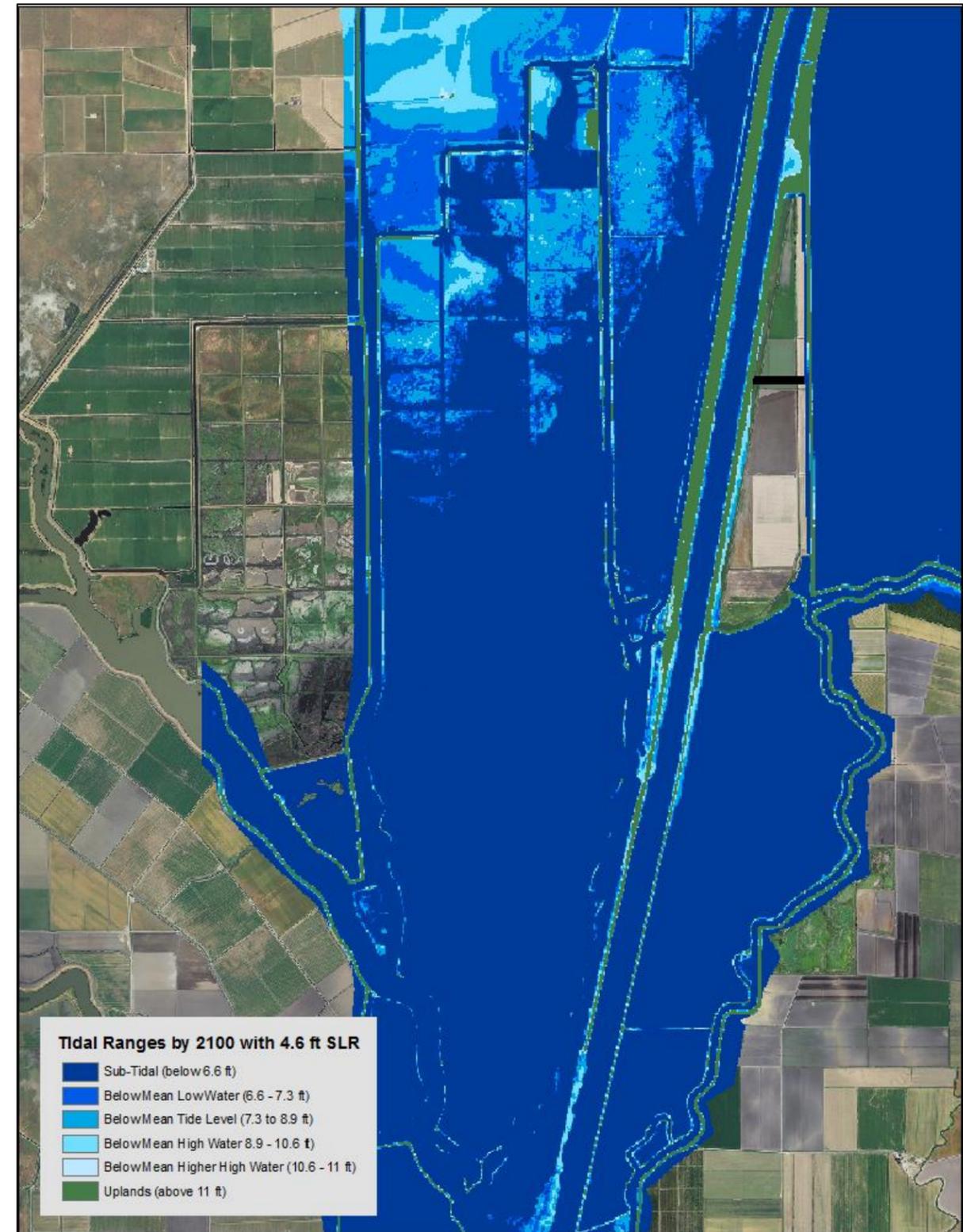
Various trappers, traders, and missionaries had ventured into and near the location of the present-day LIER and vicinity since at least the first decade of the 19th century; however, considerable historic-era development did not occur until the Mexican period. In present-day Yolo County, 11 grants of land were made by the Mexican government between 1842 and the American conquest in 1846. Of those 11 land grants, only five were confirmed by the United States. In Solano County, Rancho Suisun, near Fairfield, was one of five confirmed grants by 1848. The Indian chief Solano of the Suisun tribe requested 4 square leagues of land; this land area was later purchased by General Vallejo, who in turn sold it to Archibald A. Ritchie in 1857 for a total of 17,754 acres (Hoover et al. 1990:463). Liberty Island was not included in any of the Mexican land grants.

One of the first settlers in the area was Frederick Babel, a farmer, who arrived in the area in 1849, near the town of Clarksburg. Babel Slough north of Liberty Island was apparently named for this early family. Another early settler was John Reed Wolfskill and his brother William, who were the first settlers in Solano County. William was granted the Rio de los Putos land grant of 17,754 acres, which was partially within Yolo and Solano Counties (Hoover et al. 1990:464).



Source: NAIP 2012 imagery; cbec 2011, n.d.

Exhibit 2-22. Sea Level Rise, 2050



Source: Source: NAIP 2012 imagery; cbec 2011, n.d.

Exhibit 2-23. Sea Level Rise, 2100

During the early 20th century, farmers and ranchers were attracted by the rich fertile soil; however, farming was difficult because of annual flooding that occurred until the 1920s, when higher levees and a system of canals were constructed to control flooding (Hoover et al. 1990). Robert K. Malcom purchased Liberty Island in 1917 and started a farming operation under the name of the Liberty Farms Company (see “Liberty Island and the Liberty Farms Company” below).

b. Land Reclamation and Flood Control

This section has been summarized from the Land Management Plan for the Yolo Bypass Wildlife Area (DFG 2008).

The Delta was a rich, freshwater tidal marsh covered in tules with most of the land at or below sea level. Settlements and farms were established on the natural levees of the Sacramento River, and often the Yolo Basin was used as open rangeland. Seasonal flooding by the Sacramento River repeatedly devastated the burgeoning community of Sacramento, underscoring the need for flood protection. Lands that drained rapidly were quickly reclaimed, but long-term flooding prevented further reclamation efforts within the basins themselves.

The Swamp Land Act of 1850, in which 2,193,965 acres of swamp and overflow land were given to the State of California, helped to facilitate drainage and made these lands suitable for cultivation. Limitations on acreage were capped at first at 320 acres, then 640 acres, which were made available by the state for \$1 per acre. If a purchaser could certify that he had spent \$2 per acre in reclamation, his purchase price was refunded and he was given deed to the land. In 1861, in an attempt to increase this acreage limit, the state created the Board of Reclamation, which authorized the formation of reclamation districts to accomplish the task of more wholesale reclamation efforts.

Thirty-two reclamation districts were formed at this time. One project completed during this period was the construction of an 11.5-mile drainage canal along the trough of the Yolo Basin to Cache Slough. This first incarnation of the Tule Canal was completed in November 1864 at a cost of \$18,000. Its intent was to drain the Cache Creek Sinks area, Lake Washington, and Big Lake, near Clarksburg. Winter overflow was drained earlier, making the land available for pasture. The Tule Canal remains to this day along parts of the eastern edge of the Yolo Bypass and is an integral part of the irrigation system of the Yolo Bypass.

More local control of reclamation and flood control efforts was desired, and by 1866 this control was turned over to the counties. At this time, acreage restrictions were removed, clearing the way for speculators. Military script from the Civil War was received at face value, although it could be obtained for a few cents on the dollar. In this way land agents acquired properties sometimes exceeding 100,000 acres. It was charged that the only expense incurred by the purchaser of the Yolo Basin was that of paying witnesses to testify that the land had been reclaimed, so that the owners could get a refund on the amount paid, although less than one-sixth of the property actually was reclaimed.

After the devastating flood of 1862, extensive levee-building projects were initiated with a general strategy of raising all levees along the Sacramento River to contain river flows. It was thought that the increased velocity of the constrained river would wash debris in the river bed out to the Delta and San Francisco Bay, a common scenario in the Mississippi River system. Much of this debris came from hydraulic mining activities, especially prevalent on the Yuba and Bear Rivers. The debris clogged river

channels, forcing water overland with disastrous results. The flood of 1878 was one of the worst in valley history and hit Yolo County especially hard: “It is a tale of devastating grain fields, vineyards and orchard; of drowning cattle and houseless settlers seeking refuge in the hills and shelter under the roofs of their more fortunate neighbors” (*Yolo Democrat* 1879).

A pattern of large floods followed by periods of increased levee building activity continued for 20 years until a new flood protection paradigm was embraced. This alternative vision included using the natural basins that paralleled the Sacramento River for flood control. This concept was long advocated by William S. Green, Colusa County surveyor, newspaper editor, state assemblyman, ardent states’ rights advocate, State Library trustee, surveyor, general of California, state treasurer, and unofficial “father of California irrigation.” Observing that the Sacramento River’s channel regularly overflowed its banks and moved water onto the floodplain, he suggested intentionally diverting these waters into the basins and developed a plan to construct this proposal. The idea was embraced by others of the period, including Mr. Treadwell of Woodland, who proposed digging a channel that would extend from the confluence of the Feather and Sacramento Rivers through the trough of the Yolo Basin, pass east of Maine Prairie, and continue on to Suisun Bay.

By 1897 the Elkhorn Weir was constructed to divert Sacramento River flows into the Yolo Basin. Located on the west bank of the Sacramento River 6 miles below the mouth of the Feather River, this weir remained in operation until 1917.

Early in the 20th century, USGS recognized the wisdom of Green’s observations and proposals and confirmed that the Sacramento River channel was inadequate to handle massive flows. The Sacramento River Flood Control Project was adopted as part of the Flood Control Act of 1917, making the federal government responsible for flood control. Construction of the main levees along the Yolo Bypass began that same year. Liberty Island is located at the southernmost end of the Yolo Bypass.

The Fremont Weir was constructed in 1929, creating a fixed wall to serve as the main inlet to the newly constructed Yolo Bypass. This concrete structure is 10,000 feet long and has an elevation of 33.5 feet at its crest. To this day, whenever the Sacramento River reaches this elevation at the weir, water begins to flow into the Yolo Bypass.

Two features of the Yolo Bypass that were not part of the original design but were included in the construction were the Sacramento Weir and Sacramento Bypass. The Sacramento Weir was built by the City of Sacramento in 1916 to divert the flows of the American River into the Yolo Bypass; it has the capacity to move 112,000 cfs of water. The weir is manually opened by DWR when the Sacramento River reaches an elevation of 28 feet. After the weir is opened, the Sacramento River flows backwards from the mouth of the American River to the Sacramento Bypass because of the overwhelming flow of the American River.

The Yolo Bypass was designed so that erosion and deposition could be minimized. Rather than being constructed down the middle of the Yolo Basin trough, it was constructed upslope to maintain an elevational gradient from north to south, delivering water to the Delta rapidly. Until the 1940s, there was no levee between the current I-80 and Putah Creek, and today there is no levee south of Putah Creek for approximately 6 miles. It was determined that the high ground associated with the alluvial fan of Putah

Creek would contain most flows, and this exposed section of land had such poor agricultural potential that sediment deposition could only improve its alkali soils. Ironically, the alkali soils contribute substantially to the biological richness of the area and were an important factor that led to acquisition of the Tule Ranch by DFG in 2001.

c. Liberty Island and the Liberty Farms Company

The following two sections of this chapter have been summarized from *The Story of Liberty Island: Robert K. Malcolm* (Dickman 1981).

Thought to be one of California's pioneers of large-scale agribusiness, Robert K. Malcom began his farming business by purchasing Liberty Island and creating the Liberty Farms Company in 1917. Born in Watsonville to Scottish parents in 1868, Robert was one of nine children. He became self-supporting by the age of 14 and moved to San Francisco a few years later to work for the largest produce house on the Pacific coast. Within 2 years, Robert had saved enough money to start his own produce company, which was later formed into the partnership of Jacobs, Malcom, and Burt. By 1917 Robert had sold his interest to his partners so that he could concentrate on his next endeavor, the business of land reclamation and farming.

On November 17, 1917, Malcolm, George E. Bryan, Thomas A. Keogh, George B. Montagne, and J. H. Rosseter formed the Liberty Farm Company and merged their properties to construct levees and drain the land for farming. In February 1919, the Liberty Farm Company sold its assets and liabilities to the Liberty Farms Company, which was also headed by Robert K. Malcolm. Liberty Island received its name because at the time that the Island was reclaimed, the United States was fighting for liberty in World War I.

The Liberty Farms Company reclaimed 5,000 acres of swamp and overflow land in the Delta by 1918. This reclamation was accomplished by using four clamshell dredges to construct 20 miles of levees, 2 miles of canals measuring 20 feet wide by 8 feet deep, and 120 miles of lateral ditches measuring 4 feet wide and 5 feet deep. After the land had dried, the removal of the 15- to 20-foot-high tules began, in a slow process. The Island's rich soil produced abundant crops such as potatoes, asparagus, beans, onions, and zucchini.

Potatoes were the first crops planted and were farmed principally by the Chinese. Liberty Farms was farmed by tenants with a labor camp for 100 permanent residents and accommodations for up to 1,000 seasonal laborers. By 1948, according to the California Packing Corporation, Liberty Farms was the largest single grower of tomatoes in the United States.

Because of high demands for produce, Liberty Farms began advertising its brand, and in 1926, the Liberty Farms Company filed a U.S. federal trademark registration for the "Spotlight" brand, which was used primarily for asparagus, broccoli, green peas, cauliflower, onions, and tomatoes. Because of its large-scale farming operations, the Liberty Farms Company built a station on the Sacramento Northern Railway, a secondary road from the station to the property, a post office, and a schoolhouse for the children of its employees. At its peak, the schoolhouse had up to 65 students. By 1951 Liberty Island had a permanent population of 300 individuals that grew to more than 1,500 during harvest season.

Despite the extensive levees surrounding the Island, from 1918 to 1973 Liberty Island flooded 27 times. Although high yields helped to finance flood repair and maintenance costs, the discovery of natural gas on the property in 1955 helped to cover rising flood-related expenses. In 1965, after flooding had occurred for 4 years, the decision was made to sell, mainly because of low profits. Selling the property did not come easy because many interested parties did not wish to take on the risks that the flooding imposed on the Island. On November 1, 1973, the Moresco Brothers Farming Company, which was then farming row crops in the Stockton area, bought the land and the adjacent Miller property.

d. Natural Gas Development

In 1936, another phase of development occurred in the Delta when the largest natural gas field in California was discovered near Rio Vista. Numerous gas leases were let throughout the area, and wells were drilled during the subsequent years, ushering in a new wave of investment and speculation by outside interests. Mr. Malcom believed that no gas was contained on Liberty Island; however, he allowed three leases, at \$2 per an acre, on his property. It was not until after his death that the first well was dug, in 1955. In total, 33 wells were drilled on the property, and 1 acre of farmland per well was lost. Flooding still posed a problem for the gas production, which halted during peak floods. By the time Liberty Farms was sold in 1973, only one well was still in production. Gradually the wells were phased out of production because of flooding.

3. Existing Historic-era Cultural Resources

Portions of a historic-era levee, old infrastructure, and several pieces of associated agricultural equipment remain on the Island. The portions of the historic-era levee are located on the north, east and west sides of the Island (Exhibit 2-23). The agricultural infrastructure and equipment are located on levees or upland areas in the northern part of LIER and are all in a state of disrepair. Potential resources include small sheds, pumps, and machinery associated with past farming operations. No other historic-era structures were identified or are known to exist on the Island.

AECOM's research into cultural resources for Liberty Island included a record search of known pertinent cultural resource information as it relates to Liberty Island. This search was conducted by the Northwest Information Center of the California Historical Resources Information System, located in Rohnert Park, California. The record search included but was not restricted to a review of select publications and other information listed in the following sources:

- ▶ California Register of Historical Resources (1976)
- ▶ California Points of Historical Interest (1992 and updates)
- ▶ California Historical Landmarks (1996)
- ▶ Directory of Properties in the Historical Resources Inventory (State of California)
- ▶ California Department of Transportation Bridge Inventory, Solano and Yolo Counties
- ▶ California State Lands Commission Shipwreck Database, Yolo County (2013)
- ▶ 1859, 1867, and 1885 General Land Office plat maps (Township 6 North, Range 3 East)



Source: AECOM

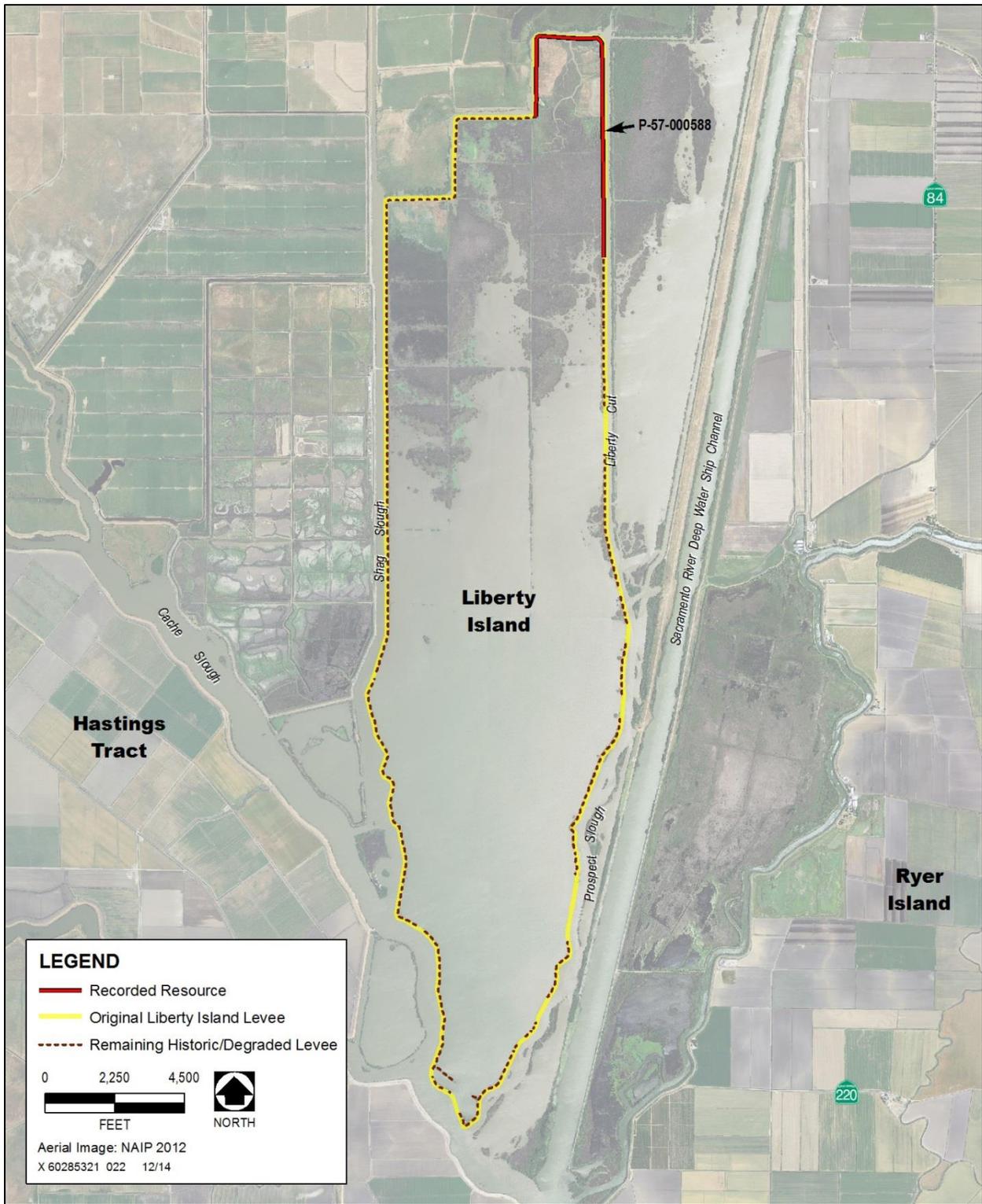
4. Cultural Resources for Liberty Island

Historic maps provide limited information about structures and features located within Liberty Island. A review of the 1859, 1867, and 1885 General Land Office plat maps indicates that at that time, a large portion of the Island was characterized as swamp and overflow lands. No features or structures are depicted within LIER.

Several studies, summarized in Table 2-5, have been conducted within and directly adjacent to LIER. All of these documents and reports are on file at the Northwest Information Center. With the exception of a few (Nelson 2004; Morgan 2003; Sikes et al. 2008; Havelaar et al. 2012), all have been linear surveys that have resulted in the inventory of only a very small percentage of the area.

These investigations have resulted in the identification of one resource (P-50-000588), an approximately 2.2-mile segment of the historic-era levee that once surrounded Liberty Island, a portion of which has been breached. This segment of levee is located around the northeast border of the Island (Exhibit 2-23) and was first recorded in 2007 (Kovak 2007) and updated in 2009 (McCrary 2009). The segment is shown as a continuous levee, and was at the time it was recorded; however, the east-to-west section along the northern boundary was breached and lowered to construct a tidal wetland and channel for native fish habitat in late 2009 (RD 2093 2009).

The remaining portions of this segment of historic-era levee, as well as most of the remaining portions of levee around the Island, are now covered in blackberries, willows, cottonwoods, and other riparian vegetation. The original historic-era levee that once entirely surrounded Liberty Island was constructed between 1917 and 1918 from dredging the surrounding channels. The segments that have not been breached and eroded represent a resource that has not been evaluated for California Register of Historical Resources (CRHR) or National Register of Historic Places (NRHP) eligibility.



Source: NWIC 2014, AECOM 2014

Exhibit 2-23 Recorded Section of Historic-Era Levee

5. Native American Consultation

The Native American Heritage Commission (NAHC) was contacted on November 19, 2013, for information about the location of any known heritage or sacred sites in the vicinity of LIER. The NAHC indicated that the sacred lands file does not contain any mapped resources within Liberty Island and provided a list of Native American individuals and organizations that may have knowledge of cultural resources on LIER. AECOM sent letters to the parties identified by the NAHC on December 13, 2013, requesting information about resources that may be present. Follow-up phone calls were placed and messages left for the respective individuals on January 3, 2014. A representative of the Yocha Dehe Wintun Nations responded with a letter stating that it respectfully declines any comment. No additional comments have been received to date.

Report Title	NWIC File Number	Author and Date	Affiliation
Investigations within Liberty Island			
Sacramento River Major and Minor Tributaries, Shag Slough Levee Repair, Yolo County, California	S-007893	Richard A. Weaver, 1986	U.S. Army Corps of Engineers
An Archaeological Assessment Within Reclamation District 2068 and 2098, Solano and Yolo Counties, California; COE Water Basin System Designation SAC 07 DACW05-97-P-0465	S-020003	William Shapiro and Keith Syda, 1997	Pacific Legacy, Inc.
Cultural Resources Inventory for the Liberty Farms Wetland Reserve Project, Solano County, California	S-028806	Jim Nelson, 2004	Tremaine & Associates, Inc.
Archaeological Survey for the Monarch Barge Removal Project, Shag Slough, Solano County, CA; Federal Project #A04235, Purchase order DTG89-04-N-HYC026, Requisition Ref. No. 24-04-894HYC026	S-029924	Sally Salzman Morgan, 2003	URS Group, Inc.
Supplemental Cultural Resources Report for the Levee Repair Project at 16 Locations in Glenn, Sacramento, Solano, Sutter, Yolo, and Yuba Counties, California	S-035012	Nancy E. Sikes, Philip G. Hanes, and Cindy J. Arrington, 2008	SWCA Environmental Consultants
Historic Properties Treatment Plan, Sacramento River Bank Protection Project	S-038637	Christian Havelaar, Melissa Cascella, Patricia Ambacher, and Gabriel Roark, 2012	ICF International
Investigations Adjacent to Liberty Island			
Cultural Resources Reconnaissance: Sacramento River Deep Water Ship Channel (Collinsville to Sacramento)	S-005055	Jeffry Seldomridge and Connie Smith-Madsen, 1976	California State University, Sacramento
Cultural Resources Survey, Cache Slough–Yolo By-Pass Levees, Yolo County, California	S-007892	Richard A. Weaver, 1986	U.S. Army Corps of Engineers
An Archaeological Survey of the Ulatis Creek Soil Conservation Service Watershed Project	S-015491	Clifford Curtice, 1964	–
An Archaeological Assessment Within Reclamation District 2060 in Solano County, California: Part of the Cultural Resources Inventory and Evaluation for U.S. Army Corps of Engineers, Sacramento District, PL 84-99 Levee Rehabilitation on the Feather, Bear, Sacramento and San Joaquin Rivers System, DACW05-97-P-0465	S-019663	William Shapiro, 1997	Pacific Legacy, Inc.

Table 2-5. Summary of Previous Cultural Investigations in the Vicinity of Liberty Island			
Report Title	NWIC File Number	Author and Date	Affiliation
An Addendum Archaeological Assessment within Reclamation District 2060 in Solano County, California: Part of the Cultural Resources Inventory and Evaluation for U.S. Army Corps of Engineers, Sacramento District, PL 84-99 Levee Rehabilitation on the Feather, Bear, Sacramento and San Joaquin Rivers System; COE Water Basin Designation SAC 08, DACWO5-98-P-0033	S-019938	William Shapiro and Keith Syda, 1997	Pacific Legacy, Inc.
Cultural Resources Inventory Report for the Liberty Farms Wetlands Reserve Program Easement, Solano County, California	S-032269	Melanie Beasley and Kim Tremaine, 2005	Tremaine & Associates, Inc.
Supplemental Cultural Resources Report for the Levee Repair Project at 16 Locations in Glenn, Sacramento, Solano, Sutter, Yolo, and Yuba Counties, California	S-035012	Nancy E. Sikes, Philip G. Hanes, and Cindy J. Arrington, 2008	SWCA Environmental Consultants
Cultural Resources Remote Sensing Survey and Diver Investigations at Selected Target Locations, Sacramento River Bank Protection Project (SRBPP), Sacramento River and Tributaries	S-038635	Andrew D. W. Lydecker, 2010	Panamerican Consultants, Inc.
Note: NWIC = Northwest Information Center, Sonoma State University, Rohnert Park, California Source: Data compiled by AECOM in 2014			

III. HABITAT DESCRIPTION

A. Vegetation Communities and Habitats

Vegetation communities in Liberty Island Ecological Reserve have been mapped by CDFW (2013a) and the Yolo Heritage Foundation (Yolo Natural Heritage Program 2013). These communities were field-verified at a broad scale by AECOM botanists Ellen Pimentel and Charles Battaglia on September 11, 2013. Revisions were also made to the communities within the Liberty Island Conservation Bank and Preserve based on the 2013 Monitoring Report (Wildlands, Inc. 2013) and recent aerial photography (Microsoft Corporation 2014). The mapped vegetation communities are described following the classification described in *A Manual of California Vegetation* (MCV) (Sawyer et al. 2009). LIER also comprises approximately 3,936 acres of open water habitat and approximately 7 acres of barren, unvegetated land.

Consistent with the MCV, the vegetation classification unit applied here is “vegetation type” rather than “vegetation community” or “plant community.” Vegetation types are mapped to the alliance level, which is based on diagnostic species from the primary layer (e.g., the tree layer in case of a woodland alliance).

Sensitive habitats include those that are afforded specific consideration through CEQA, the California Fish and Game Code, the Porter-Cologne Water Quality Control Act (Porter-Cologne Act), or the federal Clean Water Act (e.g., riparian and wetland areas). Sensitive habitats also include Natural Communities of Special Concern (NCSCs), which are communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects. NCSCs are ranked by CDFW from S1 to S3, where 1 is critically imperiled, 2 is imperiled, and 3 is vulnerable (CDFW 2013b).

CDFW’s natural-community rarity rankings follow NatureServe’s 2009 *NatureServe Conservation Status Assessments: Methodology for Assigning Ranks*, in which all alliances are listed with a global (G) and state (S) rank, where G1 is critically imperiled, G2 is imperiled, G3 is vulnerable, G4 is apparently secure, and G5 is secure (NatureServe 2012). NCSCs on LIER were identified based on the vegetation classification used in the *List of Vegetation Alliances and Associations* (DFG 2010a). Vegetation communities that have an NCSC rating are noted in the descriptions below.

Vegetation types present within LIER are described in this section and their location and extent within LIER is shown in Exhibit 3-1a and 3-1b. The vegetation type descriptions note whether the type is a NCSC or is otherwise considered a sensitive habitat.

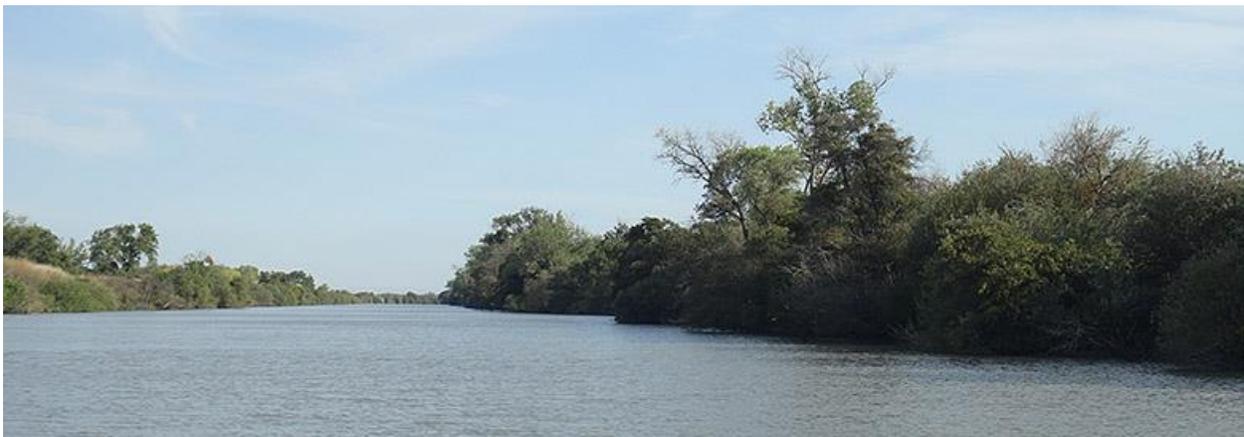
1. Riparian Forest and Scrub

Several vegetation types present on Liberty Island form riparian forest and scrub communities: white alder groves, Fremont cottonwood forest, black willow thickets, sandbar willow thickets, and Himalayan blackberry brambles. These types are found along the levees and levee remnants surrounding Liberty Island, and in a few places of higher ground in the Island’s interior. Most riparian vegetation types are considered sensitive because of their limited distribution in California. All of the riparian vegetation types may be protected under Section 1600 of the California Fish and Game Code, and several riparian communities are considered NCSCs, as noted in the individual type descriptions below. Most of the riparian vegetation types on Liberty Island are dominated by native species. The sandbar willow

thickets—Himalayan blackberry association and Himalayan blackberry brambles association—are codominated or dominated by Himalayan blackberry (*Rubus armeniacus [discolor]*), a nonnative invasive species.



Source: AECOM



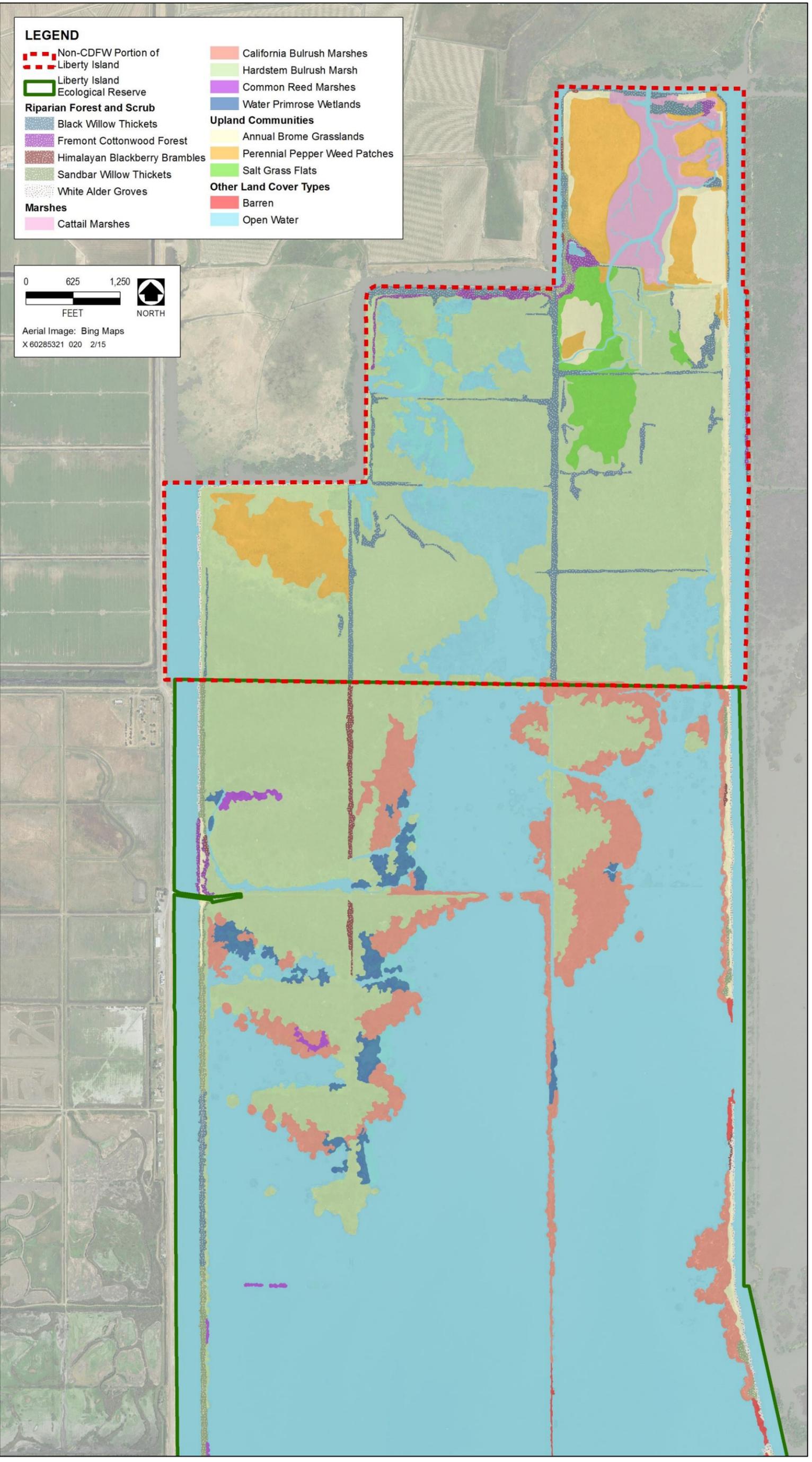
Source: AECOM

a. White Alder Groves

White alder groves are dominated by white alder (*Alnus rhombifolia*). These groves have an open to continuous canopy, and white alder has more than 30% relative cover in the tree layer. Trees are less than 35 meters (m) tall. There are approximately 27 acres of white alder groves on Liberty Island. The associations mapped on Liberty Island are *Alnus rhombifolia/Cornus sericea* and *Alnus rhombifolia/Salix exigua—(Rosa californica)*, which include stands with a well-developed shrub layer. The associations mapped on Liberty Island are listed by CDFW as high priority for inventory and are ranked G4 S4, indicating that they are uncommon but not rare in the state (DFG 2010b).

b. Fremont Cottonwood Forest

Fremont cottonwood forest is dominated by Fremont cottonwood (*Populus fremontii*) and includes those areas where the species has more than 50% relative cover in the tree layer. Trees are less than 25 m tall. The tree canopy is continuous to open and is simple in the association mapped within LIER (i.e., the



Source: AECOM 2015, CDFW 2014

Exhibit 3-1a. Vegetation Map of Liberty Island Ecological Reserve - North



Source: AECOM 2015, CDFW 2014

Exhibit 3-1b. Vegetation Map of Liberty Island Ecological Reserve - South

canopy does not contain a mix of species). There are approximately 10 acres of Fremont cottonwood forest on Liberty Island. The association mapped in the northern portion of Liberty Island includes willows (*Salix laevigata*, *S. lasiolepis*, *S. lucida* ssp. *lasiandra*) in the canopy. The shrub layer may be intermittent to open and is dominated by the same species found in white alder groves. The Fremont cottonwood forest alliance is considered an NCSC with a rank of G4 S3 (DFG 2010b).

c. Black Willow Thickets

Black willow thickets are dominated by black willow (*S. gooddingii*) and include those areas where the species has more than 50% relative cover in the tree layer. Trees are less than 30 m tall. The association mapped within LIER is simple, and both the tree canopy and the shrub layer may be open to continuous. There are approximately 55 acres of black willow thickets on Liberty Island. The association mapped in the northern portion of Liberty Island includes other willow trees in the canopy. The shrub layer is dominated by the same species found in white alder groves. All associations of black willow thickets are considered NCSC with a rank of G4 S3 (DFG 2010b).

d. Sandbar Willow Thickets

Sandbar willow thickets are dominated by sandbar willow, and on Liberty Island they may be codominant with arroyo willow (*S. lasiolepis*) and Himalayan blackberry (*Salix exigua*—[*Salix lasiolepis*]*—Rubus discolor* association). Shrubs are less than 7 m tall and the shrub canopy is intermittent to continuous. Sandbar willow may have 5% or more absolute cover when dominant in the shrub canopy, more than 20% absolute cover when codominant with other species in the shrub canopy, more than 50% relative cover in the shrub canopy, or more than 30% relative cover with arroyo willow in the shrub layer. Approximately 48 acres of black willow thickets are present on Liberty Island.

e. Himalayan Blackberry Brambles

Himalayan blackberry brambles are dominated by nonnative invasive Himalayan blackberry (*Rubus armeniacus* [*discolor*]) and located in areas with greater than 60% relative cover in the shrub layer. Brambles are less than 3 m tall and the canopy is intermittent to continuous. Approximately 7 acres of blackberry brambles are mapped on Liberty Island.

2. Marshes

Several marsh vegetation types are found in still, shallow waters throughout Liberty Island: hardstem bulrush marsh, California bulrush marsh, common reed marshes, cattail marshes, water primrose wetlands, Brazilian waterweed wetlands, and water hyacinth wetlands. Marshes are wetland vegetation types that generally fall under the jurisdiction of state and federal agencies. Marshes, like most wetland vegetation types, are generally considered sensitive habitats because of their limited distribution in California and are typically regulated under the Clean Water Act or Porter-Cologne Act. Hardstem bulrush marsh, California bulrush marsh, and cattail marshes are dominated by native species, although common reed (*Phragmites australis*), a nonnative species, may be codominant. Common reed marshes, water primrose wetlands, Brazilian waterweed wetlands, and water hyacinth are dominated by nonnative species.



Source: AECOM



Source: AECOM

a. Hardstem Bulrush Marsh

Hardstem bulrush marsh is dominated by hardstem bulrush (*Schoenoplectus acutus*), with 10% or more absolute cover in the herbaceous layer. Plants are less than 4 m tall and cover is intermittent to continuous. The association mapped on Liberty Island is *Schoenoplectus acutus*—*Typha latifolia*—*Phragmites australis*; in this association, cattails (*Typha latifolia*) may have more than 30% to 60% relative cover, and nonnative common reed (*Phragmites australis*) is codominant. This vegetation type currently covers most of the vegetated portion of Liberty Island, comprising a total of approximately 750 acres. Hardstem bulrush marsh is not currently considered an NCSC, but it falls under the coastal and valley freshwater marsh community tracked in the California Natural Diversity Database (CNDDDB) (DFG 2010b).

b. California Bulrush Marsh

California bulrush marsh is dominated by California bulrush (*Schoenoplectus californicus*), with 10% or more absolute cover in the herbaceous layer. Plants are less than 4 m tall and cover is intermittent to

continuous. The association mapped within LIER is *Schoenoplectus californicus*—*Schoenoplectus acutus*. In this association, hardstem bulrush has less than 50% relative cover and may be codominant with California bulrush. After hardstem bulrush marsh, California bulrush marsh covers most of the vegetated portion of LIER, comprising approximately 158 acres. California bulrush marsh is not currently considered an NCSC, but it falls under the coastal and valley freshwater marsh community tracked in the CNDDDB (DFG 2010b).

c. Cattail Marshes

Cattail marshes within LIER are dominated by cattails (*Typha angustifolia*), with more than 50% relative cover in the herbaceous layer. Other cattail species, common reed, hardstem bulrush, California bulrush, and emergent trees found in riparian communities may also be present. The herbaceous layer is less than 1.5 m tall, and the canopy is intermittent to continuous. Cattail marshes are found at the northern portion of Liberty Island within the Liberty Island Conservation Bank, where they occupy approximately 37 acres. Cattail marsh is not currently considered an NCSC, but it falls under the coastal and valley freshwater marsh community tracked in the CNDDDB (DFG 2010b).

d. Common Reed Marshes

Common reed marshes are dominated by common reed and may be codominant with hardstem bulrush, California bulrush, or cattails. Common reed may have 2% or more absolute cover and 50% or more relative cover in the herbaceous layer, or 30% or more absolute cover in the herbaceous layer. Emergent shrubs and trees found in the riparian communities may be present at low cover. The herbaceous layer is less than 4 m tall and the canopy is continuous. Common reed has a worldwide distribution and was once thought to be introduced to North America. It is now known that there is a native genotype of common reed that has recently been described as a distinct subspecies (*Phragmites australis* ssp. *americanus*). Although common reed is now thought to be native to California, it is still generally considered an invasive species. Common reed marshes are found in small patches throughout the marsh communities within LIER and comprise a total of approximately 6 acres.

e. Water Primrose Wetlands

Water primrose wetlands are dominated by nonnative invasive water primrose (*Ludwigia* sp.) as emergent or floating plants on the water surface. Plants are less than 3 m tall and the canopy is open to continuous. Water primrose wetlands are found in still water in the interior of LIER, along canals, and along the edges of hardstem and California bulrush marshes. Water primrose wetlands are mapped to occupy approximately 28 acres around the large areas of California bulrush marsh to the south, but they are now also invading substantial areas of open water in the central section of the northern “stair step.”

f. Brazilian Waterweed Wetlands

Brazilian waterweed wetlands are dominated by nonnative invasive Brazilian waterweed (*Egeria densa*) as emergent or floating plants on the water surface. Brazilian waterweed wetlands are not included in the MCV. However, they were described in the report *Vegetation and Land Use Classification and Map of the Sacramento–San Joaquin River Delta* (Hickson and Keeler-Wolf 2007), prepared for CDFW’s Bay Delta Region, as the *Egeria*—*Cabomba*—*Myriophyllum* spp. Provisional Association. Brazilian waterweed wetlands are intermittent to dense (60% to 90% absolute cover) and 0 to 0.5 m tall. Co-

dominant species may include fanwort (*Cabomba caroliniana*) and parrotfeather (*Myriophyllum* sp.). Mosquito fern is constant at less than 25% relative cover. Brazilian waterweed wetlands are found in open-water and shallow-margin areas of LIER, but because they are generally not visible above the water surface, they are not mapped separately from the Open Water in Exhibit 3-1a and 3-1b.

g. Water Hyacinth Wetlands

Water hyacinth wetlands are dominated by nonnative invasive water hyacinth (*Eichhornia crassipes*) as floating herbaceous plants on the water's surface. Water hyacinth wetlands are not included in the MCV. However, they were described in the report *Vegetation and Land Use Classification and Map of the Sacramento–San Joaquin River Delta* (Hickson and Keeler-Wolf 2007). Stands are dense (97% to 100% absolute cover) and 0 to 0.5 m tall. Water hyacinth wetlands are dominated by water hyacinth at 97% to 98% relative cover; other species at very low relative cover may include marsh pennywort (*Hydrocotyle ranunculoides*), water primrose, hardstem bulrush, and cattails. Water hyacinth wetlands are found in still water in the interior of LIER, but because the floating mats move day to day, they are not mapped separately from the Open Water in Exhibit 3-1a and 3-1b.

3. Upland Communities

Upland communities include poison hemlock or fennel patches, annual brome grasslands, perennial pepper weed patches, and salt grass flats. These vegetation types are dominated by weedy, nonnative herbs and are found along the levee slopes surrounding Liberty Island, and in two places in the northern portion of the Island: the northernmost “stair step” to the east, west, and south of the Liberty Island Conservation Bank and Preserve, and in the northern end of the southernmost “stair step.”



Source: AECOM

a. Poison Hemlock or Fennel Patches

Poison hemlock or fennel patches are dominated by nonnative invasive poison hemlock (*Conium maculatum*) and/or fennel (*Foeniculum vulgare*) at more than 50% relative cover. Plants are less than 2 m tall and the canopy is open to continuous. Other herbs present in this vegetation type within LIER include teasel (*Dipsacus fullonum*), milk thistle (*Silybum marianum*), white sweetclover (*Melilotus albus*), and

yellow starthistle (*Centaurea solstitialis*). Emergent trees and shrubs found in the riparian communities may be present. Approximately 3 acres of this vegetation type are mapped on Liberty Island.

b. Annual Brome Grasslands

Annual brome grasslands are dominated by nonnative annual bromes (*Bromus diandrus*, *B. hordeaceus*) where these species have more than 50% to 80% relative cover in the herbaceous layer. Grasses are less than 75 centimeters (cm) tall and cover is intermittent to continuous. Other herbs present in this vegetation type on Liberty Island include wild oats (*Avena fatua*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), common mallow (*Malva neglecta*), yellow starthistle, gumplant (*Grindelia camporum*), and field bindweed (*Convolvulus arvensis*). Approximately 58 acres of this vegetation type are present on Liberty Island, mostly in the northern “stair step” portion of the island.

c. Perennial Pepper Weed Patches

Perennial pepper weed patches are dominated by invasive perennial pepper weed (*Lepidium latifolium*), with more than 30% absolute cover or more than 90% relative cover with other nonnatives. Emergent trees and shrubs may be present. The herbaceous layer is less than 2 m tall and the canopy is intermittent to continuous. Approximately 88 acres of perennial pepper weed patches are present on Liberty Island, all in the northern “stair step” portion of the Island.

d. Salt Grass Flats

Salt grass flats are dominated or codominated by salt grass (*Distichlis spicata*) in the herbaceous layer. Salt grass has greater than 30% relative cover in the herbaceous layer. Herbs are less than 1 m tall and cover is open to continuous. Other herbs present include riggut brome (*B. diandrus*), alkali heath (*Frankenia salina*), and perennial pepperweed. Seasonally inundated depressions with salty surfaces were observed. Salt grass flats are often found on alkaline or saline soils, which are intermittently flooded, although it is not clear how often these stands are inundated on Liberty Island. Approximately 33 acres of salt grass flats are present in the northern “stair step” portion of Liberty Island.

B. Terrestrial Wildlife Species

Most of the wildlife habitat within LIER is aquatic in the form of open water, but substantial areas of emergent wetland and riparian woodland, and smaller areas of upland grasslands and ruderal vegetation occur in the northern portion (Exhibit 3-1a). These communities provide valuable wildlife habitat for a variety of species and species guilds. LIER lies within a central portion of the Pacific Flyway, the major pathway for migratory bird species on the West Coast. Many of the species that inhabit the Island are present during the fall and winter months, when the Central Valley, and specifically the Yolo Bypass, become home to an abundance of birds. The most conspicuous groups of wintering birds are waterfowl, shorebirds, wading birds, and raptors. Neotropical migratory birds, cavity-nesting birds, and upland game species are also present on the Island. Key wildlife species and species that use the habitats in these communities are discussed below.

1. Waterfowl

LIER lies in the Pacific Flyway. Large numbers of ducks and geese winter in the area after migrating from northern breeding areas. Waterfowl populations are a highly valued and diversified biological resource. They are of high interest to a variety of recreational users of LIER, particularly hunters and bird-watchers.

Species that occur in high abundance within LIER include northern pintail (*Anas acuta*), northern shoveler (*A. clypeata*), mallard (*A. platyrhynchos*), gadwall (*A. strepera*), American wigeon (*A. americana*), cinnamon and green-winged teal (*A. cyanoptera* and *A. crecca*), lesser scaup (*Aythya affinis*), snow goose (*Chen caerulescens*), and white-fronted goose (*Anser albifrons*). Some species, such as mallard, gadwall, and Canada goose (*Branta canadensis*), are year-round residents and breed locally in wetlands and nearby uplands. Diving ducks such as ring-necked duck (*Aythya collaris*), canvasback (*A. valisineria*), scaup (*Aythya* spp.), goldeneye (*Bucephala* spp.), and ruddy duck (*Oxyuria jamaicensis*) typically feed in deeper water and can also occur.

Since the California Gold Rush of 1849, wetland acreage in California has been reduced by 90% as a result of large-scale habitat conversion (California Natural Resources Agency 2010). As a result, waterfowl breeding and wintering populations have declined from historical levels. LIER is a critical link in the chain of wetlands making up the Pacific Flyway that contributes to the preservation of wintering and breeding waterfowl populations.

Waterfowl abundance within LIER peaks from December through April, when large numbers have arrived from the north and are attracted to the food resources found within LIER and the surrounding seasonally flooded wetlands and agricultural lands. Most waterfowl are attracted to the abundance of rice farmed in the area and to the food resources and habitat provided within the Yolo Bypass Wildlife Area (YBWA) to the north. A secondary peak in waterfowl abundance can occur in late summer. This secondary peak is correlated with the presence of new hatchlings from year-round breeding ducks and early-arriving migrants. The permanent wetland and limited upland habitats within LIER support nesting mallard, gadwall, and cinnamon teal ducks, and the dense areas of permanent wetland vegetation provide brood cover for ducklings for the first few weeks of their lives.

2. Shorebirds and Wading Birds

LIER provides shallow-water, mudflat, and mounded-island habitat for large numbers of shorebirds and wading birds that annually migrate through, winter, and/or breed in the area. Shorebirds and wading birds that breed in or near LIER include American avocet (*Recurvirostra americana*), black-necked stilt (*Himantopus mexicanus*), killdeer (*Charadrius vociferus*), spotted sandpiper (*Actitis macularia*), Virginia rail (*Rallus limicola*), white-faced ibis (*Plegadis chihi*), double-crested cormorant (*Phalacrocorax auritus*), black-crowned night heron (*Nycticorax nycticorax*), great blue heron (*Ardea herodias*), and snowy and great egret (*Egretta thula* and *Ardea alba*).

During avian surveys conducted by CDFW biologists, great blue heron, egret, and double-crested cormorant rookeries were documented in riparian woodland habitat on the Little Holland Tract levee, and a great blue heron rookery was documented near the northern boundary of LIER. Riparian woodland habitats along Liberty Cut, Shag Slough, and the canal following the northern “stair steps,” and in the

levee remnants that remain as islands at the southern ends of these areas also provide excellent opportunities for rookeries. Additionally, herons, egrets, cormorants, ibis, and black-crowned night herons from nearby nesting colonies in the region feed on the Island during summer months, primarily on fish and amphibians.



Source: AECOM

Other species of shorebirds and wading birds either observed or with potential to occur within LIER during these periods include western and least sandpiper (*Calidris maurim* and *C. minutilla*), long- and short-billed dowitchers (*Limnodromus scolopaceus* and *L. griseus*), dunlin (*Calidris alpina*), greater and lesser yellowlegs (*Tringa melanoleuca* and *T. flavipes*), whimbrel (*Numenius phaeopus*), long-billed curlew (*Numenius americanus*), and Wilson's phalarope (*Phalaropus tricolor lobatus*).

On a regional scale, substantial extents of historic habitat used by these species have been lost, resulting in smaller, detached patches of suitable habitat for nesting and foraging. Available information suggests that these species' populations are declining (USFWS 2009). Maintaining existing wetland and riparian communities, restoring additional suitable communities, and reducing the effects of factors that can suppress breeding success is critical to maintaining healthy shorebird and wading bird populations in the region.

3. Neotropical Migratory Birds

Many species of neotropical migratory birds migrate through or breed within LIER. The neotropical migratory bird guild consists of species that breed in North America and winter in Central and South America. Representative species that breed and/or migrate through this area include western kingbird (*Tyrannus verticalis*), western wood-pewee (*Contopus sordidulus*), tree swallow (*Tachycineta bicolor*), barn swallow (*Hirundo rustica*), Bullock's oriole (*Icterus bullockii*), Wilson's warbler (*Wilsonia pusilla*), yellow warbler (*Dendroica petechia*), and blue grosbeak (*Guiraca caerulea*).

Regionally, substantial extents of historic habitat used by neotropical migratory species have been lost, and available information suggests that population levels for many of these species are declining

(Rosenberg and Wells 2014). Managing existing habitat and restoring additional suitable wetland, riparian, and grassland habitats with variations in height and density of vegetation would be beneficial to many neotropical migratory songbirds.

4. Raptors

A variety of migratory and resident raptors that winter and/or breed in the area are known to occur in the Delta and the Yolo Bypass. Raptors that could either occur or have the potential to occur within LIER include red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*), white-tailed kite (*Elanus leucurus*), rough-legged hawk (*B. lagopus*), ferruginous hawk (*B. regalis*), prairie falcon (*Falco mexicanus*), peregrine falcon (*F. peregrinus anatum*), kestrel (*F. sparverius*), barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), short-eared owl (*Asio flammeus*), and northern harrier (*Circus cyaneus*).

5. Cavity-Nesting Birds

Cavity-nesting birds such as American kestrel, tree swallow, and wood duck (*Aix sponsa*) have been documented within LIER and have the potential to nest in tree cavities and constructed nest boxes within the upland habitats, particularly riparian woodland, on Liberty Island.

American kestrel is a year-round resident that nests in cavities such as old woodpecker holes, natural tree hollows, and rock crevices. In natural settings, this species feeds on insects, small birds, and rodents, capturing prey on the ground.

Tree swallows are summer migrants that occur in the region from late winter to early fall (February–October), with peak abundance in June and July. Postbreeding flocks of swallows may also occur in the late summer, particularly when flying insect populations associated with marshes are abundant.

Wood ducks prefer riparian habitats and wooded swamps with downed trees, shrubs, and adequate vegetative cover in which to hide and forage. Wood ducks generally nest in tree cavities or constructed boxes near or directly over water but have also been known to nest up to 2 kilometers (1.2 miles) away from water (BNA 2014). Typical tree and shrub species utilized by wood ducks include alder (*Alnus* spp.), willows (*Salix* spp.), and buttonbush (*Cephalanthus occidentalis*), and they are often associated with emergent herbaceous vegetation such as arrowhead (*Sagittarius* spp.) and smartweed (*Polygonum* spp.). Wood ducks eat seeds, fruits, insects, and other arthropods and, like many duck species, are also popular game birds.

6. Upland Game Birds

LIER provides habitat for several upland game birds of interest to recreational hunters. The primary upland game bird species on Liberty Island are mourning dove (*Zenaida macroura*) and ring-neck pheasant (*Phasianus colchicus*). High winter and spring floods, however, can substantially affect pheasant nesting and recruitment success, thereby reducing populations in subsequent years.

7. Other Wildlife

The upland grassland and ruderal vegetation at LIER supports several common mammal species, such as black-tailed jack rabbit (*Lepus californicus*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*),

California ground squirrel (*Spermophilus beecheyi*), California vole (*Microtus californicus*), western harvest mouse (*Reithrodontomys megalotis*), house mouse (*Mus musculus*), Botta's pocket gopher (*Thomomys bottae*), Virginia opossum (*Dedelphis virginiana*), Norway rat (*Rattus norvegicus*), coyote (*Canis latrans*), and possibly red and/or gray fox (*Vulpes vulpes*, *Urocyon cinereoargenteus*).

Other species associated with aquatic habitat and emergent wetland and riparian communities that have been documented within LIER include northern river otter (*Lutra canadensis*) and American beaver (*Castor canadensis*). Species such as American mink (*Mustela vison*) and muskrat (*Ondatra zibethicus*) are documented in the region and could also occur.

Common reptile and amphibian species found in the area and within LIER include western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*), gopher snake (*Pituophis melanoleucus*), red-eared slider turtle (*Chrysemys scripta*), Pacific tree frog (*Hyla regilla*), western toad (*Bufo boreas*), and bullfrog (*Rana catesbeiana*). Giant garter snake (*Thamnophis gigas*) is also present in the region and documented approximately 1.5 miles from LIER, and emergent wetland, pond, and canal habitat within the northern section of LIER provides suitable habitat; however, predatory game fish can access nearly all waters and create an unfavorable environment.

Several bat species occur in the region and could forage and roost within LIER. Trees in the riparian forest provide suitable roosting habitat for special-status species such as pallid bat (*Antrozous pallidus*), western red bat (*Lasirurs blossevillii*), and Townsend's big-eared bat (*Corynorhinus townsendii*). Other bat species that occur within LIER include hoary bat (*Lasiurus cinereus*), California myotis (*Myotis californicus*), little brown myotis (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), long-legged myotis (*Myotis volans*), and Mexican free-tailed bat (*Tadarida brasiliensis*).

C. Aquatic Habitats

The habitats within and adjacent to LIER are characteristic of the northern Delta and include several aquatic habitats: floodplain, sloughs, cuts, shallow channels, shoals, deep river channels, levee breaches, and open water. These habitats support a large and diverse aquatic community that includes submergent and emergent vegetative communities, aquatic invertebrates, special-status fish species, and several recreationally important fish species. The following sections briefly describe major habitats located on and near LIER.

1. Floodplain

LIER is located at the southern end of the Yolo Bypass. The bypass hosts a diverse assemblage of wildlife species inhabiting seasonal wetlands, permanent wetlands, riparian forest, uplands, vernal pools, and agricultural habitats. There are more introduced fish species than native species in the Yolo Bypass floodplain (Sommer et al. 2003). The floodplain dewatered seasonally, from late spring through autumn, which prevents nonnative fish species from establishing year-round dominance (Sommer et al. 2003). Many native fish species are adapted to spawn and rear in winter and early spring (Moyle 2002) during the winter flood pulse. Nonnative fish species typically spawn from late spring through summer, when most of the floodplain is not available to them.

Floodplain habitat plays a critical role in the life history of many native species. Sommer et al. (1997) demonstrated the importance of the Yolo Bypass as high-quality habitat for native aquatic species such as Sacramento Splittail, Chinook Salmon, and Steelhead. They also showed that larval fish production was substantially higher within floodplain habitat than in surrounding river channels. Sommer et al. (2001a) suggested that seasonal floodplain habitat provides better rearing conditions than main river channels because of its larger amounts of suitable habitat and increased food resources.

Floodplain habitat also has an enhanced food web. Sommer et al. (2001a) reported that drift insects (primarily chironomids) were 10–100 times more abundant in the floodplain during 1998 and 1999 flood events than in the adjacent Sacramento River channel. Sommer et al. (2001a) also observed that this higher abundance of drift insects was reflected in the diets of juvenile Chinook Salmon; Yolo Bypass salmon had much more prey in their stomachs than salmon collected in the Sacramento River. However, they noted that the increased feeding success may have been partly offset by substantially higher water temperatures in the floodplain habitat, resulting in increased metabolic costs for young fish. The higher water temperatures were a consequence of the broad shallow shoals, which warm up faster than deep river channels. Through bioenergetic modeling, Sommer et al. (2001a) concluded that floodplain salmon had substantially better feeding success than fish in the Sacramento River, even when the prey data were corrected for increased metabolic costs of warmer floodplain habitat.

Floodplain inundation may also provide benefits to organisms downstream in the brackish portion of the Delta. At the base of the estuarine food web, phytoplankton are responsible for most of the primary production in the estuary (Jassby et al. 1993). However, to the detriment of the organisms that depend on phytoplankton, phytoplankton biomass in the estuary has undergone a major long-term decline as a result of multiple factors, such as introduction of new benthic grazers (i.e., Asian clam) (Alpine and Cloern 1992), water exports and low outflows (Jassby et al. 1995), and climate change (Cloern et al. 2011). Modeling studies by Jassby and Cloern (2000) suggest that phytoplankton produced in the Yolo Bypass may be an important source of organic carbon to the Delta, at least during flood events. This conclusion is supported by Schemel et al. (1996), who found that the Yolo Bypass is the major pathway for organic matter to the Delta in wet years. It is also supported by Lehman, Sommer, and Rivard (Lehman et al. 2008), who concluded that Sacramento River water passing through the floodplain of the Yolo Bypass increased net primary productivity and the production of total, diatom, and green algal biomass and phytoplankton cells with high cellular carbon content. They further concluded that this biomass is an important additional source of organic carbon for the Delta food web.

2. Sloughs and Cuts

There are many sloughs and cuts in the area surrounding LIER. Siltation and reduced water depth in many of these areas have adversely affected navigation. Stands of emergent vegetation, particularly cattails and bulrush, border many of the cuts and sloughs around Liberty Island. Common invertebrates present in the sloughs and cuts include amphipods, shrimp, polychaetes (e.g., marine worms), and small bivalves (e.g., clams). Fish species commonly found in the area include Threadfin Shad, Striped Bass, Sacramento Splittail, Delta Smelt, Tule Perch, Sacramento Pikeminnow, White Catfish, Yellowfin Goby, Common Carp, and Largemouth Bass. In addition, the calm waters and shelter provided by cuts and sloughs attract early life stages and serve as rearing habitat for many fish species.

3. Shallow Channels and Shoals

The area between the shore and deep-water river channels is characterized by water less than 10 feet deep, mud, silt, and/or sand substrates, and by reduced tidal and river currents. Smaller channels are characterized by water less than 6 feet deep with silt and or mud substrates. Areas within the interior open waters of Liberty Island are characterized as shallow shoal-type habitat. Many areas adjacent to the shoals and channels are bordered by bulrush. Large numbers of small crustaceans, particularly Mysid Shrimp (*Mysis* sp.), Bay Shrimp (*Palaemon* sp. and *Cragon* sp.), and amphipods inhabit the shallow-water area in and adjacent to LIER. These invertebrates serve as an important food supply for young-of-the-year Striped Bass, juvenile Chinook Salmon, and other young fish. The shallow shoal areas serve as foraging and rearing habitat for most of the fish species found in the area. Other fish found inhabiting shallow channel and shoal areas include Threespine Stickleback, Tule Perch, Sacramento Pikeminnow, gobies, Inland Silverside, Sacramento Splittail, Delta Smelt, Common Carp, White Catfish, and Largemouth Bass.

4. Deep River Channels/Levee Breaches

River channels are characterized by water more than 10 feet deep and by strong tidal and river currents, typically 1.1 to 1.5 feet per second or more. The Sacramento River and Sacramento Deep Water Ship Channel adjacent to Liberty Island are also deep-water, maintained, navigational shipping channels with water depths ranging from 40 to 60 feet. In areas where water velocities are high, the river bottom is generally composed of sand. This is typical of the scour that occurs as a result of high tidal velocities within the deeper levee breaches and within the navigational shipping channels. Finer silt and other sediments occur in areas adjacent to main channels or levee breaches where water velocities are reduced. Invertebrates inhabiting these channels include bottom-dwelling polychaetes, amphipods, bivalves, and shrimp. These higher velocity areas also serve as habitat for larger predatory fish, such as Striped Bass, that prey on smaller fish as they pass in and out of levee breaches and higher velocity river channels.

5. Open Water

Open water within LIER supports submergent, emergent, and floating aquatic vegetation. In certain areas, however, open-water habitat lacks aquatic vegetation. The boundaries for vegetated areas in open water vary seasonally in their extent and presence, especially for free-floating vegetation such as water hyacinth. Open-water habitat serves as a migratory route for several species of anadromous fish whose adults swim upstream to their natal tributary rivers to spawn. Juveniles return downstream during their migration to the ocean. These fish species include Steelhead, Chinook Salmon, White and Green Sturgeon, Striped Bass, and American Shad. Open-water habitat within Liberty Island also supports populations of native and nonnative resident species including Largemouth Bass, Sacramento Pikeminnow, White Catfish, and Threadfin Shad.



Source: AECOM

6. Aquatic Vegetation

Aquatic vegetation consists of phytoplankton, submergent and emergent plants (generally rooted in substrates whose stems may or may not extend above the water surface), and free-floating plants. As water temperatures drop in late fall, rooted plants generally die back to their stem bases, to rhizomes, and/or to other overwintering vegetative structures (e.g., turions). Active growth increases stem biomass through the spring and summer and peaks in early fall. Most of these plant species reproduce through vegetative propagules such as turions, specialized buds, and stem fragments.

Light availability (which decreases with depth), turbidity, and shade can restrict submergent plants to relatively shallow areas. In the Liberty Island area, most submergent vegetation appears to be restricted to water less than 10 feet deep. Emergent plants are restricted to shallow water. Submergent and emergent species include coontail (*Ceratophyllum demersum*), common elodea (*Elodea canadensis*), waterbuttercup (*Ranunculus aquatilis*), pondweed (*Potamogeton* sp.), curlyleaf pondweed (*P. crispus*), Brazilian waterweed, parrotfeather (*Myriophyllum aquaticum*), Eurasian milfoil (*M. spicatum*), water primrose, cattails, and bulrushes.

Most free-floating plants also reproduce vegetatively. The growth rates and abundance of most species increase from late spring through summer and decrease from late fall through early spring. Many species also produce overwintering buds, spores, and seeds. Floating plants present in and around Liberty Island include duckweed (*Lemna* sp. and *Spirodela* sp.), mosquito fern (*Azolla* sp.), and water hyacinth.

a. Phytoplankton

Phytoplankton are small photosynthetic, vegetative organisms that form the base of the aquatic food web in the Delta. They are usually microscopic in size and consist of single cells or chains of cells. Major groups of phytoplankton in the Delta include diatoms, dinoflagellates, and cryptomonads (Herbold et al. 1992).

Phytoplankton abundance varies seasonally and from year to year. Typically, abundance is low during the winter, increases substantially from spring through summer, and decreases in the fall. Factors affecting the abundance of phytoplankton include seasonal patterns of solar radiation, seasonal water temperatures, availability of nutrients, water flow patterns and residence time, and salinity gradients. Turbidity, suspended sediments, and water depth also affect the availability of sunlight and abundance of

phytoplankton, particularly in the shallow open waters of Liberty Island, where sediment resuspension rates are high.

Consumption by animals also affects phytoplankton abundance. Consumption by benthic herbivores, including the introduced Asian Clam (*Potamocorbula amurensis*) and the Freshwater Clam (*Corbicula fluminea*), can be particularly influential (Lucas et al. 2002). For example, a substantial decrease in phytoplankton abundance has occurred in Suisun Bay since 1986; the decrease is associated with and may be a result of the introduction of the Asian Clam, and has raised concerns about effects of the Asian Clam on zooplankton abundance.

Seasonal and interannual patterns in phytoplankton abundance affect the abundance of other aquatic organisms. The seasonal abundance (standing crop) of copepods, cladocerans, and other open-water herbivores closely follows the seasonal cycle of phytoplankton abundance. Juvenile survival and growth of many fish species such as Striped Bass and Threadfin Shad largely depend on the quality and quantity of phytoplankton and/or associated zooplankton available as food.

b. Submergent and Emergent Aquatic Vegetation

Submergent vegetation within LIER's open-water and shallow-margin habitats is dominated by the nonnative species Brazilian waterweed. The species is native to warm temperate South and Central America in southeastern Brazil, Argentina, and Uruguay. Emergent vegetation throughout the area consists primarily of bulrush, cattails, and common reed. See Section III.A.2, "Marshes," for more information about submergent and emergent aquatic vegetation communities.

c. Floating Aquatic Vegetation

Large expanses of open water in and around Liberty Island are dominated by the invasive, nonnative species water primrose and, to a lesser extent, water hyacinth. Water primrose and water hyacinth wetlands are described in more detail in Section III.A.2, "Marshes," and their ecology and control are described in Section III.C.7 below.

7. Assessment of Invasive Plant Issues

Several problematic invasive species are present within LIER including water primrose, curlyleaf pondweed, Brazilian waterweed, parrotfeather, Eurasian milfoil, and water hyacinth. Hydrilla (*Hydrilla verticillata*) is not widespread at this time, but could become a problem in the future. The California Department of Boating and Waterways has programs designed to control water hyacinth and Brazilian waterweed in the Delta and serves as the lead state agency to cooperate with other state, local and federal agencies in controlling these species. The importance of the programs is evident in that water hyacinth and Brazilian waterweed have a negative impact on the Delta's ecosystem by displacing native plants, blocking light needed for photosynthesis, reducing DO in the water, and depositing silt and organic matter several times the normal rate. Water primrose, Brazilian waterweed, and water hyacinth currently dominate aquatic vegetation assemblages in and around LIER and the Delta. The ecology and control methods of each species are described below.

a. Water Primrose

Water primrose is an emergent aquatic herb that forms floating mats in shallow-margin habitats, rooting at the nodes and creeping or climbing on other plants on land (Hoch and Grewell 2012). It can reproduce sexually and vegetatively, and plant fragments often catch on watercraft and then spread to new areas. The dense growth of stems and fibrous roots impedes water movement, blocks the growth of native plants, reduces available habitat for waterfowl and fish, and ultimately changes the entire ecosystem.

There is some confusion as to which species of this nonnative genus occurs in California (Cal-IPC 2014). Control methods include herbicide application and/or mechanical removal, and have shown varied results. Rapid regrowth has been observed in shallow channels where complete removal of the plant was not possible, while deeper channels showed slower regrowth (Meisler 2008).

b. Brazilian Waterweed

Brazilian waterweed is a dioecious (i.e., separate male and female plants), rooted submergent plant with leafy stems that extend to the water surface (Hoshovsky and Anderson 2000; DiTomaso and Healy 2003). Only male Brazilian waterweed plants occur in California, and thus, they do not produce seeds. New plants are formed through stem fragmentation. New shoots are initiated from the stem bases during winter (Getsinger and Dillon 1984; Haramoto and Ikusima 1988). In the spring, these grow to the water surface and active growth continues through the fall. During active growth, new stems are initiated from the base of the shoot system, branches are formed off of existing shoots, and older shoots fragment or die back. The plants die back to the stem bases in late fall.

Brazilian waterweed grows in still, shallow water (<6 feet) in its native range. However, in California and other areas where it has been introduced, the species occurs across a wider range of depths (up to 23 feet deep) and frequently occurs in flowing water (Cook and Urmi-Konig 1984). Temperature, the availability of light, turbidity, and velocity strongly affect growth and survival. Growth of Brazilian waterweed diminishes substantially below 50°F to 59°F and above 77°F to 86°F (Barko and Smart 1981; Cook and Urmi-Konig 1984; DiTomaso and Healy 2003).

Shade reduces growth, but even at 95% shade, Brazilian waterweed can grow and develop a canopy (Barko and Smart 1981; Getsinger and Dillon 1984; Haramoto and Ikusima 1988). The species can grow in turbid water (Tanner et al. 1993), but turbidity reduces light availability, limiting growth in deeper water. The turbid water in and around Liberty Island likely restricts the growth of Brazilian waterweed to water depths less than 10 feet. Even at moderate velocities (>0.7 foot per second), water flow may fragment stems, causing reduced growth and survival (Schutten and Davy 2000). However, the growth form is very plastic and the species can adjust to its physical setting, thus reducing its propensity to fragment. Regardless, high water velocities, high winds, and wave action appear to limit the distribution and abundance of Brazilian waterweed in the north Delta (EDAW et al. 2005).

Other factors affecting Brazilian waterweed growth and survival in the Delta include salinity and exposure during low tides. Brazilian waterweed tolerates salinities as high as 10–12 parts per million for short durations (e.g., a few days). However, extended periods of increased salinity may cause large die-offs (EDAW et al. 2005). Brazilian waterweed cannot survive for long durations in areas dewatered during low tide; desiccation occurs fairly quickly when exposed to air.

Brazilian waterweed forms thick mats that obstruct boat passage, clog water intakes and aqueducts, trap sediments, crowd out native vegetation, and impede the migration of anadromous fish. The species may also adversely affect water quality by producing organic carbon. Brazilian waterweed also diminishes habitat quality for native species by displacing native flora and providing habitat for nonnative predatory fish species including Striped Bass, which feed on Delta Smelt and juvenile Chinook Salmon (Grimaldo et al. 2004; Brown 2003).

Brazilian waterweed is difficult to control. Mechanical removal does not eradicate the plant and produces large amounts of stem fragments that may establish elsewhere. In addition, vertebrates can be removed or otherwise harmed during mechanical removal of aquatic weeds (Booms 1999; DBW 2000). Herbicide applications are more effective; herbicides that may effectively control Brazilian waterweed and are permitted in California for application in aquatic habitats include diquat, acrolein, and fluridone. However, herbicide application is not without problems. Dense stands of aquatic plants and moving water both complicate and tend to reduce the success of herbicide applications. Furthermore, the site may be continually recolonized by surviving plants and by stem fragments from upstream sources. Water-level drawdowns to expose and desiccate plants have effectively controlled Eurasian milfoil (Poovey and Kay 1998) and may be an effective control method for Brazilian waterweed.

c. Water Hyacinth

Water hyacinth forms dense, interconnected mats that drift along the water's surface. Water hyacinth reproduces vegetatively from short lateral stems called stolons and from seeds. Water hyacinth is one of the world's most problematic weeds (Godfrey 2000). It is a floating plant that can survive on moist substrates in marshes and along channels, and it has thick, waxy leaves that are held upright above the water surface on bulbous, air-filled stalks (Bossard et al. 2000). In the north Delta, water hyacinth grows year round (albeit slowly in winter, and frost can damage leaves and stems), and it reproduces throughout the summer and fall (Penfound and Earle 1948; Owens and Madsen 1995). Seeds may remain dormant for years or may germinate in spring on exposed sediments along shorelines or on floating mats of vegetation (Penfound and Earle 1948; DiTomaso and Healy 2003). Growth rates can be extremely high during warm weather and can result in a doubling of plant biomass in less than a week (DiTomaso and Healy 2003). Throughout the spring and summer, mats of water hyacinth may expand laterally at more than 2 feet per month (Penfound and Earle 1948). As a result, dense mats of water hyacinth can clog small or still channels, forming a continuous layer of vegetation that extends nearly a meter below the surface (i.e., the depth to which its roots extend). This has occurred in some channels in the Liberty Island area.

Mechanical and biological controls have been largely unsuccessful. Repeated mechanical harvesting, however, can reduce and maintain biomass at a lower level; the process can remove or otherwise harm vertebrates (Booms 1999; DBW 2000). Water level drawdowns can cause desiccation and death of water hyacinth, but it can survive when left exposed on moist substrates; therefore, exposure to air has to be prolonged to ensure desiccation of substrates.

D. Fish, Other Aquatic Species, and Related Processes

This section summarizes the assemblage of fish and other aquatic species known to occur or having the potential to occur within LIER. The primary sources of information used to determine the presence or potential presence of species included peer-reviewed literature, publicly available theses, USFWS and

CDFW published fish sampling data, unpublished CDFW fish sampling data, a USFWS online-generated list, and review of the CNDDDB (2013).

The LIER is a dynamic ecosystem at the southern or downstream end of the Yolo Bypass floodplain and hosts a variety of habitat types. The synergy among habitat types, physical processes, and hydrology creates high-quality aquatic habitat for native fish species and has particularly high biological value to special-status species such as Chinook Salmon, Steelhead, Delta Smelt, Longfin Smelt, and Green Sturgeon (Lehman et al. 2010; McLain and Castillo 2009; Sommer and Mejia 2013). Recent and ongoing studies suggest the habitat within and adjacent to LIER provides hydrologic conditions unique to the Delta that is critical to long-term conservation of native fish resources. In particular, high year-round turbidities, the location within a fertile floodplain, and a robust food web make LIER highly beneficial to Delta fish resources. For these reasons, CDFW and other resource agencies have identified LIER as critical to native and special-status species in the Delta and as a high-priority land unit for management and restoration efforts.

Many authors have characterized LIER and the adjacent areas as having high turbidity (Morgan-King and Schoellhamer 2013; Sommer and Mejia 2013). A positive correlation exists between turbidity and benefits to native fish resources (Merz et al. 2011; Sommer et al. 2011; Sommer and Mejia 2013). High turbidities are associated with predator avoidance and higher feeding efficiencies in both adult and juvenile life stages, which translate into higher survival (Gregory and Levings 1998; Baskerville-Bridges et al. 2004; Sommer and Mejia 2013).

The sources of turbidity in natural waters are suspended and colloidal material, the effect of which is to disturb clearness and diminish the penetration of light. Turbidity typically is caused by phytoplankton, zooplankton, organic and inorganic detritus, silica and other sands, clay or silt, and substances such as zinc, iron, and manganese.

Organic and inorganic sediments are an important component to a healthy and functional inland estuary such as LIER. Several watercourses converge in this area to create a freshwater estuary and bring with them a high sediment load. The primary sediment sources are the Sacramento River, the Yolo Bypass, and Cache Slough (Morgan-King and Schoellhamer 2013), and much of the sediment is transported in winter and spring during large pulse flows following precipitation and snowmelt events (Lehman et al. 2008). A transition zone develops at the convergence of rivers and estuaries where hydrologic and physical processes affect sediment transport processes (Wright and Schoellhamer 2005). The primary drivers of these important processes are tidal characteristics and wind and wave interactions (Uncles and Stephens 2010; Sanford et al. 2001). These processes effectively trap sediment and maintain high turbidity year-round in LIER, particularly during low-flow periods, which occur during much of the annual flow cycle. Excluding the winter flood pulse, the highest turbidities occur during late spring and summer, when wind speed is the greatest (Morgan-King and Schoellhamer 2013). Juvenile fish utilize LIER during this time to take advantage of the increased food resources, which leads to greater growth and survival (Sommer et al. 2004; Lehman et al. 2008).

The low-gradient and wide floodplain habitat within the Yolo Bypass and LIER, coupled with the estuarine habitat within and around LIER, plays a critical role in the life history of many native species,

including special-status species such as Delta Smelt, Sacramento Splittail, Longfin Smelt, Green Sturgeon, Steelhead, and Chinook Salmon (Schemel et al. 2004; DWR 2009; Sommer and Mejia 2013).

The importance of floodplain habitat to native fish species has been demonstrated by many authors (Brown and Hartman 1988; Sommer et al. 1997; Sommer et al. 2001b; Jeffres et al. 2008). Bayley (1991) reported a positive correlation between fish yields in watersheds and water surface area in floodplains. Floodplains can be particularly beneficial to juvenile anadromous salmonids, which use them for foraging and refuge during their downstream migrations (Brown and Hartman 1988).

Downstream migration of juvenile salmonids during high-flow events in winter is more passive than active (Kjelson et al. 1981), and the salmonids are essentially entrained in the water column until they encounter slower water velocities and active swimming is possible (Jeffres et al. 2008). Sommer et al. (2001b) and Jeffres et al. (2008) reported high growth rates for juvenile Chinook Salmon rearing in floodplain habitat; both authors suggested that increased growth in the floodplain habitat was the result of higher water temperatures and higher productivity relative to the adjacent main-stem river habitat; and Jeffres et al. (2008) hypothesized that floodplain habitat is important for increased growth of juvenile Chinook Salmon throughout a variety of flow conditions.

Based on these studies, Chinook Salmon that rear in floodplains and estuarine habitat like those associated with LIER will return to the ocean as larger and fitter juveniles. Studies show that survival to adulthood increases when juveniles are larger at ocean entry (Unwin 1997; Galat and Zweimuller 2001). Jeffres et al. (2008) also concludes that restoring floodplain habitats in Central California should have major benefits to Chinook Salmon populations.

A key attribute of floodplains is their potential for higher productivity compared to the river channel (Junk et al. 1989; Schemel et al. 2004). Net primary productivity is high in floodplains, and phytoplankton production enhanced by river floodplain interactions form the base of aquatic food webs (Schemel et al. 2004; Lehman et al. 2010). High primary production contributes to robust food webs, which can benefit fish resources by resulting in efficient bottom-up energy transfer (Sommer et al. 2001; Lehman et al. 2010). Several studies have reported high primary production in the Yolo Bypass, which drains directly into LIER (Sommer et al. 2001b; Lehman et al. 2008; Lehman et al. 2010).

Net primary productivity is high in floodplains where a high ratio of euphotic zone depth to mixing zone depth reduces the loss of gross primary productivity to respiration (Heip et al. 1995; Lehman et al. 2008). Shallow water depth and long residence time in floodplains also facilitates sedimentation of suspended solids, thus increasing the total irradiance available for the growth of phytoplankton in the water column (Tockner et al. 1999; Lehman et al. 2008). Long residence time in floodplains increases the availability of phytoplankton biomass to the food web by accumulating phytoplankton cells, particularly during the drain phase of the flood pulse cycle (Kiss 1987; Lewis 1988; Van den Brink et al. 1993; Hein et al. 1999).

Phytoplankton biomass in LIER tends to be low in winter during high pulse flows (Schemel et al. 2004). After floodwaters recede in spring and summer, the biomass of phytoplankton in LIER increases as water depth decreases, and water temperature and surface area to volume increase. The phytoplankton blooms benefit higher trophic levels. The diatom, green algae, and chrysophyte phytoplankton that grow in Liberty Island are excellent food resources for local mesozooplankton because they are within the

optimum feeding-size range of the calanoid copepods *Eurytemora affinis* and *Pseudodiaptomus forbesii*, important mesozooplankton food for juvenile fish (Lehman 2000; Kimmerer 2004; Lehman et al. 2010). The abundance of juvenile native fish utilizing LIER in the spring and summer is attributed to the presence of abundant phytoplankton and zooplankton food resources (Sommer et al. 2004; Lehman et al. 2008). Primary production export from the Yolo Bypass also benefits Delta fish resources at a regional scale.

Declines in fishes and other aquatic species in the lower Sacramento River and downstream in the San Francisco Estuary have been linked to reduced production and abundance of phytoplankton and to habitat alterations, including drastic reductions in floodplain and shallow-water habitats (Bennett and Moyle 1996; Kimmerer and Orsi 1996; Jassby et al. 2002; Schemel et al. 2004). Based on the observation that phytoplankton biomass peaked during drainage events in the Yolo Bypass, Schemel et al. (2004) suggested that phytoplankton production in the floodplain and biomass transport to downstream locations would be higher in years with multiple inundation and draining sequences.

The importance of phytoplankton, primary production, and floodplain habitat to fish resources were highlighted by the following management recommendations from Lehman et al. (2008):

1. Divert water into the floodplains early in the spring to enhance net primary productivity. Early flooding may also enhance the growth of diatom and green algae with wide spherical diameters and high carbon content that respire less at low light and water temperature than other phytoplankton. Early flooding may be critical for production of native juvenile fish species that occur earlier in the floodplain (i.e., Yolo Bypass) than nonnative species and may have evolved to take advantage of high net primary productivity in early spring.
2. Extend the duration of the draining phase in the floodplain (i.e., Yolo Bypass). Increasing the duration of the draining phase allows total, diatom, and green algal biomass to accumulate. An accumulation of phytoplankton biomass facilitates the efficient bottom-up transfer of energy through the food web by aggregating food resources of optimum size and high carbon content for use by aquatic organisms. Most fish species remain in the floodplain for only a short period, and aggregation of food resources may reduce the energy needed for fish to obtain food as they move through the floodplain.
3. Frequently release small discharges of river water through the floodplain (i.e., Yolo Bypass) to enhance the phytoplankton carbon load to the estuary downstream. Regular and small discharges would move this accumulated phytoplankton biomass to the estuary downstream where it can support bottom-up food web production.
4. Manage the timing of primary productivity in the floodplain (i.e., Yolo Bypass) to meet the resource needs of aquatic organisms. The successful use of floodplains as a management tool to enhance fishery production will depend on the ability to provide the quantity and quality of food needed by aquatic organisms at different life stages. This requires a thorough understanding of the high-frequency spatial and temporal variability of food web dynamics in floodplains.

1. Delta Regional Ecosystem Restoration Implementation Plan: Delta Specific Conceptual Models

A formalized approach to developing conceptual models for the Delta has been developed under the auspices of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP), a component of the Ecosystem Restoration Program (ERP). These models will be used to evaluate proposed restoration projects in LIER. CDFW is ERP's state implementing agency, with the primary role of funding and managing grant projects in the ERP focus area to address ERP goals and objectives through coordination and collaboration with other local, state, and federal agencies. The fundamental approach to modeling employed in this effort is a driver-linkage-outcome approach that uses deterministic models of ecosystem components linked together with cause-and-effect relationships of interacting variables and outcomes.

The DRERIP conceptual models were developed to show the characteristics and dynamics of the Delta ecosystem, qualitatively predict ecosystem and species response to specific changes in ecosystem attributes, and provide the science-based information needed to determine whether a restoration action would result in or contribute to a desired management outcome. The models were designed to provide information for use in structured assessments of proposed restoration actions to inform sound public policy. Development and use of the models is adaptive; the models will be updated and refined as new information is developed and the need for modifications is identified during use.

The suite of DRERIP models includes models for ecosystem elements and for species life history. The ecosystem-based models are grouped into three broad elements: processes (transport, sediment, organic carbon, and aquatic food web), habitats (fish habitat linkages, tidal marsh, riparian vegetation, aquatic vegetation, and floodplains), and stressors (chemical stressors, pyrethroids, selenium, mercury, and DO). A life-history model was developed for eight species: Delta Smelt, Longfin Smelt, Chinook Salmon, Steelhead, Sacramento Splittail, White Sturgeon, Green Sturgeon, and Potamocorbula.

2. Common Fish Species

LIER provides vital spawning, rearing, and migratory habitat for a diverse assemblage of native and nonnative fish species (Table 3-1) (Moyle 2002; Sommer et al. 2001a, 2001b). Native and nonnative species that use LIER can be separated into three types: anadromous, resident, and migratory resident. Juveniles of anadromous species spend time rearing in freshwater habitat before migrating to the ocean; adults reside in the ocean before returning to freshwater to spawn. Each anadromous species uses LIER during specific months of the year. Resident species occupy freshwater habitat throughout their life cycle and exhibit both migratory and nonmigratory behavior. Therefore, not all resident species are expected to occur within LIER year round.

As shown in Table 3-1, the following species occur or have the potential to occur within LIER:

- ▶ *Native anadromous species*—four runs of Chinook Salmon, Steelhead, Green and White Sturgeon, and Pacific Lamprey
- ▶ *Native resident species*—Delta Smelt, Sacramento Pikeminnow, Sacramento Splittail, Sacramento Sucker, Hardhead, and Longfin Smelt (Sacramento Splittail and Delta Smelt also show a strong migratory life history pattern in some parts of the estuary) (Moyle et al. 2004; Sommer et al. 2011)

- ▶ *Nonnative anadromous species*—Striped Bass and American Shad
- ▶ *Nonnative resident species*—Largemouth Bass, Smallmouth Bass, White and Black Crappie, Channel Catfish, White Catfish, Brown Bullhead, Bluegill, Green Sunfish, and Golden Shiner

Common Name	Scientific Name	Common Name	Scientific Name
American Shad	<i>Alosa sapidissima</i>	Red Shiner	<i>Cyprinella lutrensis</i>
Bigscale Logperch	<i>Percina macrolepida</i>	Redear Sunfish	<i>Lepomis microlophus</i>
Black Bullhead	<i>Ameiurus melas</i>	River Lamprey*	<i>Lampetra ayersii</i>
Black Crappie	<i>Pomoxis nigromaculatus</i>	Sacramento Blackfish*	<i>Orthodon microlepidotus</i>
Bluegill	<i>Lepomis macrochirus</i>	Sacramento Perch*	<i>Archoplites interruptus</i>
Brown Bullhead	<i>Ameiurus nebulosus</i>	Sacramento Pikeminnow*	<i>Ptychocheilus grandis</i>
California Roach*	<i>Hesperoleucus symmetricus</i>	Sacramento Splittail*	<i>Pogonichthys macrolepidotus</i>
Channel Catfish	<i>Ictalurus punctatus</i>	Sacramento Sucker*	<i>Catostomus occidentalis</i>
Chinook Salmon*	<i>Oncorhynchus tshawytscha</i>	Shimofuri Goby	<i>Tridentiger bifasciatus</i>
Common Carp	<i>Cyprinus carpio</i>	Smallmouth Bass	<i>Micropterus salmoides</i>
Delta Smelt*	<i>Hypomesus transpacificus</i>	Spotted Bass	<i>Micropterus punctulatus</i>
Fathead Minnow	<i>Pimephales promelas</i>	Steelhead*	<i>Oncorhynchus mykiss</i>
Golden Shiner	<i>Notemigonus crysoleucas</i>	Striped Bass	<i>Morone saxatilis</i>
Goldfish	<i>Carassius auratus</i>	Threadfin Shad	<i>Dorosoma petenense</i>
Green Sturgeon*	<i>Acipenser medirostris</i>	Three-spined Stickleback*	<i>Gasterosteus aculeatus</i>
Green Sunfish	<i>Lepomis cyanellus</i>	Tule Perch*	<i>Hysterocarpus traski</i>
Hardhead*	<i>Mylopharodon conocephalus</i>	Wakasagi	<i>Hypomesus nipponensis</i>
Hitch*	<i>Lavinia exilicauda</i>	Warmouth	<i>Chaenobryttus gulosus</i>
Inland Silverside	<i>Menidia beryllina</i>	Western Mosquitofish	<i>Gambusia affinis</i>
Largemouth Bass	<i>Micropterus salmoides</i>	White Catfish	<i>Ameiurus catus</i>
Longfin Smelt*	<i>Spirinchus thaleichthys</i>	White Crappie	<i>Pomoxis annularis</i>
Pacific Lamprey*	<i>Lampetra tridentata</i>	White Sturgeon*	<i>Acipenser transmontanus</i>
Pacific Staghorn Sculpin*	<i>Leptocottus armatus</i>	Yellowfin Goby	<i>Acanthogobius flavimanus</i>
Prickly Sculpin*	<i>Cottus asper</i>		

Note: *Native species
Sources: Moyle 2002; Sommer et al. 2001; CDFW; USFWS online generated list; compiled by AECOM in 2014

Throughout LIER, several factors influence the use of aquatic habitats by various fish species: variations in permanent habitat conditions; seasonal inundation of the floodplain (i.e., the Yolo Bypass); and the habitat requirements, life history, daily and seasonal movements, and behavior of each species. Altered flow regimes, flood control, and floodwater conveyance activities along much of the Yolo Bypass have affected available habitat and ecological processes. (See Section II.I, “Geomorphology, Hydrology, Water Quality, and Climate,” for additional information about physical processes).

Historically, seasonal flooding covered various lands adjacent to the Sacramento River and its tributaries, providing important spawning and rearing habitat for many fish species, such as Sacramento Splittail,

Chinook Salmon, and Steelhead. Construction of levees and flood control structures (i.e., Fremont Weir and Sacramento Weir) has reduced the overall amount of seasonal flooding and shallow-water habitat in the Sacramento River system. In the winter and spring, however, agricultural fields and wetland habitats throughout LIER and surrounding areas often flood during high flows and provide spawning and rearing habitat for many species (Sommer et al. 2001, 2003).

3. Sport Fish Species

Sport fish species are an important component of resource management throughout the Delta, including LIER, and some of these species contribute to local and regional economies. With the exception of White Sturgeon, the primary sport fish species present in and around Liberty Island are nonnative.

Striped Bass, White Sturgeon, White Catfish, Channel Catfish, Largemouth Bass, and various species of sunfish (family *Centrarchidae*) are among the most common sport fish species targeted by recreational anglers in and around Liberty Island. Although the recreational fishery for these species in the Delta is poorly documented, it is likely the largest sport fishery in central California in terms of effort and numbers of fish caught. Factors that may be limiting to these species in the Delta include degradation and loss of existing aquatic habitat as a result of agricultural practices, water use projects, channel dredging, levee stabilization, and increased channel velocities (Moyle 2002).

4. Sensitive Fish Habitat

Various laws protect economically and recreationally important fish species and their habitat. Critical habitat is protected under the federal Endangered Species Act (ESA). A designation of critical habitat provides additional protective measures for special-status fish species. Essential fish habitat (EFH) falls under the Magnuson-Stevens Act. A designation of EFH provides additional protection for fish species of economic importance. Each type of habitat is described below.

a. Critical Habitat

ESA requires the federal government to designate critical habitat for all listed species. Critical habitat is designated by determining the conservation value of particular areas and balancing the benefits of designation against its impacts (e.g., economic, national security). The proposed designation then goes through a period of public comment before the final rule is published and critical habitat is designated. Critical habitat is defined as:

- ▶ specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and
- ▶ specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.

Areas within and around LIER have been designated as critical habitat for Delta Smelt, Central Valley Spring-run Chinook Salmon Evolutionarily Significant Unit (ESU), Sacramento River Winter-run Chinook Salmon ESU, and Central Valley Steelhead Distinct Population Segment (DPS).

b. Essential Fish Habitat

The Magnuson-Stevens Act defines EFH as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. The Sustainable Fisheries Act of 1996, which amended the Magnuson-Stevens Act, established new requirements for EFH descriptions in fishery management plans (FMPs). The Sustainable Fisheries Act also requires federal agencies to consult with NMFS regarding effects on EFH for those species managed under FMPs.

Three FMPs, each managed by the Pacific Fishery Management Council, apply to Northern California:

- ▶ The Pacific Coast Coastal Pelagic Species FMP manages Northern Anchovy, Pacific Sardine, Pacific (Chub) Mackerel, Jack Mackerel, and Market Squid.
- ▶ The Pacific Coast Salmon FMP manages all anadromous salmonids present in California.
- ▶ The Pacific Coast Groundfish FMP manages more than 90 species that occur primarily in marine environments.

The following EFH components must be adequate for spawning, rearing, and migration: substrate composition; water quality; water quantity, depth, and velocity; channel gradient and stability; food; cover and habitat complexity; space; access and passage; and habitat connectivity.

Habitat within and surrounding LIER is considered EFH under the Pacific Coast Coastal Pelagic Species FMP and the Pacific Coast Salmon FMP.

5. Other Aquatic Organisms

a. Zooplankton

Zooplankton are primary consumers and are at the center of the estuarine food web; therefore, they are important not only to the lower trophic levels upon which they feed (e.g., phytoplankton, detritus, other zooplankton), but also to the higher trophic levels for which they serve as prey (e.g., fish and macroinvertebrates). Zooplankton include herbivores that forage mainly on phytoplankton, detritivores that feed on detritus and microbes, carnivores that feed on other zooplankton, and omnivores that feed on a variety of food sources. Zooplankton are primarily suspension feeders and include macroinvertebrates such as calanoid copepods and cladocerans, and eggs and larva from fish, crabs, and shrimp (Thorp and Covich 2009).

The abundance and distribution of zooplankton in the Delta vary substantially in response to seasonal cycles and environmental factors such as salinity gradients, water flow, and tidal currents. Seasonal variations in abundance are determined by water temperature, photoperiod, seasonal cycles of phytoplankton, and Delta inflow and outflow (Kimmerer 2002a, 2002b). Biomass tends to be highest in the Delta during spring and early summer. Salinity is one of the major factors affecting the distribution of zooplankton, as evidenced by the changes in species composition that occur in various regions of the Delta. In the low-salinity conditions within the Delta, the primary zooplankton are calanoid copepods (*Eurytemora affinis* and *Acartia clausi*) and Opossum Shrimp (*Neomysis mercedis*), whereas Cladocerans (*Daphnia pulex* and *D. parvula*) are the primary zooplankton in freshwater conditions.

The distribution and abundance of zooplankton are substantially affected by food availability. Physical and chemical conditions that promote phytoplankton productivity (e.g., warm temperatures, high solar radiation, high nutrients, slow-moving water, low turbidity and suspended-sediment concentrations, shallow waters) indirectly promote zooplankton productivity. Water body configuration and bathymetry also indirectly affect phytoplankton productivity, and therefore, zooplankton productivity. The shallow areas of Suisun Bay are highly productive, as are many of the shallow slow-moving areas farther upstream in the Delta.

The location of the salt water/freshwater mixing zone during the spring also influences phytoplankton and zooplankton abundance in the Delta (Orsi and Mecum 1986). Throughout the Delta, plankton abundance is highest when the mixing zone is located in the shallow portions of Suisun Bay, and abundance decreases when the mixing zone is upstream in the deeper channels of the lower Sacramento and lower San Joaquin Rivers; this occurs during drought years when Delta outflow is reduced.

The abundance of several important zooplankton species inhabiting the Delta has decreased substantially over the past several decades. Dramatic changes occurred with the introduction of *Corbicula fluminea* in the mid to late 1940s (Ingram 1959; Brown et al. 2007) and *Potamocorbula amurensis* in 1986 (Kimmerer and Orsi 1996; Carlton et al. 1990); both are invasive clams. The clams are associated with changes in zooplankton community structure primarily because they consume diatoms, copepods, and other planktonic invertebrates through filtration (Carlton et al. 1990; Brown et al. 2007). The copepod *Pseudodiaptomus forbesi*, *Acanthomysis mysids*, and various amphipods became abundant in regions formerly dominated by the copepod *Eurytemora affinis* shortly after establishment of the invasive clams (Kimmerer and Orsi 1996; Kimmerer et al. 1999).

b. Benthic and Epibenthic Macroinvertebrates

Adult benthic macroinvertebrates typically live within the top 12 inches of sediment on the floor of the Delta. Adult epibenthic macroinvertebrates typically live on the sediment surface. However, larvae of many benthic and epibenthic invertebrates live in the open water as components of the planktonic drift community. Benthic and epibenthic species in the north Delta include Bay Shrimp (*Crangon franciscorum*), Opossum Shrimp, amphipods (*Americorophium stimpsoni*, *Gammarus daiberi*), polychaetes (*Laonome* sp.) and oligochaetes (*Varichaetadrilus angustipenis*), and clams (*Potamocorbula amurensis*, *Corbicula fluminea*).

DWR has sampled the Delta benthic community since 1975 (DWR 2012b). The benthic monitoring program collects a large number of organisms but a relatively small number of species. Of the 211 species collected in 2011, 10 represented 81% of all organisms collected and included the following species (DWR 2012b):

- ▶ Amphipods (phylum Arthropoda):
 - *Ampelisca abdita*
 - *Americorophium spinicorne*
 - *Americorophium stimpsoni*
 - *Corophium alienense*
 - *Gammarus daiberi*

- ▶ Asian Clams, phylum Mollusca
 - *Potamocorbula* (formerly *Corbula*) *amurensis* (Huber 2010)
 - *Corbicula fluminea*
- ▶ Sabellid Polychaete, phylum Annelida
 - *Manayunkia speciosa*
- ▶ Tubificid worms, phylum Annelida
 - *Limnodrilus hoffmeisteri*
 - *Varichaetadrilus angustipenis*

Of these 10 dominant species, *Potamocorbula amurensis* and *Ampelisca abdita* represent macrofauna that typically inhabit higher saline environments and were collected in San Pablo Bay, Suisun Bay, and Grizzly Bay (DWR 2012b). *Corophium alienense*, *Americorophium spinicorne*, and *Americorophium stimpsoni* tolerate a wider range of salinity. These species were collected both in the higher saline western sampling sites and the more brackish-to-freshwater eastern sampling sites (DWR 2012b). *Gammarus daiberi*, *Manayunkia speciosa*, *Limnodrilus hoffmeisteri*, *Varichaetadrilus angustipenis*, and *Corbicula fluminea* are predominantly freshwater species and were collected at sampling sites east of Suisun Bay (DWR 2012b). All organisms collected during the 2011 sampling fell into nine phyla: Cnidaria (hydras, sea anemones), Chordata (tunicate), Phoronida (phoronids), Platyhelminthes (flatworms), Nemertea (ribbon worms), Nematoda (roundworms), Annelida (segmented worms), Arthropoda (e.g., aquatic insects, amphipods, isopods, shrimp, crabs, mites), and Mollusca (clams, snails) (DWR 2012). Annelida, Arthropoda, and Mollusca constituted 98% of the organisms collected during the 2011 sampling period (DWR 2012b).

Many of the more common benthic species present in the Delta, such as *Corbula amurensis*, *Corbicula fluminea*, and *Potamocorbula amurensis*, are nonnative and were transported and introduced through ballast water discharge from commercial ships or on the shells of oysters brought from the East Coast for commercial farming in the late 19th century (Carlton 1979). Today, more than 40% of the benthic community's species assemblage is nonnative (Carlton 1979; Cohen 2000). For example, all but two of the benthic mollusks (i.e., oysters and clams) are introduced. Many introduced species serve ecological functions similar to those of displaced native species; however, some nonnative species may be detrimental to the Delta's aquatic ecosystem.

The composition and abundance of the benthic and epibenthic macroinvertebrate community is influenced by a variety of physical and water quality conditions including flow velocities, substrate characteristics, and salinity gradients (Thompson et al. 2000), as well as the volume of flow through the Delta, local runoff, and pollution (Nichols and Pamatmat 1988; Herbold et al. 1992). Benthic communities are also influenced by disturbances such as dredging and filling activities. Sediment grain-size distributions show that sandy sediments persist in areas of high current velocities such as channels (Rubin and McCulloch 1979). Finer sediments settle in areas of lower flow velocities such as shoals, small channels, and shallow open-water habitat in flooded islands like Liberty Island (Krone 1979). Benthic and epibenthic invertebrates generally are most abundant in areas characterized by low flow velocities, fine-grained

sediments, and relatively stable benthic environments (i.e., little sediment resuspension, movement, or disturbance, and slow rates of accretion and depletion of sediments). Benthic and epibenthic macroinvertebrate communities show reduced species diversity and abundance in deeper water channels characterized by high flow velocities, coarse substrates, and substantial daily, seasonal, or interannual substrate movement, accretion, and depletion (Krone 1979; Rubin and McCulloch 1979).

Reproduction patterns and the availability of colonists can have a profound effect on benthic community recovery following disturbance (Hanson et al. 2004). Polychaete worms, bivalve mollusks, crabs, and shrimp recruit by (1) planktonic larval stages that are capable of dispersing over large geographic areas, or (2) larger crawl-away larvae that remain near the bottom and close to adult colonies (Hanson et al. 2004). Amphipods and other similar crustaceans brood their young until they are small juveniles capable of dispersing, much like crawl-away larvae. In some species, adults are the dispersal stage and the first colonists after disturbance. Benthic macroinvertebrates typically have high fecundity and dispersal mechanisms that facilitate colonization.

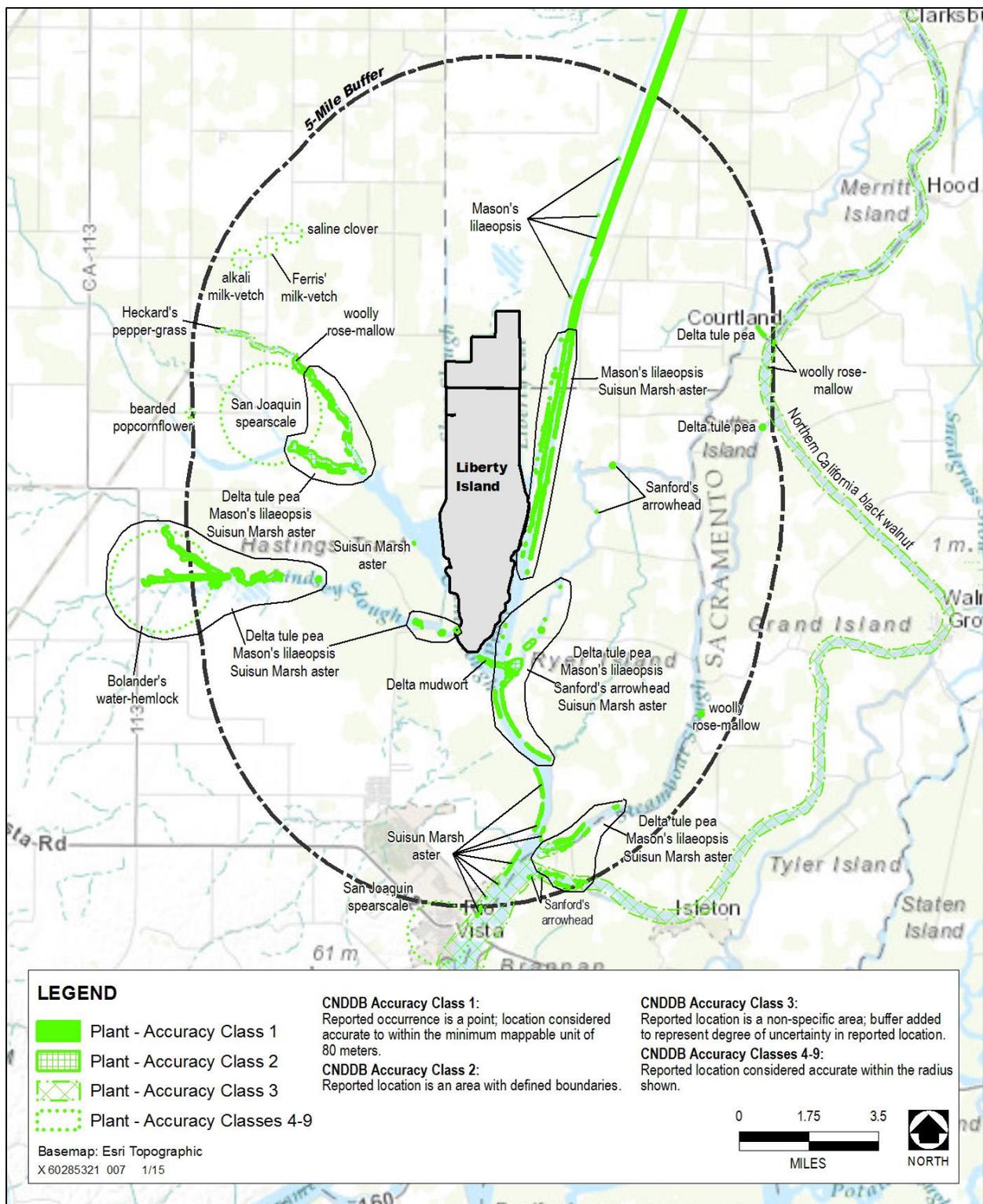
E. Rare, Threatened, and Endangered Species

Special-status plant and wildlife species are legally protected or are otherwise considered sensitive by federal, state, or local resource conservation agencies and organizations. Special-status plants and wildlife species known or with potential to occur within LIER are discussed separately below.

1. Special-Status Plant Species

Special-status plants are those plants listed as threatened or endangered under the federal ESA or the California Endangered Species Act (CESA). In addition to plants listed under ESA and CESA, the California Native Plant Society (CNPS) and CNDDDB include rare plants jointly listed by CNPS and CDFW as “rare,” “threatened,” or “endangered.” These plants are categorized by their “California rare plant ranks” (CRPRs) (formerly referred to as “CNPS lists”), as defined in Table 3-2. Plants ranked as CRPR 1A, 1B, 2A, or 2B may qualify as endangered, rare, or threatened species within the definition presented by Section 15380 of the State CEQA Guidelines. CDFW recommends, and local governments may require, that CEQA projects address CRPR 1A, 1B, and 2 species. In general, CRPR 3 and 4 species do not meet the definition of endangered, rare, or threatened pursuant to State CEQA Guidelines Section 15380; however, the lead agency may evaluate these species on a case-by-case basis to determine significance criteria under CEQA.

The Delta is home to many special-status plant species, some of which are endemic to this region. A list of special-status plant species potentially present within LIER was developed from searches of CDFW’s CNDDDB (2013), the CNPS on-line Inventory of Rare and Endangered Plants of California (CNPS 2013), and USFWS’s endangered species list generator (USFWS 2013), and a review of the Jepson Interchange (UC Berkeley 2013). CNDDDB data reviewed included previously documented special-status plants within a 5-mile radius of the Island (Exhibit 3-2). The CNPS and USFWS data reviewed included plants that either are known to occur or have potential to occur in any of the surrounding nine USGS 7.5-minute quadrangle maps.



Source: CNDDB 2013, adapted by AECOM in 2014

Exhibit 3-2. CNDDB Plant Occurrences within 5 Miles of Liberty Island

These database searches resulted in a list of special-status plant species that are known to occur or have potential to occur within LIER (Table 3-2). Incidental observations of special-status plants were made by AECOM botanists Ellen Pimentel and Charles Battaglia during a site visit on September 11, 2013. No protocol-level special-status plant surveys have been conducted within LIER.

As described below, special-status plant species with potential to occur within LIER are associated with freshwater marsh, banks of sloughs, riparian forest and scrub, and ponds. Special-status plants that are not expected to occur are listed in Table 3-2 but are not described in the text below. Partially barren depressions with common salt-tolerant plants were observed on the upland areas on the northernmost “stair-step” portion of LIER; however, these areas do not contain hardpan clay or alkaline soils and are not vernal pools. Therefore, the vernal pool– and alkaline-associated plant species listed in Table 3-2 are not expected to occur and are not described.

Watershield

Watershield has a CRPR of 2B.3 and is found in the North Coast Ranges, Sacramento Valley, Cascade Range, Sierra Nevada, and Modoc Plateau of California; it is also known from several other parts of eastern North America, Central America, South America, Africa, eastern Asia, and eastern Australia (CNPS 2013; Rosatti 2012). Watershield is a perennial aquatic herb in the watershield family (Cabombaceae) that grows from 30 to 200 cm long (Rosatti 2012). It blooms from April to October, but may be identified outside of the bloom period by its floating leaves and thick mucilage covering the submersed plant parts (Rosatti 2012). Watershield grows in freshwater marshes, ponds, and slow streams (CNPS 2013; Rosatti 2012). Threats to the species include hydrological changes to its habitat, and possibly invasive aquatic species (CNDDDB 2013).

There are no records of watershield within 5 miles of LIER, and many California occurrences are historical (CNDDDB 2013; CNPS 2013), but there is potentially suitable habitat in the freshwater marshes and ponds.

Bristly Sedge

Bristly sedge has a CRPR of 2B.1 and is found in the southern inner North Coast Ranges, central high Cascade Range, western Modoc Plateau, southern Sacramento Valley, and Bodega Bay area (CNDDDB 2013; CNPS 2013; Zika et al. 2012). Bristly sedge is presumed to have been extirpated from the San Joaquin Valley, San Francisco Bay area, and San Bernardino County; however, it is found in many places throughout North America, although it is listed as sensitive or endangered in some other states (CNPS 2013; Zika et al. 2012). Bristly sedge is a perennial herb of the sedge family (*Cyperaceae*) that grows from 50 to 100 cm tall and blooms from May to September (Zika et al. 2012; CNPS 2013). It grows on lake edges, in marshes and swamps, along banks of sloughs and ditches, and in wet places in coastal prairie and valley and foothill grassland (CNDDDB 2013; CNPS 2013). Threats to bristly sedge include drainage of its marshy habitats, competition with and treatment of nonnative plants, and road maintenance (CNDDDB 2013; CNPS 2013).

Bristly sedge has not been documented within 5 miles of LIER, but suitable habitat is present throughout Liberty Island.

Table 3-2. Special-Status Plants Known from or with Potential to Occur within Liberty Island Ecological Reserve					
Species	Status ¹			Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	CRPR		
Ferris' milkvetch <i>Astragalus tener</i> var. <i>ferrisiae</i>	–	–	1B.1	Vernally mesic meadows and seeps, subalkaline flats in valley and foothill grassland on overflow land in the Central Valley; usually seen on dry, adobe clay soil, 5 to 75 m in elevation. Blooms April–May.	Not expected to occur. No adobe clay soils present within LIER. Nearby occurrence is historical.
Alkali milkvetch <i>Astragalus tener</i> var. <i>tener</i>	–	–	1B.2	Alkaline areas including playas, vernal pools, and valley and foothill grassland underlain by adobe clay soils; from 0 to 60 m in elevation. Blooms March–June.	Not expected to occur. No adobe clay soils present within LIER. Nearby occurrence is historical.
Heartscale <i>Atriplex cordulata</i> var. <i>cordulata</i>	–	–	1B.2	Alkaline flats and scalds in the Central Valley; saline or alkaline areas in chenopod scrub, valley and foothill grassland underlain by sandy soils, and meadows and seeps; from 1 to 560 m in elevation. Blooms April–October.	Not expected to occur. No alkaline or sandy soils present within LIER. Not documented within 5 miles of LIER.
Brittlescale <i>Atriplex depressa</i>	–	–	1B.2	Alkaline clay soils, usually in alkali scalds in meadows, valley and foothill grassland, playas, and chenopod scrub; rarely associated with riparian, marshes, or vernal pools; from 1 to 320 m in elevation. Blooms April–October.	Not expected to occur. No alkaline soils present within LIER. Not documented within 5 miles of LIER.
Lesser saltscale <i>Atriplex persistens</i>	–	–	1B.2	Alkaline vernal pools; from 10 to 115 m in elevation. Blooms June–October.	Not expected to occur. No suitable habitat present. Not documented within 5 miles of LIER.
Watershield <i>Brasenia schreberi</i>	–	–	2B.3	Freshwater marshes and swamps, ponds, slow streams; from 30 to 2,200 m in elevation. Blooms June–September.	Could occur. Suitable habitat present, but not documented within 5 miles of LIER.
Bristly sedge <i>Carex comosa</i>	–	–	2B.1	Coastal prairie, marshes and swamps, valley and foothill grassland, on lake margins and wet places; from 0 to 625 m in elevation. Blooms May–September.	Could occur. Suitable habitat present, and known to occur in the Delta along sloughs and in marshes, although not documented within 5 miles of LIER.
Pappose tarplant <i>Centromadia parryi</i> ssp. <i>parryi</i>	–	–	1B.2	Chaparral, coastal prairie, meadows and seeps, coastal salt marshes and swamps, vernal mesic sites in valley and foothill grassland; often on alkaline soils; from 0 to 420 m in elevation. Blooms May–November.	Could occur. Potentially suitable habitat present in the northernmost “stair-step” grassland, but not documented within 5 miles of LIER.
Bolander's water-hemlock <i>Cicuta maculata</i> var. <i>bolanderi</i>	–	–	2B.1	Coastal freshwater or brackish marshes and swamps; from 0 to 200 m in elevation. Blooms July–September.	Could occur. Suitable habitat present and one occurrence documented within 5 miles of LIER.
Dwarf downingia <i>Downingia pusilla</i>	–	–	2B.2	Margin of vernal lakes, vernal pools, or other seasonal wetlands in valley and foothill grassland; from 1 to 485 m in elevation. Blooms March–May.	Not expected to occur. No suitable habitat present and not documented within 5 miles of LIER.
San Joaquin spearscale <i>Extriplex</i> (formerly	–	–	1B.2	Chenopod scrub, meadows and seeps, playas, valley and foothill grassland; often in seasonal alkali wetlands or alkali	Not expected to occur. No suitable habitat present and not documented within 5

Table 3-2. Special-Status Plants Known from or with Potential to Occur within Liberty Island Ecological Reserve					
Species	Status ¹			Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	CRPR		
Atriplex) joaquinana				sink scrub; from 1 to 835 m in elevation. Blooms April–October.	miles of LIER.
Fragrant fritillary Fritillaria liliacea	–	–	1B.2	Cismontane woodland, coastal scrub, coastal prairie, valley and foothill grassland; often on serpentine, usually on heavy clay soils; from 3 to 410 m in elevation. Blooms February–April.	Not expected to occur. No heavy clay soils within LIER. Not documented in Sacramento County or Yolo County.
Adobe-lily Fritillaria pluriflora	–	–	1B.2	Chaparral, cismontane woodland, valley and foothill grassland; usually in adobe clay soils, serpentine areas of interior foothills; from 60 to 705 m in elevation. Blooms February–April.	Not expected to occur. This species generally occurs at higher elevations and suitable soils are not present within LEIR.
Bogg's Lake hedge hyssop Gratiola heterosepala	–	E	1B.2	Warm, shallow water at edges of lakes or vernal pools; primarily in clay soils; from 5 to 2,400 m in elevation. Blooms April–August.	Not expected to occur. No suitable habitat within LIER. Not documented within 5 miles of LIER.
Woolly rose- mallow Hibiscus lasiocarpus var. occidentalis	–	–	1B.2	Freshwater marshes and swamps, generally found on wetted river banks and low peat islands in sloughs; known from the Delta watershed; from 0 to 120 m in elevation. Blooms June–September.	Could occur. Suitable habitat present and several occurrences documented within 5 miles of LIER.
Carquinez goldenbush Isocoma arguta	–	–	1B.1	Flats, lower hills, on low benches near drainages and on tops and sides of mounds in swale habitat, valley and foothill grassland; alkaline soils; from 1 to 20 m in elevation. Blooms August–December.	Not expected to occur. Not known from Yolo County or Sacramento County. No suitable habitat present and unlikely to become established due to regular inundation across LIER; not documented within 5 miles of LIER.
Northern California black walnut Juglans hindsii	–	–	1B.1	Riparian forest/woodland on deep alluvial soil along creeks and streams; from 0 to 440 m in elevation. Blooms April–May.	Known to occur. CDFW confirms presence on remnant levees, but nearby occurrences have been extirpated and few native stands remain; future survey work needed.
Delta tule pea Lathyrus jepsonii var. jepsonii	–	–	1B.2	Freshwater and brackish marshes and swamps, usually on marsh/slough edges; generally restricted to the Delta; from 0 to 4 m in elevation. Blooms May–July (rarely into September).	Could occur. Suitable habitat present and several occurrences documented within 5 miles of LIER.
Legenere Legenere limosa	–	–	1B.1	Vernal pool bottoms; from 1 to 880 m in elevation. Blooms April–June.	Not expected to occur. No suitable habitat present. Not documented within 5 miles of LIER.
Heckard's peppergrass Lepidium latipes var. heckardii	–	–	1B.2	Alkaline flats in valley and foothill grassland, sometimes edges of vernal pools; from 2 to 200 m in elevation. Blooms March–May.	Not expected to occur. No suitable habitat present and not documented within 5 miles of LIER.
Mason's lilaeopsis	–	R	1B.1	Freshwater and brackish marshes and swamps, riparian scrub; generally found	Known to occur. CDFW recorded this species within

Species	Status ¹			Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	CRPR		
<i>Lilaeopsis masonii</i>				in tidal zones on muddy or silty soils formed through river deposition or bank erosion; from 0 to 10 m in elevation. Blooms April–November.	LIER, mostly on remnant levees on the eastern side; CNDDDB documents other occurrences adjacent to LIER, including one in Lindsey Slough along the south end of Little Hastings Tract.
Delta mudwort <i>Limosella australis</i> (formerly <i>subulata</i>)	–	–	2B.1	Freshwater and brackish marshes and swamps, riparian scrub; generally on mud banks of the Delta in marshy or scrubby riparian associations; from 0 to 3 m in elevation. Blooms May–August.	Known to occur. CDFW recorded this species adjacent to LIER on an in-channel island in Liberty Cut; CNDDDB documents two other occurrences within 5 miles of LIER, including one just south of Liberty Island at the confluence of Miner Slough and Cache Slough.
Little mousetail <i>Myosurus minimus</i> <i>ssp. apus</i>	–	–	3.1	Alkaline vernal pools in valley and foothill grassland; from 20 to 640 m in elevation. Blooms March–June.	Not expected to occur. No suitable habitat present. Not documented within 5 miles of LIER.
Baker's navarretia <i>Navarretia leucocephala</i> <i>ssp. bakeri</i>	–	–	1B.1	Vernal pools and swales, meadows and seeps, cismontane woodland, lower montane coniferous forest, and valley and foothill grassland; mesic sites on adobe clay or alkaline clay soils; from 5 to 1,740 m in elevation. Blooms April–July.	Not expected to occur. No adobe clay or alkaline soils present within LIER. Not documented within 5 miles of LIER.
Colusa grass <i>Neostapfia colusana</i>	T	E	1B.1	Usually in large or deep vernal playa pools (flowering on drying pool bottoms); on adobe clay soils; from 5 to 200 m in elevation. Blooms May–August.	Not expected to occur. No suitable habitat present. Not documented within 5 miles of LIER.
Bearded popcornflower <i>Plagiobothrys hystriculus</i>	–	–	1B.1	Mesic sites in valley and foothill grassland, margins of vernal pools, often in vernal swales; from 0 to 274 m in elevation. Blooms April–May.	Not expected to occur. No suitable habitat present. Two occurrences documented within 5 miles of LIER.
Sanford's arrowhead <i>Sagittaria sanfordii</i>	–	–	1B.2	Shallow freshwater marshes and swamps, ponds, ditches, in standing or slow-moving water; from 0 to 650 m in elevation. Blooms May–October.	Could occur. Suitable habitat present and several occurrences documented within 5 miles of LIER.
Side-flowering skullcap <i>Scutellaria lateriflora</i>	–	–	2B.2	Mesic sites in meadows and seeps, marshes and swamps; often found on logs, generally restricted to the Delta; from 0 to 500 m elevation. Blooms April–May.	Could occur. Suitable habitat present, but no occurrences documented within 5 miles of LIER.
Keck's checker-mallow <i>Sidalcea keckii</i>	E	–	1B.1	Cismontane woodland, valley and foothill grassland; on serpentinite and clay soils; from 75 to 650 m in elevation. Blooms April–May (rarely into June).	Not expected to occur. This species generally occurs at higher elevations and no serpentinite soils are present within LIER. No occurrences documented

Table 3-2. Special-Status Plants Known from or with Potential to Occur within Liberty Island Ecological Reserve

Species	Status ¹			Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	CRPR		
					within 5 miles of LIER.
Suisun Marsh aster <i>Symphyotrichum lentum</i>	–	–	1B.2	Generally occurs in brackish and freshwater marshes and swamps, often along sloughs; endemic to Delta; from 0 to 3 m in elevation. Blooms May–November.	Known to occur along the banks of the “stair-step” slough and Shag Slough. Could occur in suitable habitat elsewhere within LIER.
Saline clover <i>Trifolium hydrophilum</i>	–	–	1B.2	Marshes and swamps, mesic sites in alkaline soils in valley and foothill grassland, vernal pools; from 0 to 300 m in elevation. Blooms April–June.	Not expected to occur. No suitable alkaline soils or vernal pool habitat present. There is one occurrence documented within 5 miles of LIER.
Crampton’s <i>Tuctoria/ Solano</i> grass <i>Tuctoria mucronata</i>	E	E	1B.1	Clay bottoms of large or deep vernal pools, lakes in valley and foothill grassland; from 5 to 10 m in elevation. Blooms April–August.	Not expected to occur. No suitable habitat present. Not documented within 5 miles of LIER.
Notes: CDFW = California Department of Fish and Wildlife; CNDDB = California Natural Diversity Database; CRPR = California Rare Plant Rank; Delta = Sacramento–San Joaquin Delta; LIER = Liberty Island Ecological Reserve; m = meters; USFWS = U.S. Fish and Wildlife Service					
¹ Legal Status Definitions USFWS E Endangered T Threatened CDFW E Endangered T Threatened R Rare CRPR Categories 1A - Plants presumed extinct or extirpated in California, and rare elsewhere 1B - Plant species considered rare, threatened, or endangered in California and elsewhere 2A - Plant species considered extirpated in California, but more common elsewhere 2B - Plant species considered rare, threatened, or endangered in California but more common elsewhere			² Potential Occurrence Definitions Could occur—Species could potentially occur based on suitable habitat within LIER and on nearby documented occurrences. Known to occur—Species has been documented within LIER and suitable habitat is present. Not expected to occur—None of the species’ life history requirements are provided by habitat within LIER, and/or LIER is outside of the species’ known distribution, and/or the species is not likely to occur because of marginal habitat or distance from known occurrences. 3 - Plants about which we need more information—a review list 4 - Plants of limited distribution—a watch list CRPR Extensions 1 = seriously endangered in California (>80% of occurrences are threatened and/or have high degree and immediacy of threat). 2 = fairly endangered in California (20–80% of occurrences are threatened and/or have moderate degree and immediacy of threat). 3 = not very endangered in California		
Sources: CNPS 2013; CNDDB 2013; UC Berkeley 2013; USFWS 2013; compiled by AECOM in 2013.					

Pappose Tarplant

Pappose tarplant has a CRPR of 1B.2 and is endemic to California, found along the North Coast Ranges and central coast, and in the southern Sacramento Valley (CNPS 2013; Baldwin 2012). Pappose tarplant is an annual or perennial herb in the sunflower family (*Asteraceae*) that grows from 10 to 70 cm tall (Baldwin 2012). It blooms from May to November and is found in chaparral, coastal prairie, meadows and seeps, coastal salt marsh, and vernal mesic areas in valley and foothill grassland, often in alkaline soils (CNPS 2013).

Pappose tarplant has not been documented within 5 miles of LIER, but there is potentially suitable habitat in the northernmost “stair-step” grassland. Threats to the species include agriculture, competition with nonnative plants, development, grazing, soil disturbance, and road maintenance (CNDDDB 2013; CNPS 2013).

Bolander’s Water-Hemlock

Bolander’s water-hemlock has a CRPR of 2B.1 and is found in Suisun Marsh and along the central coast of California; it is presumed extirpated from the Southern California coast and is also known from the states of Arizona, New Mexico, and Washington (CNPS 2013; Constance and Wetherwax 2012a).

Bolander’s water-hemlock is a perennial herb in the carrot family (*Apiaceae*) that grows from 100 to 150 cm tall (Constance and Wetherwax 2012a). It blooms from July to September and is found in coastal freshwater or brackish marshes (CNPS 2013).

One occurrence of Bolander’s water-hemlock has been documented within 5 miles of LIER (CNDDDB 2013) and suitable habitat is present in the freshwater marshes. Threats to the species include development, competition with nonnative plants, bank erosion, and hydrological changes to habitat (CNDDDB 2013; CNPS 2013).

Woolly Rose-Mallow

Woolly rose-mallow has a CRPR of 1B.2 and is endemic to California, found almost exclusively in the Sacramento Valley and Delta (CNPS 2013; Hill 2012). Woolly rose-mallow is a perennial herb to subshrub in the mallow family (*Malvaceae*) that grows from 1 to 2 m tall (Hill 2012). It blooms with large, showy flowers from June to November (CNPS 2013; Hill 2012). It grows in freshwater marshes and along banks of rivers and sloughs, including within riprap along levee slopes (CNDDDB 2013; CNPS 2013).

Several occurrences of woolly rose-mallow have been documented within 5 miles of LIER, and suitable habitat is present throughout the marshes and along the banks of the sloughs and levee slopes. Threats to the species include development, agriculture, recreation, bank and hydrology alteration, competition with and treatment of nonnative plants, and erosion (CNDDDB 2013; CNPS 2013).

Northern California Black Walnut

Northern California black walnut has a CRPR of 1B.1 and is endemic to California, historically found from the inner North Coast Ranges, Sacramento and San Joaquin Valleys, and San Francisco Bay area (CNPS 2013; Whittemore 2012). Northern California black walnut is a deciduous tree in the walnut family (*Juglandaceae*) that grows from 6 to 23 m tall (Whittemore 2012). It grows along streams in riparian forests (CNPS 2013; Whittemore 2012).

One historic occurrence of Northern California black walnut has been documented within 5 miles of LIER (CNDDDB 2013), but this and most other occurrences are presumed extirpated through hybridization with cultivated walnut (*Juglans regia*), eastern black walnut (*J. nigra*), or Arizona walnut (*J. major*) (Kirk 2003). Hybridization continues to threaten extant populations (CNPS 2013). Suitable habitat exists in riparian communities within LIER, and CDFW staff confirmed that black walnut grows on some of the

remnant levees, so additional survey work is needed to determine whether these are native or hybridized species.

Delta Tule Pea

Delta tule pea has a CRPR of 1B.2 and is endemic to California, found almost entirely in the Delta and northeastern San Francisco Bay area (Steele and Isely 2012; CNPS 2013). It is a perennial climbing herb in the legume family (*Fabaceae*) that typically grows above the tidal zone in marsh vegetation, although it also occurs in riparian scrub or at the edges of riparian forest near Liberty Island (CNDDDB 2013). Delta tule pea blooms from May to September (CNPS 2013); however, it is distinguished from the closely related California tule pea (*Lathyrus jepsonii* var. *californicus*) by its glabrous, robust stems (Steele and Isely 2012). The decline of Delta tule pea populations has resulted primarily from agriculture, installation of riprap and maintenance of levees, water diversions, erosion, and competition with nonnative plants (CNDDDB 2013; CNPS 2013).

Several occurrences of Delta tule pea have been documented within 5 miles of LIER (CNDDDB 2013), and suitable habitat is present in the marsh and riparian communities, as well as along the banks of sloughs and levee slopes.

Mason's Lilaepsis

Mason's lilaepsis is listed as rare by CDFW and has a CRPR of 1B.1. It is endemic to California, found almost entirely in the Delta and northeastern San Francisco Bay area (Constance and Wetherwax 2012b; CNPS 2013). Mason's lilaepsis is a diminutive (1.5 to 7.5 cm), rhizomatous perennial herb in the carrot family (Hickman 1993) that blooms from April through November (CNPS 2013). It is generally found within the tidal zone on open sites along shores, at the toes of cut banks, and in marshes (CNDDDB 2013; CNPS 2013). Threats to Mason's lilaepsis include erosion, channel stabilization, development, flood control projects, recreation, agriculture, and competition with and treatment of nonnative plants (CNDDDB 2013; CNPS 2013; Constance and Wetherwax 2012b).

Several occurrences of Mason's lilaepsis have been documented within LIER, mostly on the eastern remnant levees. Within 5 miles of LIER, there are several additional occurrences, including one in Lindsey Slough (CNDDDB 2013), and suitable habitat is present on muddy banks at the edges of the marsh and riparian communities within LIER.

Delta Mudwort

Delta mudwort has a CRPR of 2B.1 and occupies a similar habitat and range in California as Mason's lilaepsis (CNPS 2013). The native status of Delta mudwort in California is inconclusive. It is also known from the North American Atlantic coast, and the current Jepson Manual (Baldwin et al. 2012) treats it as a naturalized species, meaning that it is nonnative but well established in California (Wetherwax 2012). Delta mudwort looks similar to Mason's lilaepsis but is a member of the figwort family (*Scrophulariaceae*) and blooms from April through August (CNPS 2013; Wetherwax 2012). Threats to Delta mudwort are similar to those of Mason's lilaepsis (CNDDDB 2013; CNPS 2013).

Two occurrences of Delta mudwort have been documented within 5 miles of LIER, including one just south of Liberty Island at the confluence of Miner Slough and Cache Slough (CNDDDB 2013). Delta

mudwort has also been found adjacent to LIER on an in-channel island in Liberty Cut. Suitable habitat is present on muddy banks at the edges of the marsh and riparian communities.

Sanford's Arrowhead

Sanford's arrowhead has a CRPR of 1B.2 and is endemic to California, found throughout the Sacramento and San Joaquin Valleys, on the North Coast, in the Cascade Range foothills, and on the northern portion of California's south coast (Ventura County) (CNPS 2013; Turner et al. 2012). Sanford's arrowhead is a perennial, tuberiferous herb in the water-plantain family (Alismataceae) with emergent, lance-shaped leaves that blooms from May to October (Turner et al. 2012). It is found in shallow freshwater marsh, sloughs, ponds, ditches, and other channels with slow-moving or standing water (CNDDDB 2013). Primary threats to Sanford's arrowhead include habitat loss related to development, vegetation clearing (manual removal and herbicide application), and channel modification and maintenance. Competition with nonnative invasive plants, trampling by humans, and garbage also threaten some populations (CNDDDB 2013; CNPS 2013).

Sanford's arrowhead has been documented in several locations within 5 miles of LIER (CNDDDB 2013), and suitable habitat is present in the marshes, sloughs, and ponds.

Side-Flowering Skullcap

Side-flowering skullcap has a CRPR of 2B.2 and is rare in California, found only in the Delta and the Saline Valley east of the Sierra Nevada, but more common across North America (CNPS 2013; Olmstead 2012). It is a rhizomatous perennial herb in the mint family (Lamiaceae) that grows from 20 to 60 cm tall and blooms from May through September (CNPS 2013; Olmstead 2012). Side-flowering skullcap is found in mesic sites in meadows and seeps, marshes and swamps, and often on logs in Delta channels (CNDDDB 2013; CNPS 2013). It is potentially threatened by recreation and agriculture (CNDDDB 2013).

Side-flowering skullcap has not been documented within 5 miles of LIER, but suitable habitat exists in the marshes and sloughs.

Suisun Marsh Aster

Suisun Marsh aster has a CRPR of 1B.2 and is endemic to California, found almost exclusively in the Delta and San Francisco Bay area (CNDDDB 2013; CNPS 2013). It is a perennial herb reaching more than 1 m in height that blooms from May to November (Allen 2013). Suisun Marsh aster grows in brackish and freshwater marshes and along the banks of sloughs and river channels, including along levee slopes covered in riprap (CNDDDB 2013; CNPS 2013). The decline of Suisun Marsh aster populations has been caused primarily by loss of marsh habitat, maintenance of levees, and competition from nonnative invasive plants (CNDDDB 2013; CNPS 2013). Suisun Marsh aster was observed by AECOM botanists Ellen Pimentel and Charles Battaglia during a site visit on September 11, 2013, along the banks of LIER in the "stair-step" slough and Shag Slough. Several occurrences of Suisun Marsh aster have been documented on the LIER remnant levees, and suitable habitat exists in the marsh communities.

2. Special-Status Wildlife Species

Special-status wildlife species are legally protected or are otherwise considered sensitive by federal, state, or local resource conservation agencies and organizations (CDFW 2015). The following special-status wildlife species are addressed in this section:

- ▶ species listed as threatened or endangered under the ESA or CESA, or petitioned for such listing;
- ▶ species identified by USFWS or CDFW as species of special concern, and
- ▶ species fully protected in California under the California Fish and Game Code;
- ▶ Species on the North American Bird Conservation Initiative Watch List.

LEIR and the surrounding area in the Delta provide habitat for several special-status wildlife species. A list of special-status wildlife species potentially present within LIER was developed from searches of CDFW's CNDDDB (2013), review of the CDFW Special Animal List (CDFW 2015), USFWS's endangered species list generator (USFWS 2013), CDFW field survey data, and literature associated with biological resources within LIER.

The CNDDDB data reviewed included previously documented special-status wildlife occurrences within a 5-mile radius of LIER (Exhibit 3-3) and the USFWS data included wildlife either known to occur or with potential to occur within the surrounding nine USGS 7.5-minute quadrangles. These searches resulted in a list of special-status wildlife species that are known to occur or have potential to occur within LIER (Table 3-3).

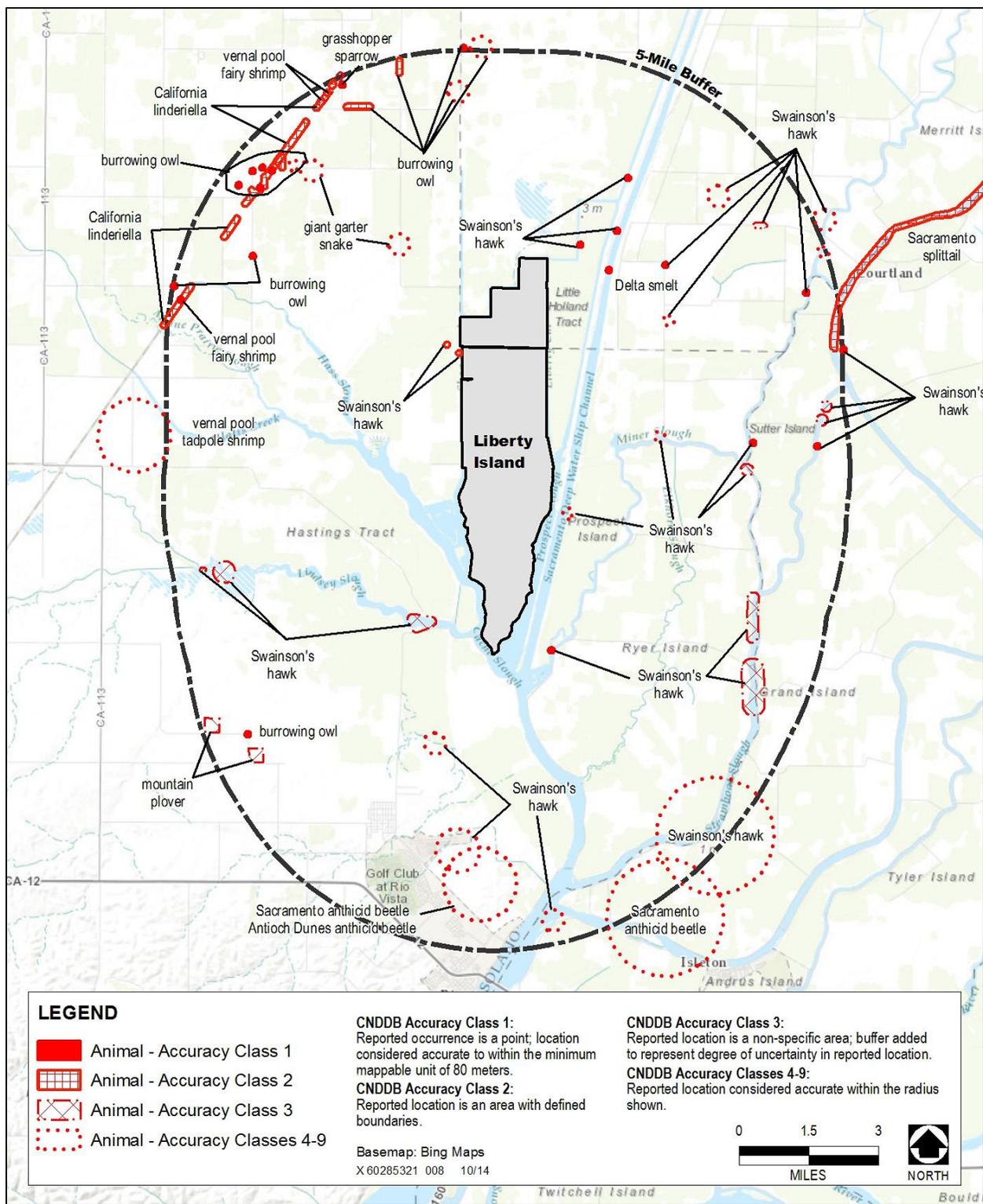
Special-status species with the potential to occur within LIER are discussed further below. Reptiles are discussed first, followed by birds (nonbreeding and breeding raptors, waterbirds, and songbirds) and mammals. Species listed in Table 3-3 that are not expected to occur are not discussed, usually because no suitable habitat is present within LIER. For example, vernal pool shrimp and valley elderberry longhorn beetle (invertebrates) are not specifically discussed below because no vernal pool or vernal mesic aquatic habitat and no elderberry shrubs are known to occur within LIER. Also, California tiger salamander and California red-legged frog (amphibians) are not discussed because no suitable aquatic habitat is present given regular flooding and inundation, the lack of upland habitat, and the presence of predatory fish in the open water and sloughs.

a. Reptiles

Giant Garter Snake

This species inhabits sloughs, low-gradient streams, marshes, ponds, small lakes, agricultural wetlands, and other waterways in the Central Valley and feeds on small fish and frogs during its active season (early spring to fall). Giant garter snakes move considerable distances along waterways; studies have documented them moving up to 2 miles in a single day (Hansen and Brode 1993). Consequently, the sizes of their home ranges vary widely.

Giant garter snake also uses adjacent uplands for basking and has been known to retreat as far as 820 feet from its active-season habitat, presumably to reach overwintering sites above the annual high-water mark (Hansen 1986, 1988; USFWS 1999). Giant garter snakes require adequate water during the snake's active period to provide a prey base and cover; emergent, herbaceous wetland vegetation, such as cattail and bulrushes, for escape cover and foraging habitat; upland habitat for basking, cover, and retreat sites; and higher elevation uplands for cover and refuge from floodwaters (USFWS 1999).



Source: CNDDB 2013

Exhibit 3-3. CNDDB Wildlife Occurrences within 5 Miles of Liberty Island

Table 3-3. Special-Status Wildlife Known or with Potential to Occur within Liberty Island Ecological Reserve				
Species	Status¹		Habitat	Potential for Occurrence
	USFWS	CDFW		
Invertebrates				
Vernal pool fairy shrimp <i>Branchinecta lynchi</i>	T	–	Inhabits vernal pools and other seasonal wetlands in valley and foothill grasslands.	Not expected to occur. No vernal pools or suitable habitat occur within LIER.
Conservancy fairy shrimp <i>Branchinecta conservatio</i>	E	–	Inhabits large vernal pools and seasonal wetlands in valley and foothill grasslands.	Not expected to occur. No vernal pools or suitable habitat occur within LIER.
Valley elderberry longhorn beetle <i>Desmocerus californicus dimorphus</i>	T	–	Inhabits elderberry shrubs, typically in riparian habitats.	Not expected to occur. No elderberry shrubs were identified in the riparian woodland habitat within LIER; therefore, no suitable habitat is anticipated.
Vernal pool tadpole shrimp <i>Lepidurus packardii</i>	E	–	Inhabits vernal pools and other seasonal wetlands in valley and foothill grasslands.	Not expected to occur. No vernal pools or suitable habitat occur within LIER.
Reptiles				
Western pond turtle <i>Actinemys marmorata</i>	P	SSC	Inhabits slow-moving streams, sloughs, ponds, irrigation and drainage ditches, and adjacent upland areas.	Could occur. Emergent wetland, pond, and canal habitat associated with the northern “Stair-step” section provides suitable aquatic and upland estivation habitat.
Giant garter snake <i>Thamnophis gigas</i>	T	T	Inhabits slow-moving streams, sloughs, ponds, marshes, flooded rice fields, irrigation and drainage ditches, and adjacent upland areas.	Could occur. Emergent wetland, pond, and canal habitat associated with the northern section provides suitable aquatic habitat; however, predatory game fish can access nearly all waters and create an unfavorable environment.
Amphibians				
California tiger salamander <i>Ambystoma californiense</i>	T	SSC	Breeds in vernal pools and seasonal wetlands with a minimum 10-week inundation period in the winter. In summer, aestivates in grassland habitat, primarily in rodent burrows.	Not expected to occur. Because of predators, winter flooding, and long periods of inundation, LIER does not provide suitable habitat.
California red-legged frog <i>Rana aurora draytonii</i>	T	SSC	Inhabits central coast and Sierra Nevada foothill streams and ponds with dense shrubby or riparian and emergent and submerged aquatic vegetation; needs at least 11–20 weeks of cold, predator-free water for larval development and upland refugia.	Not expected to occur. Believed to be absent from most of the Delta and valley floor; predatory game fish and bullfrogs and winter flooding within the bypass create unsuitable conditions.
Birds				
Cooper’s hawk <i>Accipiter cooperii</i> (nesting)	–	WL	Nests and forages primarily in riparian woodlands and other wooded habitats.	Could occur. Suitable foraging and nesting habitat occurs in uplands and riparian woodland habitat within LIER.

Table 3-3. Special-Status Wildlife Known or with Potential to Occur within Liberty Island Ecological Reserve				
Species	Status¹		Habitat	Potential for Occurrence
	USFWS	CDFW		
Sharp-shinned hawk <i>Accipiter striatus</i> (nesting)	–	WL	Forages primarily in riparian woodlands and other wooded habitats. Winter visitor to the Central Valley floor.	Could occur. Suitable foraging habitat occurs in uplands and riparian woodland habitat within LIER.
Tricolored blackbird <i>Agelaius tricolor</i> (nesting colony)	SSC	E	Nests colonially in tules, cattails, willows, thistles, blackberries, and other dense vegetation. Forages in grasslands and agricultural fields.	Known to occur. Documented within LIER during CDFW avian surveys; suitable foraging and nesting habitat occurs within uplands and the dense tule and cattail marshes. A breeding colony was recorded in 2005 within the YBWA.
Grasshopper sparrow <i>Ammodramus</i> <i>savannarum</i> (nesting)	–	SSC	Nests and forages in dense native grasslands containing diverse assemblages of grasses and forbs. This species is rare and localized in Yolo County.	Known to occur. Documented within LIER during CDFW avian surveys; suitable foraging habitat occurs in grassland and ruderal vegetation, but no high-quality nesting habitat currently exists.
Golden eagle <i>Aquila chrysaetos</i> (nesting and wintering)	BCC	FP, WL	Nests and forages in a variety of open habitats, including grassland, shrubland, and cropland; most common in mountain habitats; rare foothill breeder; nests in cliffs, rock outcrops, and large trees.	Could occur. Suitable foraging habitat occurs in the upland and openings within the riparian woodland habitat.
Great egret <i>Ardea alba</i> (rookeries)	–	–	Nests colonially in tall trees. Forages in fresh and saline marshes, shallow open water, and occasionally cropland or low, open, upland habitats.	Could occur. Rookeries are documented in riparian habitat on the Little Holland Tract levee, adjacent to the east side of Liberty Island.
Great blue heron <i>Ardea herodias</i> (rookeries)	–	–	Nests colonially in tall trees. Forages in fresh and saline marshes, shallow open water, and occasionally cropland or low, open, upland habitats.	Could occur. Rookeries are documented in riparian habitat on the Little Holland Tract levee, adjacent to the east side of Liberty Island.
Short-eared owl <i>Asio flammeus</i> (nesting and wintering)	–	SSC	Nests on the ground and forages in open marsh, grassland, shrub, and agricultural habitats. Winter visitor and rare year-round nesting species to Yolo County.	Could occur. Suitable foraging and nesting habitat occurs within LIER.
Burrowing owl <i>Athene cunicularia</i> (nesting and wintering)	BCC	SSC	Nests and forages in grasslands, shrublands, deserts, and agricultural fields, especially where ground squirrel burrows are present.	Could occur. Numerous CNDDB occurrences within 5 miles of LIER. Upland areas within LIER provide suitable foraging and nesting habitat, but high winter and spring floods could adversely affect nesting.
Redhead <i>Aythya americana</i> (nesting)		SSC	Nests in freshwater emergent wetlands with dense patches of tules or cattails and open water greater than 1 m deep; forages by diving in deep open water.	Could occur. Open water provides suitable foraging habitat and dense cattail and tule wetlands provide suitable nesting habitat. Species known to nest annually in the YBWA.

Table 3-3. Special-Status Wildlife Known or with Potential to Occur within Liberty Island Ecological Reserve				
Species	Status¹		Habitat	Potential for Occurrence
	USFWS	CDFW		
Ferruginous hawk <i>Buteo regalis</i> (wintering)	BCC	WL	Forages most commonly in grasslands and shrub-steppe; also forages in agricultural fields. Winter visitor to the Central Valley.	Could occur. Suitable foraging habitat occurs in upland habitats within LIER when not flooded.
Swainson's hawk <i>Buteo swainsoni</i> (nesting)	BCC	T	Nests in riparian woodlands and isolated trees; forages in agricultural, grassland, and shrub habitats. Summer visitor in the Central Valley.	Known to occur. Numerous nests documented within 5 miles of LIER, with the closest at the northwest corner of Liberty Island. Suitable foraging and nesting habitat occurs in riparian woodlands and isolated trees and in the open upland areas.
Mountain plover <i>Charadrius montanus</i> (wintering)	BCC	SSC	Winter visitor that forages in short grasslands, plowed agricultural fields, and usually areas where vegetation is sparse and trees are absent.	Could occur. Upland grassland and ruderal vegetation within LIER may provide marginally suitable foraging habitat.
Black tern <i>Chlidonias niger</i> (nesting)	–	SSC	Nests in flooded rice fields and freshwater marshes, and prefers floating mats or secluded small islands or mounds near water; forages near nest sites over water.	Could occur. No nesting has been documented, but migrants are known to occur in the Yolo Bypass and could use the large areas of marsh within and around LIER.
Northern harrier <i>Circus cyaneus</i> (nesting)	–	SSC	Nests and forages in open marsh, grassland, shrub, and agricultural habitats.	Known to occur. Known to nest and forage in open habitats within the Yolo Bypass. Nesting is not known to occur on LIER, but LIER provides suitable foraging and nesting habitat.
Western yellow-billed cuckoo <i>Coccyzus americanus occidentalis</i> (nesting)	T	E	Nests in valley, foothill, and desert riparian forest with densely foliated deciduous trees and shrubs, especially willows; other associated vegetation includes cottonwood trees, blackberry, nettle, and wild grape.	Could occur. A rare summer resident at isolated sites in the Sacramento Valley and Northern California; potentially suitable riparian habitat occurs within LIER.
California yellow warbler <i>Dendroica petechia brewsteri</i> (nesting)	–	SSC	Nests in riparian woodland and riparian scrub habitats. Forages in a variety of wooded and shrub habitats during migration.	Could occur. Suitable foraging and nesting habitat occurs in the upland and riparian woodland habitat.
Snowy egret <i>Egretta thula</i> (rookeries)	–	–	Nests colonially in dense marshes and low trees. Forages in fresh and saline marshes, shallow open water, and occasionally irrigated cropland or wet upland habitats.	Could occur. Species documented within LIER during CDFW avian surveys but has not been observed at any adjacent rookery sites.
White-tailed kite <i>Elanus leucurus</i> (nesting)	–	FP	Nests in woodlands and isolated trees; forages in grassland, shrub, and agricultural habitats.	Known to occur. Known to nest and forage in open habitats within the Yolo Bypass, and LIER provides suitable foraging and nesting habitat.
Little willow flycatcher <i>Empidonax traillii brewsteri</i>	–	E	Migrates through the Central Valley during spring and fall. Forages in riparian willow scrub.	Known to occur. Documented within LIER during avian surveys; suitable foraging habitat occurs in riparian woodland habitat.

Table 3-3. Special-Status Wildlife Known or with Potential to Occur within Liberty Island Ecological Reserve				
Species	Status ¹		Habitat	Potential for Occurrence
	USFWS	CDFW		
California horned lark <i>Eremophila alpestris</i> actia (nesting)	–	WL	Nests and forages in open habitats with sparse vegetation including grasslands and fallow agricultural fields.	Could occur. Suitable foraging and nesting habitat occurs within open grassland and ruderal vegetation.
Merlin <i>Falco columbarius</i> (wintering)	–	WL	Forages in agricultural, grassland, mudflat, and shoreline habitats. Winter visitor to California.	Could occur. Suitable foraging habitat occurs in open areas of grassland and ruderal vegetation, and along mudflats and shorelines.
Prairie falcon <i>Falco mexicanus</i> (wintering)	–	WL	Forages most commonly in grasslands and shrub-steppe; also forages in agricultural fields. Currently presumed to be a nonbreeding visitor to Yolo County.	Could occur. Suitable foraging habitat occurs in grassland and ruderal vegetation within LIER when not flooded.
American peregrine falcon <i>Falco peregrinus</i> anatum (wintering)	–	E, FP	Forages in a wide variety of habitats, but is most common near water, where shorebirds and waterfowl are abundant. Year round resident to California.	Could occur. Suitable foraging habitat occurs along mudflats and shorelines when shorebirds and waterfowl are present.
Greater sandhill crane <i>Grus canadensis</i> tabida (wintering)	–	T, FP	Forages primarily in moist croplands with rice or corn stubble; also frequents grasslands and emergent wetlands. Winter visitor to the Central Valley.	Unlikely to occur. Sandhill crane prefer managed wetlands and agricultural fields in the Delta while wintering. Grassland, ruderal vegetation, and emergent wetland habitats within LIER provide marginally suitable foraging habitat.
Bald eagle <i>Haliaeetus</i> <i>leucocephalus</i> <i>leucocephalus</i> (wintering)	D	E, FP	Forages primarily in large inland fish-bearing waters with adjacent large trees or snags, and occasionally in uplands with abundant rabbits, other small mammals, or carrion.	Could occur. Open water, emergent wetland, shoreline, and upland habitats within LIER provide moderately suitable foraging habitat.
Loggerhead shrike <i>Lanius ludovicianus</i> (nesting and wintering)	BCC	SSC	Nests and forages in grassland, agricultural open woodland, and shrub habitats.	Could occur. Known to nest and forage in upland habitats throughout the YBWA, and upland habitats and wooded areas within the LIER provide moderately suitable nesting and foraging habitat
California gull <i>Larus californicus</i> (wintering)	–	WL	Forages in landfills, open water, wetland, and cropland habitats. Although individuals may be present year round, this species does not breed in the Central Valley.	Known to occur. Documented during avian surveys; likely forages year round within LIER.
California black rail <i>Laterallus jamaicensis</i> coturniculus (nesting)	–	T, FP	Nests and forages in dense saline, freshwater, and brackish emergent marshes with shallow perennial water and upland refugia.	Could occur. Populations documented in San Francisco Bay and Suisun Marsh estuaries and in the Sierra Nevada foothills.
Long-billed curlew <i>Numenius americanus</i> (wintering)	–	WL	Forages in cropland, grassland, wetland, and mudflat habitats. Although individuals may be present throughout the year, this species does not breed in the Central Valley.	Known to occur. Documented during CDFW avian surveys, and suitable wetland, mudflat, and grassland habitats occur.

Table 3-3. Special-Status Wildlife Known or with Potential to Occur within Liberty Island Ecological Reserve				
Species	Status¹		Habitat	Potential for Occurrence
	USFWS	CDFW		
Black-crowned night heron <i>Nycticorax nycticorax</i> (rookeries)	–	–	Nests colonially in dense marshes, groves of low trees, and dense shrubs; forages in freshwater and saline marshes and in shallow open water at the edge of marsh vegetation.	Documented during CDFW avian surveys and suitable nesting and foraging habitat occurs within LIER and throughout the Delta.
Osprey <i>Pandion haliaetus</i> (wintering)	–	WL	Forages exclusively in fish-bearing waters, and nests in nearby trees or tall, constructed platforms such as utility poles.	Known to occur. Documented during CDFW avian surveys, and suitable nesting and foraging habitat occurs in riparian trees and open water.
American white pelican <i>Pelecanus erythrorhynchos</i> (wintering)	–	SSC	Forages in open water. Although individuals may be present year round, this species does not breed in the Central Valley.	Known to occur. Documented during 2005/2006 avian surveys, and suitable foraging habitat occurs in open water and wetlands.
Double-crested cormorant <i>Phalacrocorax auritus</i> (rookeries)	–	WL	Forages in open water. Breeds colonially in rock ledges and trees.	Could occur. Rookeries are documented in riparian habitat on the Little Holland Tract levee, adjacent to the east side of Liberty Island.
White-faced ibis <i>Plegadis chihi</i> (nesting)	–	WL	Forages in wetlands and irrigated or flooded croplands and pastures. Breeds colonially in dense freshwater marsh.	Known to occur. Documented during CDFW avian surveys, and suitable nesting habitat occurs in the dense emergent wetland habitat in the northern third of LIER.
Mammals				
Pallid bat <i>Antrozous pallidus</i>	–	SSC	Roosts in crevices or cavities found on trees, cliffs, rocky outcrops, and caves; has also been found in riprap, bridges, and buildings; roosts must protect bats from high temperatures. Forages in grassland, shrub, and wooded habitats, often associated with water.	Could occur. Riparian woodland habitat provides suitable roosting habitat, and the upland grassland and shrubland provide suitable foraging habitat.
Townsend's big-eared bat <i>Corynorhinus townsendii</i>	–	SSC	Typically roosts in caves, but may also use mines, tunnels, tree hollows, buildings, and internal spaces on bridges. Forages along the edges of woodlands and waterways in the air and by gleaning insects off leaves.	Not expected to occur. Riparian woodland habitat provides suitable roosting habitat, and the upland grassland and shrubland provide suitable foraging habitat.
Western red bat <i>Lasiurus blossevillii</i>	–	SSC	Roosts in the foliage of large shrubs and trees, usually sheltering on the underside of overhanging leaves. Forages over a variety of habitats, but essentially wherever insects to prey on are abundant.	Could occur. Riparian woodland habitat provides suitable roosting habitat, and the upland grassland and shrubland provide suitable foraging habitat.

Table 3-3. Special-Status Wildlife Known or with Potential to Occur within Liberty Island Ecological Reserve																		
Species	Status ¹		Habitat	Potential for Occurrence														
	USFWS	CDFW																
Ringtail Bassariscus astutus	–	FP	In the Central Valley, occurs almost exclusively in riparian forests along major waterways such as the Sacramento River. Principal habitat requirements are thought to be den sites among boulders or in tree hollows with sufficient food in the form of rodents, other small animals.	Could occur. Riparian woodland habitat within the northern section of LIER provides potentially suitable habitat.														
Notes: CDFW = California Department of Fish and Wildlife; CNDDDB = California Natural Diversity Database; Delta = Sacramento–San Joaquin Delta; LIER = Liberty Island Ecological Reserve; m = meters; m ² = square meters; USFWS = U.S. Fish and Wildlife Service; YBWA = Yolo Bypass Wildlife Area																		
¹ Legal Status Definitions <table border="0"> <tr> <td><u>USFWS</u></td> <td><u>CDFW</u></td> </tr> <tr> <td>E Endangered</td> <td>E Endangered</td> </tr> <tr> <td>T Threatened</td> <td>T Threatened</td> </tr> <tr> <td>C Candidate for listing</td> <td>FP Fully protected</td> </tr> <tr> <td>P Petitioned for listing</td> <td>SSC Species of special concern</td> </tr> <tr> <td>D Delisted</td> <td>WL Watch List</td> </tr> <tr> <td>BCC Birds of Conservation Concern</td> <td></td> </tr> </table>					<u>USFWS</u>	<u>CDFW</u>	E Endangered	E Endangered	T Threatened	T Threatened	C Candidate for listing	FP Fully protected	P Petitioned for listing	SSC Species of special concern	D Delisted	WL Watch List	BCC Birds of Conservation Concern	
<u>USFWS</u>	<u>CDFW</u>																	
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D Delisted	WL Watch List																	
BCC Birds of Conservation Concern																		
² Potential Occurrence Definitions <i>Could occur</i> —Species could potentially occur because of the presence of suitable habitat in the planning area and nearby documented occurrences. <i>Known to occur</i> —Species has been documented in the planning area and suitable habitat is present. <i>Not expected to occur</i> —None of the species' life history requirements are provided by habitat in the planning area and/or the planning area is outside of the species known distribution and/or the species is not likely to occur because of marginal habitat quality or distance from known occurrences.																		
Sources: CDFW 2015; CNDDDB 2013; USFWS 2013; compiled by AECOM 2013																		

Historic vegetation that once provided these habitat components, however, has been lost. Flooded rice fields, agricultural ditches and canals with nearby vegetation, and restored wetlands now function as critical replacement habitat. Adjacent upland breeding and overwintering sites, however, are often the missing component (CALFED 2000a, 2000b) and likely result in limited reproduction. Additionally, much of the aquatic habitat in the Central Valley and Delta supports populations of introduced game fish that prey on juvenile giant garter snakes, making protected offshore islands, sloughs, and agricultural canals extremely important for this species' survival (DFG 2007),.

Giant garter snake has not been documented within LIER, but the sloughs, canals, and emergent wetland and pond habitat provide suitable foraging habitat. Suitable basking habitat also exists in the upland areas, but wintering habitat is limited because of high flooding levels that can inundate all but the highest levees during the winter and spring. Most of the aquatic habitat within LIER also contains nonnative fish that prey on juvenile giant garter snakes, and bullfrogs, also a predator, may be present in backwater areas of wetlands and riparian woodlands. The closest documented occurrence of giant garter snake is approximately 1.5 miles northwest of LIER, along Liberty Island Road, where it was observed in an agricultural canal lined with tules and cattails in 1994. Records from 1987 also document it around the same area and habitat type, but about 1 mile farther away.

Western Pond Turtle

This species forages in ponds, slow-moving rivers and streams, sloughs, marshes, and irrigation ditches with rocky or muddy bottoms; it nests in nearby uplands with low, sparse vegetation. Exposed logs, rocks, islands, and banks are important components for basking and thermoregulation. Individual western pond turtles may move up to 3 miles along and more than 1,000 feet away from water features during their seasonal movements (Morey 2002).

No CNDDDB occurrence records exist for western pond turtle within 5 miles of LIER. However, the species is widely distributed across the Yolo Bypass Wildlife Area (YBWA) and is believed to breed in that area. The western pond turtle was also documented immediately north of LIER on the recently restored Yolo Ranch property (SFCWA 2013). Although aquatic habitat within LIER is subjected to greater tidal influence than these sites, the canals, sloughs, small ponds, and uplands in the northern portion of Liberty Island could provide suitable foraging and possibly breeding habitat.

The decline of the western pond turtle can be attributed mostly to habitat loss and conversion of aquatic habitat for agriculture, urban, or industrial uses. Most of the habitat that remains is fragmented and often lacks adjacent uplands with suitable nesting habitat. Other factors that have likely contributed to population declines include agricultural practices (e.g., disking, mowing, burning, and herbicide and rodenticide application) that degrade the habitat and/or lead to wildlife mortality; nonnative predatory fish that prey on juveniles and injure adults; competition from nonnative turtles; and inundation of nesting sites from flooding that occurs as a result of high winter and spring runoff (CALFED 2000b).

b. Birds

As described below, LIER provides suitable and important nesting habitat for special-status raptors, waterbirds, and songbirds that either are known to nest or could potentially nest and regularly forage on or adjacent to Liberty Island, or that do not nest on-site and instead arrive in the Central Valley as a result of long-distance or local migration patterns. Because of the large areas of wetland and open-water habitat, LIER is particularly important to waterbirds. Most of these species occur to forage in these habitats, but some species have the potential to nest as well. Cooper's Hawk

This species is primarily a year-round resident, but individual Cooper's hawks can migrate from higher elevations in the Sierra Nevada to the Central Valley or Southern California in the winter. Migratory species pass through the area near LIER during their winter migration from the northern United States and British Columbia south to Central America. Cooper's hawk nests and forages in riparian woodlands and other wooded habitats and preys on smaller birds and small mammals.

No CNDDDB occurrence records exist for Cooper's hawk within 5 miles of LIER. Although Cooper's hawk has been observed during avian surveys conducted on Liberty Island by CDFW biologists, it is not expected to nest there because the species generally requires more extensive woodland habitat.

Sharp-Shinned Hawk

Migrant sharp-shinned hawks migrate south from Canada in the fall and winter to central California and farther south. Others are year-round residents in the Central Valley, but migrate locally to higher elevations outside the valley floor to breed and nest. This species nests in dense forest, ideally with a

closed canopy, and it is not found where trees are scarce or scattered, except during migration. Although the sharp-shinned hawk favors forests with conifers, it also nests in riparian and mixed forests. Songbirds make up about 90% of the species' diet, with mice and other small mammals making up the rest (BNA 2014).

No CNDDDB occurrence records exist for sharp-shinned hawk within 5 miles of LIER. Although sharp-shinned hawk has been observed during avian surveys conducted on Liberty Island by CDFW biologists, it is not expected to nest here because the species generally requires more extensive woodland habitat.

Tricolored Blackbird

The tricolored blackbird is native to California, and in most years, the Central Valley alone holds more than 90% of all breeding adults (Shuford and Gardali 2008). Breeding occurs from mid-March through early August, but fall breeding has also been documented at several sites in the Central Valley from September to November (Shuford and Gardali 2008). During the winter, virtually all birds outside of the state concentrate in the California breeding range. Tricolored blackbird nests in dense colonies in a variety of habitats: freshwater marsh, riparian scrub, and other vegetation that provides dense cover for protection from predators. Tricolored blackbird colonies range in size from fewer than 25 to more than 100,000 individuals, and colony locations often change from year to year. This species forages in grasslands, pastures, and agricultural fields, where it preys primarily on insects in the summer and a variety of grain and weedy seeds in the fall and winter.

No CNDDDB occurrence records exist for tricolored blackbird within 5 miles of LIER, but this species is regularly observed foraging in upland communities and agricultural areas within the YBWA, and breeding within the wildlife area was documented in 2005. The large areas of freshwater marsh and riparian scrub within LIER provide suitable foraging and potential summer nesting habitat for tricolored blackbird.

Grasshopper Sparrow

This species occurs in California primarily as a summer resident and breeds from mid-March to August (Shuford and Gardali 2008). The winter status of grasshopper sparrow is obscure, and the species is occasionally seen in the winter at breeding sites; however, the species is thought to be at least partly migratory, and the occasional birds seen in the winter may not be the same individuals there in the spring and summer. Agriculture and urbanization have greatly reduced numbers of grasshopper sparrows in the Central Valley, but they still breed primarily at the edges and in low foothills and, more sparingly, on the valley floor (Shuford and Gardali 2008). Grasshopper sparrow nests and forages in dense native grasslands containing diverse assemblages of tall grasses and forbs.

No CNDDDB occurrence records exist for grasshopper sparrow within 5 miles of LIER, but they are regularly observed foraging and are presumed to breed within the Tule Ranch Unit of the YBWA, which provides remnant high-quality native grassland habitat for this species. Although LIER lacks suitable, high-quality habitat for grasshopper sparrow, it was documented during avian surveys conducted on Liberty Island by CDFW biologists, and it could use the upland habitats within LIER for foraging.

Golden Eagle

This species is primarily a year-round resident in California, but some golden eagles migrate thousands of miles from Alaska and Canada into California. Residents occasionally nest in the foothills of the inner Coast Ranges and Sierra Nevada and forage in upland habitats on the valley floor. They are known to forage in a variety of habitats including grassland, shrubland, and agricultural fields. Their primary prey species include rabbits and rodents, but they also take other mammals, birds, and reptiles. Carrion (e.g., a carcass found on the landscape) is also a part of their diet, especially during winter months.

No CNDDDB occurrence records exist for golden eagle within 5 miles of LIER, and this species has not been recorded during avian surveys on Liberty Island. However, the species is known to forage occasionally to the north in the YBWA, and it could forage during the winter in the upland grassland and ruderal vegetation on the northern portion of the Island.

California Yellow Warbler

The California yellow warbler currently occupies much of its former breeding range in California, except in the Central Valley, where the species is believed to be close to extirpation (Shuford and Gardali 2008). The breeding range for California yellow warbler extends well into Canada and Alaska, and it migrates into Central and South America for the winter. Although this species is known to breed in virtually all counties surrounding the valley floor, including the Cascade Range and Sierra Nevada, the Coast Ranges, and the southern deserts, no breeding has been documented in the Central Valley since 1974 (Shuford and Gardali 2008). California yellow warbler nests and forages in riparian woodland and riparian scrub habitats located near water, where it gleans insects from the riparian foliage.

No CNDDDB occurrence records exist for California yellow warbler within 5 miles of LIER, but it has been observed within the YBWA as a summer migrant. The riparian woodland habitat within LIER provides suitable foraging and potentially suitable nesting habitat.

Great Egret, Great Blue Heron, Snowy Egret, and Black-Crowned Night Heron

These four waterbird species are fairly common, year-round residents in California, although snowy egret generally migrates south of the Sacramento Valley in the winter. All forage in shallow open water and along the margins of lakes, rivers, sloughs, and ditches where they wait motionlessly or stalk slowly before taking their prey by surprise; however, snowy egret is the most active feeder, and is known to also run through shallow water after prey. Great egret and great blue heron also forage in the grasslands and agricultural fields, while snowy egret and black-crowned night heron are unlikely to forage in these upland habitats.

All of these species have highly variable diets that consist of fish, crustaceans, mollusks, amphibians, reptiles, aquatic insects and other invertebrates, small mammals, and potentially small birds. The night heron, unlike the other three, feeds nocturnally and crepuscularly (i.e., at twilight or just before dawn). All nest colonially, usually near aquatic or wetland feeding areas, and the rookery site must be isolated from human activities or parents may abandon nests. Great egret and great blue heron nest in tall trees and snowy egret and night heron nest in lower trees, shrubs, and occasionally at ground level.

No CNDDDB occurrence records exist for any of these species within 5 miles of LIER; however, during avian surveys conducted by CDFW biologists from 2004 to 2007, great blue heron and great egret rookeries were documented in riparian woodland habitat just outside LIER, on the Little Holland Tract levee, and a second great blue heron rookery was documented in riparian habitat in the northern portion of LIER. In recent years, use of the Little Holland Tract rookeries has been much lower than when first documented from 2004 to 2007. Riparian woodland habitat on Liberty Cut, Shag Slough, the canal following the northern “stair-steps,” and the larger levee remnants remaining as islands are potentially sites for rookeries; however, this species prefers large, tall trees, which are limited. The abundant fish populations in the open waters provide a consistent food source for this species throughout the year.

Short-Eared Owl

Short-eared owl occurs in the Central Valley as a resident and a winter visitor, and it is rarely observed from September through April (Zeiner et al. 2008a). Short-eared owls forage for voles and other small mammals in a variety of open habitats including wetlands, grasslands, low shrublands, and agricultural fields. They use dense vegetation in grasslands, shrublands, and wetlands for cover to rest and roost. The resident populations are small but are augmented during winter by migrants from northern populations (YNHP 2013). The known nesting distribution for residents is highly restricted; in most years, it has been limited to a single location in the Hunt-Wesson Hawk and Owl Reserve east of the Yolo County Landfill (YNHP 2013). There are no confirmed nesting records for this site since the late 1980s, but recent possible nesting activity has been reported in the YBWA and in uncultivated agricultural fields to the south in Yolo County (YNHP 2013).

No CNDDDB occurrence records exist for short-eared owl within 5 miles of LIER, and this species has not been recorded during avian surveys on Liberty Island. The marsh upland grassland and ruderal vegetation on the northern portion of the Island provide moderately suitable roosting and foraging habitat, but the lack of quality nesting habitat coupled with the rarity of this species makes it highly unlikely that nesting would occur.

Burrowing Owl

A year-round resident of the Central Valley, burrowing owl forages in grasslands, low shrublands, and agricultural fields and typically nests in underground burrows created by ground squirrels. Its prey species typically include insects, scorpions, small mammals, birds, amphibians, and reptiles.

There are numerous CNDDDB occurrence records of burrowing owls within 5 miles of LIER, most of which are located 4–5 miles northwest of Liberty Island and outside the floodplain of the Yolo Bypass. Upland habitat in the northern section of Liberty Island provides potentially suitable foraging habitat for burrowing owl. However, flooding that inundates all but the highest levees during the winter and spring in approximately 60% of water years likely reduces the quality of the foraging habitat and limits nesting on the Island.

Redhead

Considered a year-round resident, redhead is patchily distributed in the Central Valley. The breeding season extends from April through August; from mid-September to early April, migrants and winter

visitors from the north augment the relatively small breeding population (Shuford and Gardali 2008). Suitable nesting habitat has dramatically declined in the Central Valley because of the loss of vast wetland complexes, but small numbers of redheads still nest in publicly managed state and federal wildlife reserves and private duck clubs that maintain summer water greater than 3 feet deep. A few breeding pairs are documented each year within the YBWA and other parts of Yolo County (YNHP 2013), but no other recent nesting has been documented within 5 miles of LIER or in the surrounding region.

Redhead typically nests in freshwater emergent wetlands with dense stands of tule and cattails that are interspersed with areas of deep open water. Redheads are solitary, monogamous nesters that often parasitize the nests of other ducks (including redheads) and waterbirds. Nests built from marsh plants and secured to tall emergent vegetation are usually placed over water, but occasionally on islands or dry ground. Unlike the diet of most diving ducks, redheads' diet consists mostly of aquatic plants, but redheads occasionally take aquatic insects, grasshoppers, small clams, and snails (Shuford and Gardali 2008).

The combination of low reproductive success and high juvenile and adult mortality make this species especially vulnerable and threaten its population viability (Shuford and Gardali 2008). This species was not documented during avian surveys conducted by CDFW biologists from 2004 to 2007, but the dense freshwater marsh and deep-water aquatic habitat within Liberty Island provides suitable foraging habitat and potential nesting habitat.

Ferruginous Hawk

The ferruginous hawk is a winter visitor to the Central Valley, where it forages in open upland habitats such as grasslands. It preys primarily on rabbits and ground squirrels but can also take other small mammals and birds.

No CNDDDB occurrence records exist for ferruginous hawk within 5 miles of LIER, but it is occasionally observed foraging in upland habitats on the YBWA and could potentially forage in the northern portion of LIER.

Swainson's Hawk

This species breeds in California from March to September and migrates to wintering grounds in Mexico and South America. In recent years, however, a population of about 30 individuals has been wintering in the Delta (Estep 2001; Herzog 1996). Swainson's hawks typically nest in large native trees with a panoramic view of their foraging habitat, but they occasionally nest in nonnative trees, such as eucalyptus (*Eucalyptus* spp.) and pine (*Pinus* spp.). Nests occur in riparian woodlands, roadside trees, trees along field borders, isolated trees, and small groves, and on the edges of remnant oak woodlands. Swainson's hawk requires large areas of open landscape for foraging. With the substantial conversion of native grasslands to farming, this species now primarily nests and forages on agricultural lands that provide low, open vegetation and high rodent prey populations. Foraging usually occurs in adjacent grasslands, suitable grain or alfalfa fields, or livestock pastures; during the breeding season, Swainson's hawks prey on mice, gophers, ground squirrels, rabbits, large arthropods, amphibians, reptiles, and birds.

Numerous CNDDDB occurrence records document Swainson's hawk within 5 miles of LIER. The closest records document two active nest locations from 2001 to 2007 across the canal from the northwest corner of Liberty Island on Shag Slough. Numerous other nests are documented slightly farther away, but they occur in all directions relative to the Island. Upland habitat in the northern section of LIER provides potentially suitable foraging habitat for Swainson's hawk, and the riparian woodlands that line Shag Slough, Liberty Cut, and the canal that follows the northern "stair-step" provide moderately suitable nesting habitat.

Mountain Plover

This species is a short-distance migrant and winter visitor to California, primarily from September to mid-March, with peak numbers from December through February (Shuford and Gardali 2008). Mountain plovers breed and migrate into the Central Valley from east of the Rocky Mountains and as far north as Montana. Central Valley wintering populations are concentrated in two main areas—in Colusa, Yolo, and Solano Counties and from Stanislaus County south to Kern County—with two main populations in Yolo and King Counties (Shuford and Gardali 2008).

Mountain plovers are highly colonial and typically overwinter on dry alkali lakes, coastal prairies, fallow fields with short or limited vegetation, and barren habitats. Wintering plovers most frequently inhabit fallow, grazed, or burned sites with short and patchy vegetation and cover estimates of less than 65%, probably because most native grassland and playa habitat has been cultivated (Shuford and Gardali 2008). Plovers feed primarily on insects, specifically grasshoppers, crickets, beetles, flies, and earwigs that they take from cracks and crevices in the soil.

No CNDDDB occurrence records exist for mountain plover within 5 miles of LIER, and the habitat quality within most of LIER is marginal because of the lack of open fields with short, patchy vegetation. Suitable foraging habitat could exist in the open upland areas in the northern section of LIER, where periodic flooding and dry down occur and barren areas with short, patchy vegetation were observed during a summer site visit in 2014. However, during wet winters when the Yolo Bypass floods, no suitable habitat would be expected within LIER. .

Black Tern

This species is a summer resident that arrives in California from its South American wintering grounds in late April through mid-May. In the Central Valley, most black terns nest in rice fields, especially with small islands (dirt mounds), although they formerly nested in ephemeral seasonal marshes created from flood events (YNHP 2013). They tend to select nest sites in freshwater marshes containing vegetation that is tall and sparse or short and dense (YNHP 2013) and are semicolonial nesters, especially in productive foraging areas with clusters of 10–50 nests. Nests are built on floating mats, small islands or mounds, and even artificial platforms. In the Great Plains, black terns require large landscapes of wetland complexes and upland habitats and tend to nest in larger wetlands near untilled upland grasslands (YNHP 2013). Thus, the current habitat in the Central Valley is relatively unsuitable compared to historic conditions. Black terns forage primarily on insects but also consume small fish when available, and on spiders, grubs, crayfish, and small mollusks.

No CNDDDB occurrence records exist for black tern within 5 miles of LIER and this species was not documented by CDFW biologists from 2004 to 2007; however, the area's dense freshwater marsh and aquatic habitat could potentially provide suitable foraging and marginal nesting habitat for this species.

Northern Harrier

The northern harrier occurs year round within its breeding range in California. In the Central Valley, the species occurs in greater numbers during the winter, when migrants move into the area from Alaska and Canada and augment the resident population before heading farther south. Harriers in the Central Valley breed mainly at private or public wildlife refuges and in suitable agricultural fields and pasturelands (Shuford and Gardali 2008). They nest on the ground and forage in a variety of open habitats: marshes, grasslands, low shrublands, and agricultural fields. Their prey species consist of a variety of small mammals, such as rabbits, mice, voles, and small birds.

No CNDDDB occurrence records exist for northern harrier within 5 miles of LIER, but the species has been observed during avian surveys conducted on Liberty Island by CDFW biologists. It also is regularly observed in the YBWA, where it is known to nest and forage. The freshwater marsh and upland habitats in the northern section of LIER provide potentially suitable foraging habitat for northern harrier, and the upland areas with taller vegetation and grasses provide suitable nesting sites.

Western Yellow-Billed Cuckoo

This species is an uncommon to rare summer resident of valley and foothill riparian habitats in scattered and isolated locations in California. Birds arrive to breed from late June to mid-July after their northward migration from South America. After a relatively short postfledging period, cuckoos migrate out of California from approximately mid-August to early September. This species nests in valley and foothill riparian forest with densely foliated deciduous trees and shrubs, especially willows; other associated riparian vegetation includes cottonwood trees, blackberry, nettle, and wild grape. Western yellow-billed cuckoo feeds primarily on caterpillars, but also takes a variety of other insects, berries, grapes, and seeds.

No CNDDDB occurrence records exist for western yellow-billed cuckoo within 5 miles of LIER, but it has been occasionally documented in Colusa, Glenn, Butte, Sutter, and Yolo Counties within the last 20 years, and one unconfirmed breeding pair was recorded during a 2009 survey north of Walnut Grove, California. The riparian woodland habitat along the Little Holland Tract levee and around the northern stair steps that border LIER provides suitable foraging and moderately suitable nesting habitat for this species.

Snowy Egret

See the discussion of great egret, above.

White-Tailed Kite

A common year-round resident in coastal and valley lowlands, the white-tailed kite is rarely observed away from agricultural areas. It is not clear whether white-tailed kite migrates at all, but it may migrate short distances based on the availability of food prey (Zeiner et al. 2005). This species inhabits open lowland grassland, agricultural fields, riparian woodland, marshes, and scrub areas; prey species mainly

include small mammals, but occasionally include birds, lizards, and insects. White-tailed kites typically nest in the upper third of trees that may be 10–160 feet tall. These can be open-country trees growing in isolation, or at the edge of a forest or woodland.

No CNDDDB occurrence records exist for white-tailed kite within 5 miles of LIER, but this species is regularly observed in the area and is common in the YBWA, where it is known to nest and forage. The upland habitats in the northern section of LIER provide potentially suitable foraging habitat for white-tailed kite and the riparian woodlands in the same area provide suitable nesting trees and shrubs.

Little Willow Flycatcher

This neotropical migrant breeds in California from Tulare County north along the west side of the Sierra Nevada and Cascade Range, extending to the Northern California coast. It is one of four subspecies of willow flycatcher that all breed in North America and overwinter in Central and South America. Historically the low elevations of the San Joaquin and Sacramento Valleys were probably the prime habitat for little willow flycatcher, but much of the riparian deciduous shrub communities that once provided habitat have all but disappeared in California, especially in the Central Valley.

Much of the remaining habitat for little willow flycatcher in California now exists at the geographic and altitudinal extremes of the species' range, where late spring storms, isolation, or other unknown factors reduce the likelihood of successful breeding (Craig and Williams 1998). As a result, little willow flycatcher is now thought to occur only as a summer migrant in the Central Valley as it travels to and from its higher elevation breeding sites. It nests in montane riparian willows and migrates through the Central Valley in the spring and fall. During migration, this species is known to forage in the riparian woodlands within the YBWA, along Putah Creek, and in the toe drains of the Sacramento River levees. It feeds on a variety of insects and occasionally on berries and seeds.

No CNDDDB occurrence records exist for little willow flycatcher within 5 miles of LIER, but individuals are known to migrate through the area, and the riparian habitat within LIER provides suitable cover and foraging habitat for the species.

California Horned Lark

The California horned lark is a year-round resident in the Central Valley and elsewhere in California. Its documented range is from south of San Francisco Bay east to the San Joaquin Valley, and south to northern Baja California; however, it reportedly occurs year round and breeds in sparsely vegetated patches throughout the YBWA (DFG 2008). Migrant species from Canada can augment the year-round species during the winter, but they are a different subspecies. California horned lark inhabits flat plains with short vegetation (often less than 10 cm high) or bare ground, and is found in both grassland and fallow agricultural areas. It nests on the ground in a nest woven of fine grass or other plant materials, lined with finer material. Its diet consists primarily of weed and grain seeds, but it also eats ants, grasshoppers, and other insects.

No CNDDDB occurrence records exist for California horned lark within 5 miles of LIER, but the upland habitat within LIER provides suitable foraging and nesting habitat when not flooded.

Merlin, Prairie Falcon, and American Peregrine Falcon

These three species are primarily winter visitors to the Central Valley area and are well documented north of LIER, in the YBWA. No CNDDDB occurrence records exist for these three species within 5 miles of LIER, and they have not been recorded during avian surveys on Liberty Island.

Merlin breeds in the northern continental United States, Alaska, and Canada and migrates south into the vicinity of LIER for the winter. While in the area, it inhabits open forests, grasslands, agricultural fields, mudflats, and urban areas and feeds primarily on small shorebirds and passerines.

Prairie falcon is considered an uncommon permanent resident in the western states. In California it ranges from the southeastern deserts throughout the Central Valley and Sierra Nevada and the inner Coast Ranges. Prairie falcon generally nests outside the valley in foothill areas or at higher elevations in mountainous areas, where it scratches nests on overhanging, south-facing cliffs up to 500 feet high; however, it also nests in trees, on buildings, in caves, or in stone quarries. Migrants coming from the north winter in California and residents often wander upslope to breed in summer and back downslope for the winter. Prairie falcon forages in open grasslands and agricultural fields on small mammals and birds.

American peregrine falcon is a permanent resident in California in the Sierra Nevada, the Cascade Range, northeastern California, the Coast Ranges, and along the coast; however, in the winter its range expands into the Central Valley and Delta, where it often forages on a variety of birds along shorelines of large bodies of water. Although the species is not expected to nest in the Central Valley, the riparian woodlands, freshwater marsh, mudflats, and associated shorelines within LIER could serve as winter foraging habitat. Peregrine falcons have reportedly become more common in the YBWA since shorebird management activities were implemented in 2002.

Greater Sandhill Crane

The greater sandhill crane is a winter resident in the Central Valley from mid-September to early April, although most cranes depart by late February (Shuford and Gardali 2008). This species begins its migration in the Pacific Flyway as far north as Siberia and Alaska, and cranes migrate as far south as Central America. The Central Valley population of greater sandhill crane also supports populations that breed in northeastern California and parts of Nevada, Oregon, Washington, and British Columbia (Audubon California 2014). In the Central Valley, cranes overwinter and feed in agricultural fields and wetlands, mainly south of Yolo County and LIER, in large preserves and agricultural areas that provide abundant food and suitable habitat. Harvested cornfields are the most commonly used foraging habitat, along with winter wheat, alfalfa, pasture, and fallow fields (Pogson and Lindstedt 1988). Besides feeding, the cranes usually loaf midday along agricultural field borders, levees, rice-checks, and ditches. Nighttime roost sites are typically located within 3 miles of foraging and loafing areas, in open fields with shallow water or wetlands interspersed with uplands. Greater sandhill cranes feed mainly on seeds and cultivated grains, but they also eat berries, tubers, small vertebrates, and invertebrates.

No CNDDDB occurrence records exist for greater sandhill crane within 5 miles of LIER, and the habitat quality within most of LIER is marginal because of deep water and a lack of primary food sources. However, areas with shallow water in wetland and seasonally flooded upland habitat could provide suitable loafing and even feeding habitat. Water levels in agricultural fields and wetlands in the northern

management units of the YBWA provide high-quality habitat for cranes and similar species, and they are seen foraging there on a regular basis each year.

Bald Eagle

A year-round resident at higher elevation areas of California, the bald eagle is a winter resident in numerous traditionally used sites throughout the state, mainly near large lakes. This species typically nests in forested areas adjacent to large water bodies and avoids heavily developed areas when possible. Bald eagles are tolerant of human activity when feeding, and they forage over open water for fish. Bald eagle is also known to prey on birds, reptiles, amphibians, invertebrates such as crabs, and mammals including rabbits and muskrats.

No CNDDDB occurrence records exist for bald eagle within 5 miles of LIER, and this species has not been recorded during avian surveys on Liberty Island. However, bald eagle is known to forage in the YBWA and could forage over the large areas of open water, along the shorelines, and in the freshwater marsh habitat.

Loggerhead Shrike

The loggerhead shrike is present year round throughout most of California, but breeding populations in the northern part of the state (north of 39° north latitude or approximately north of Yolo County) and possibly elsewhere migrate south to overwinter; additionally, breeding populations from as far north as Canada are thought to migrate to and overwinter in California, where they augment year-round resident populations (Shuford and Gardali 2008). Loggerhead shrike breeds in large shrubs or trees in shrubland, sparse riparian woodland, oak woodland and savanna, chaparral, shrub steppe, desert scrub, and occasionally in rural and agricultural areas with shrubs and trees. Breeding generally occurs from February to July. California loggerhead shrikes hunt from perches and take prey primarily from the ground, and they require sharp objects such as thorny branches or barbed wire fence to impale and manipulate their prey. Their diet varies seasonally and includes arthropods (especially crickets, grasshoppers, beetles, and caterpillars), reptiles, amphibians, small rodents, and birds.

No CNDDDB occurrence records exist for California loggerhead shrike within 5 miles of LIER, but the species is known to forage and nest throughout the YBWA. LIER does not provide high-quality habitat, but open upland areas with shrubs and trees and riparian woodland habitat could provide suitable foraging and nesting habitat for this species.

California Gull

The California gull overwinters along the California coast and appears in the Central Valley throughout much of the year during its migration through the area. It breeds inland across large areas of the West from around Lake Tahoe northeast to Manitoba (BNA 2014). California gull forages in open water, wetlands, agricultural fields, parking lots, and landfills; it feeds on fish, insects and marine invertebrates, small mammals, fruit, and garbage. Although this species does not breed in the Central Valley, individuals forage throughout the Yolo Bypass and are most common during the winter floods.

No CNDDDB occurrence records exist for California gull within 5 miles of LIER, but this species was recorded by CDFW biologists from 2004 to 2007 and is regularly observed foraging in the Yolo Bypass.

The open water, wetland, and upland areas within LIER provide suitable foraging habitat for California gull.

California Black Rail

California black rail is considered a year-round resident that primarily inhabits and breeds in estuaries around San Francisco Bay and Suisun Marsh. Recent research, however, has documented small but extensive populations breeding in emergent wetlands with shallow perennial water throughout the northern Sierra Nevada foothills (Richmond et al. 2008, 2010). Of 164 marshes where black rails were located, 19 were at the eastern edge of the Sacramento Valley, but none were located in areas of the valley floor (Richmond et al. 2008).

Water depth is an important parameter for successful California black rail nest sites because rising water levels can flood and prevent nesting and can reduce access to foraging habitat; too little water will lead black rails to abandon the site until the water source is reestablished (YNHP 2013). The breeding season extends from approximately February through July, during which black rails build their nests on the ground, often under a dense canopy of vegetation. Their diet consists of a variety of insects, spiders, small crustaceans, snails, and seeds.

No CNDDDB occurrence records exist for California black rail within 5 miles of LIER, and the habitat quality within LIER is marginal because of fluctuating water depths associated with winter flooding within the Yolo Bypass. However, the density and extent of freshwater marsh habitat in the northern section of Liberty Island could provide moderately suitable cover and possibly breeding habitat. Because there are reports that California black rails may breed in the Yolo Basin (YNHP 2013), this species has the potential to occur within LIER.

Long-Billed Curlew

The long-billed curlew is a winter resident in the Central Valley and along the California coast from July to April. Summer breeding occurs mainly east of California, from southern Canada south to near Colorado, but small populations breed in wet meadow habitat in northeastern California in Siskiyou, Modoc, and Lassen Counties. In the Central Valley, long-billed curlew can be found in wetlands, tidal estuaries, mudflats, and flooded agricultural fields. The diet of the long-billed curlew consists of insects, crustaceans, clams, other bottom-dwelling marine invertebrates, and occasionally small fish, mammals, nestling birds, and berries (BNA 2014; Zeiner et al. 2008b).

No CNDDDB occurrence records exist for long-billed curlew within 5 miles of LIER, but this species was recorded by CDFW biologists from 2004 to 2007 and is regularly observed foraging in the Yolo Bypass. The wetland, mudflat, and flooded upland habitats within LIER provide suitable foraging habitat for long-billed curlew.

Osprey

The osprey breeds in Northern California from the Cascade Range south to Lake Tahoe, and along the coast south to Marin County. Most ospreys that breed in these areas migrate to Central and South America for the winter, with migration routes following wide areas through the state. Osprey forages

almost exclusively for fish over open water, but on rare occasions it has also been observed feeding on fish carcasses or on birds, snakes, voles, squirrels, muskrats, and salamanders (BNA 2014).

No CNDDDB occurrence records exist for osprey within 5 miles of LIER. However, osprey has been observed during avian surveys conducted on Liberty Island by CDFW biologists, and it is occasionally observed foraging in the YBWA to the north. The open water, wetlands, riparian woodlands, and uplands provide suitable foraging habitat; therefore, this species could forage within LIER in the winter.

American White Pelican

This species breeds in the northeastern portion of California and in patches through the intermountain West and farther north into Canada. The breeding population is divided into two groups that migrate east and west, but a large portion overwinters along the Pacific coast and lowland areas of central California. Additionally, small numbers of nonbreeding individuals may summer nearly anywhere in the normal migrant and winter ranges (Shuford and Gardali 2008). American white pelican forages for fish in open water and is abundant at the YBWA throughout the year. Winter floodwaters support a nationally significant percentage of the American white pelican population (Yolo Audubon Society Checklist Committee 2004). Smaller numbers of birds forage within the Yolo Bypass throughout the year, especially in midsummer, when birds from distant breeding colonies disperse.

No CNDDDB occurrence records exist for American white pelican within 5 miles of LIER, but individuals have been observed loafing on the open-water habitat within LIER

Double-Crested Cormorant

This species is a year-round resident along the entire California coast and on inland freshwater lakes and salt and estuarine waters. From May to August, populations of double-crested cormorants in lacustrine and riverine habitats in the Central Valley and coastal slope lowlands increase as winter migrants augment the resident population. Migrants winter mainly along the California coast and over the Coast Ranges into the Central Valley. Residents nest colonially in undisturbed riparian woodlands or on the ground, on rocks or reefs, with no vegetation; they have been documented in Yolo and Sacramento Counties and in the San Francisco Bay area. Trees that support nests may be alive when a cormorant colony first forms, but typically die after a few years from the guano buildup (BNA 2014). Cormorants are diving birds that feed mainly on fish but occasionally eat insects and crustaceans.

No CNDDDB occurrence records exist for double-crested cormorant within 5 miles of LIER; however, during avian surveys conducted by CDFW biologists from 2004 to 2007, a cormorant rookery was documented in riparian woodland habitat just outside LIER, on the Little Holland Tract levee. Riparian woodland habitat on Liberty Cut, Shag Slough, and the canal following the northern “stair-steps,” and on larger levee remnants remaining as islands are potentially sites for rookeries; however, this species prefers large, tall trees, which are limited. The abundant fish populations in the open waters provide a consistent food source for this species throughout the year.

White-Faced Ibis

The white-faced ibis is an uncommon summer resident and localized breeder in the Central Valley and elsewhere in California. It nests in scattered locations in the San Joaquin Valley, and in recent years it has

established breeding colonies in the Sacramento Valley (The Natomas Basin Conservancy 2014). This species is not known to nest within LIER or the YBWA to the north, but a breeding colony has been documented every year since 2007 in the Natomas Basin approximately 28 miles to the northwest. Since then, numbers of the white-faced ibis have increased in the basin, and approximately 2,500 pairs of ibises were recorded nesting at this site in 2010 (The Natomas Basin Conservancy 2014). Large breeding colonies have been reported in the Mendota Wildlife Area and the Colusa National Wildlife Refuge (The Natomas Basin Conservancy 2014).

The winter range of white-faced ibis is predominantly coastal Louisiana and Texas south to Mexico, but some winter groups occur locally around Los Banos in Merced County in California. There is some indication that the ibises breeding in California are actually resident populations, but more research is needed (The Natomas Basin Conservancy 2014). The white-faced ibis forages in shallow, emergent wetlands with high-quality freshwater, and in wet meadows, irrigated pasture, flooded pond edges, and wet cropland such as rice. For nesting, ibises typically use large emergent wetlands with islands of dense emergent vegetation. This species is a colonial breeder and builds a shallow nest in thick emergent vegetation such as tule or cattail, in shrubs, or in low trees. The diet of the white-faced ibis consists of invertebrates, crustaceans, frogs, and fishes. Predators include skunks, coyotes, and raptors such as peregrine falcons and red-tailed hawks. Ibis chicks may be vulnerable to predators like gulls and night herons.

No CNDDDB occurrence records exist for white-faced ibis within 5 miles of LIER, but this species was recorded by CDFW biologists from 2004 to 2007 within LIER and is regularly observed foraging in the Yolo Bypass. The upland and large areas of freshwater marsh within LIER provide suitable foraging and potential nesting habitat for white-faced ibis.

c. Mammals

Pallid Bat

Pallid bat occurs throughout the Central Valley in a variety of habitats including all types of woodland, grassland areas, wetlands, orchards, vineyards, and cropland if appropriate roosting sites are available. This species roosts in crevices or cavities found in natural features such as trees, cliffs, caves, and rocky outcrops, and in human-made features such as barns, bridges, mines, and attics (YNHP 2013).

Reproduction by the pallid bat is centered around meeting its energetic demands. Its annual cycle includes an approximate 7- to 8-month period of peak activity in spring and summer, when insects are most available and reproduction occurs. When insect prey is less available, pallid bats either hibernate to conserve energy or migrate to more suitable habitat; in mild winters, they may reside year round and alternate between activity and hibernation (YNHP 2013). In April and May, pregnant females gather in maternity colonies that can be up to several hundred individuals, and males usually occur separately in bachelor groups. Females normally give birth to twin young in May or June. Johnston et al. (2006) found that male and female pallid bats roost together and are intermittently active throughout the winter along riparian corridors on the coast.

No CNDDDB occurrence records exist for pallid bat within 5 miles of LIER, but they are difficult to observe and identify. The riparian woodlands along the eastern and northern boundary of LIER could

provide suitable foraging and or roosting habitat, but it is uncertain whether they would support maternity colonies.

Western Red Bat

Western red bat is found throughout the Central Valley in broadleaf tree communities in woodlands, agricultural areas, and urban areas with mature trees. This species roosts in the foliage of large shrubs and trees, usually sheltering on the underside of overhanging leaves. It often hangs from one foot on the leaf petiole but may occasionally hang from a twig or branch. Roost trees are typically large cottonwoods, sycamores, walnuts, and willows associated with riparian habitats (YNHP 2013). They feed on a variety of insects around the woodlands. Western red bats roost in or in areas next to rivers and streams; water is a vital habitat component because bats often drink immediately after emergence and water is an important source and concentration site for insects (YNHP 2013).

Western red bats are usually solitary, except when adult females are with their young after they are born, from late spring to early summer. Individuals appear to stay in California year round because there are occurrence records for every month of the year (Pierson et al. 2004). There is evidence of seasonal movements by western red bats in California, but little evidence of mass migrations; based on museum and capture records, the Central Valley contains the highest numbers of breeding females and is of primary importance to breeding populations (Pierson et al. 2004).

Although no CNDDDB occurrence records exist for bat species within 5 miles of LIER, they are known to occur throughout the Central Valley, and the riparian habitat along the eastern and northern sections of LIER provides suitable roosting and foraging habitat.

Ringtail

The ringtail is a nonmigratory species that is nocturnal and active year round. It is considered widely distributed in California and is believed to be a common to uncommon permanent resident. In the Central Valley, ringtails occur almost exclusively in riparian forests along major waterways such as the Sacramento River, American River, and Feather River. The species' principal habitat requirements are thought to be den sites among boulders or in tree hollows with sufficient food in the form of rodents or other small animals. Ringtails mate in late winter and a litter of three or four young are born in May or June (YNHP 2013).

No CNDDDB occurrence records exist for ringtail within 5 miles of LIER, but because of the species' secretive nature, there is little documentation about known occupied areas in the region. However, ringtail is likely to occur along the Sacramento River, Putah Creek, and Cache Creek, and potentially in other smaller drainages with sufficient riparian habitat with suitable rocky areas or tree hollows for den sites (YNHP 2013).

3. Special-Status Fish Species

Special-status fish species are legally protected or are otherwise considered sensitive by federal, state, or local resource conservation agencies and organizations. The following special-status fish species are addressed in this section:

- ▶ species listed as threatened or endangered under the federal ESA or CESA;
- ▶ species identified by USFWS, NMFS, or CDFW as species of special concern; and
- ▶ species fully protected in California under the California Fish and Game Code.

As described below and in Table 3-4, 12 special-status fish species occur or have the potential to occur within LIER. Central Valley Steelhead DPS, Central Valley Spring-run Chinook Salmon ESU, Sacramento River Winter-run Chinook Salmon ESU, Southern Green Sturgeon DPS, Delta Smelt, and Longfin Smelt are federally and/or state listed as threatened or endangered. NMFS determined that listing is not warranted for the Central Valley Fall-/Late Fall-run Chinook Salmon ESU. However, this species is designated as a federal species of concern and a state species of special concern because of specific risk factors. The Sacramento Splittail was delisted by USFWS from its federally threatened status on September 22, 2003, but it remains listed as a state species of special concern. Pacific Lamprey is listed as a federal species of concern, and Hardhead, Sacramento Perch, and River Lamprey are listed as state species of special concern.

a. Steelhead

Central Valley Steelhead DPS is federally listed as a threatened species. The DPS includes all naturally spawned populations of Steelhead in the Sacramento and San Joaquin Rivers and their tributaries (McEwan and Jackson 1996). Steelhead have a complex life history that includes the capability to be anadromous or resident; the resident form is referred to as rainbow trout (Moyle 2002).

Central Valley Steelhead DPS is classified as winter run with peak adult migration through the Delta, including Liberty Island, occurring from September through February (Busby et al. 1996). Movements of adult Steelhead from freshwater holding areas to spawning grounds can occur any time from December to March, with peak activities reportedly occurring in January and February (Moyle 2002). Spawning typically occurs from December to April at higher elevations in higher gradient streams and rivers. Unlike salmon, a small percentage of the adult Steelhead spawning population is iteroparous (i.e., reproduces more than once in a lifetime).

Steelhead eggs hatch in 3–4 weeks (at 50–59°F) and fry emerge from the gravel substrates 2–3 weeks later (Moyle 2002). Following emergence, juveniles rear and mature in freshwater for 1–3 years, usually 2 years, before emigrating to the ocean (Moyle 2002). Juvenile Steelhead emigration through the Delta generally occurs in spring and early summer. Initially, juvenile Steelhead are found in or near natal spawning streams. Juvenile Steelhead may move downstream into larger stream segments, including the mainstem Sacramento River, as they grow and mature. Juvenile Steelhead present in the Delta are usually migrants and move through the Delta and into marine areas relatively quickly. Steelhead typically spend 2 years maturing in the ocean before returning to natal freshwater streams to spawn.

Central Valley waterways currently supporting Steelhead include the upper Sacramento, Feather, Yuba, American, Mokelumne, Calaveras, Tuolumne, Merced, and Stanislaus Rivers, and Mill, Deer, and Butte Creeks (McEwan 2001; Ford and Kirihara 2010).

Table 3-4. Special-Status Fish Species Known from or with Potential to Occur within Liberty Island Ecological Reserve				
Species	Status ¹		Habitat	Potential for Occurrence
	USFWS/ NMFS	CDFW		
Central Valley Steelhead DPS <i>Oncorhynchus mykiss</i>	T	–	Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta.	Occurs in the Sacramento River and tributaries. Occurs seasonally within LIER.
Sacramento River Winter-run Chinook Salmon ESU <i>Oncorhynchus tshawytscha</i>	E	E	Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta.	Occurs in the Sacramento River and tributaries. Occurs seasonally within LIER.
Central Valley Spring-run Chinook Salmon ESU <i>Oncorhynchus tshawytscha</i>	T	T	Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta.	Occurs in the Sacramento River and tributaries. Juveniles occasionally occur seasonally within LIER.
Central Valley Fall/Late Fall-run Chinook Salmon ESU <i>Oncorhynchus tshawytscha</i>	SC	SSC	Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta.	Occurs in the Sacramento River and tributaries. Occurs seasonally within LIER.
Green Sturgeon Southern DPS <i>Acipenser medirostris</i>	T	SSC	Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta.	Occurs in the Sacramento River and tributaries. Has potential to occur within LIER.
Delta Smelt <i>Hypomesus transpacificus</i>	T	E	Spawns in tidally influenced channel habitats; rears seasonally in inundated floodplains, tidal marsh, and the Delta.	Occurs in the Sacramento River downstream of its confluence with the American River. Occurs seasonally within LIER.
Longfin Smelt <i>Spirinchus thaleichthys</i>	–	T	Spawns in tidally influenced freshwater channel habitats; rears seasonally in inundated floodplains, tidal marsh, and the Delta.	Occurs in the Sacramento River downstream of its confluence with the American River. Occurs seasonally within LIER.
Sacramento Splittail <i>Pogonichthys macrolepidotus</i>	DT	SSC	Spawning and juvenile rearing occur from winter to early summer in shallow weedy areas inundated during seasonal flooding in the lower reaches and flood bypasses of the Sacramento River, including the Yolo Bypass.	Occurs in the Delta and Sacramento River and tributaries. Occurs seasonally within LIER and breeds successfully.
Hardhead <i>Mylopharodon conocephalus</i>	–	SSC	Spawning occurs in pools and side pools of rivers and creeks; juveniles rear in pools of rivers and creeks, and in shallow to deeper water of lakes and reservoirs.	Occurs in freshwater portions of Sacramento River and tributaries. Occurs seasonally within LIER.

Table 3-4. Special-Status Fish Species Known from or with Potential to Occur within Liberty Island Ecological Reserve

Species	Status ¹		Habitat	Potential for Occurrence
	USFWS/ NMFS	CDFW		
Sacramento Perch <i>Archoplites interruptus</i>	–	SSC	Spawning has been reported to extend from spring to late summer, depending on location and water temperature, among aquatic plants or congregating in shallow waters in schools among or near inshore vegetation.	Historically occurred in the Sacramento and San Joaquin Rivers and tributaries; depleted in native range, and now are restricted to a few locations, principally ponds and reservoirs where they are stocked. Has the potential to occur in low numbers within LIER.
Pacific Lamprey <i>Lampetra tridentata</i>	SC	–	Spawning occurs in wider, low elevation streams in gravel substrates, usually in pool tail-outs and low gradient riffles. Juveniles rear in backwater or eddy areas of low stream velocity where sediments are soft and rich in dead plant material.	Occurs in the Sacramento River and tributaries. Adults occur seasonally within LIER; juveniles may occur year-round within LIER.
River Lamprey <i>Lampetra ayresi</i>	–	SSC	Spawning occurs in mid-elevation streams in gravel substrates, usually in pool tail-outs and low gradient riffles. Juveniles rear in backwater or eddy areas of low stream velocity where sediments are soft and rich in dead plant material.	Occurs in the Sacramento River and tributaries. Adults occur seasonally within LIER; juveniles may occur year-round within LIER.

Notes: CDFW = California Department of Fish and Wildlife; Delta = Sacramento–San Joaquin Delta; LIER = Liberty Island Ecological Reserve; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service

¹ Legal Status Definitions	
USFWS and NMFS	CDFW
E Endangered (legally protected)	E Endangered (legally protected)
T Threatened (legally protected)	T Threatened (legally protected)
DT Delisted from threatened status	FP Fully protected (legally protected, no take allowed)
SC Species of concern	SSC California species of special concern (no formal protection)

Source: Data compiled by AECOM in 2013

b. Chinook Salmon

Chinook Salmon are relatively common in the Sacramento and San Joaquin Rivers. Chinook Salmon runs are distinguished by several physical and temporal properties, including most fish entering freshwater, the time of spawning migrations, spawning areas, incubation times, incubation temperature requirements, and migration timing of juveniles (DFG 1995). Adults and juveniles move through Liberty Island and other areas in the Yolo Bypass during migrations to and from the ocean. These areas are migratory corridors and provide juvenile rearing habitat. During higher flows, a higher number of adults and juveniles would be expected to utilize Liberty Island and the Yolo Bypass.

Three special-status Chinook Salmon ESUs are present within Liberty Island—winter-run, spring-run, and fall/late fall–run:



Source: USFWS

The *Sacramento River Winter-run Chinook Salmon ESU* is listed as endangered under the CESA and ESA. Designated critical habitat includes the Sacramento River but does not include Liberty Island or other areas within the Yolo Bypass. Adult Winter-run Chinook Salmon migrate into the Sacramento River from November through May and migrate past the Red Bluff Diversion Dam from mid-December through early August (Hallock and Fisher 1985). Adults will hold in deep pools for several months before moving to spawning areas and spawning from April through August (Moyle 2002). Peak spawning occurs in May and June (Vogel and Marine 1991; Hallock and Fisher 1985). Juveniles typically rear in freshwater habitats for 5–9 months before emigrating to the ocean (Moyle 2002).

The *Central Valley Spring-run Chinook Salmon ESU* is listed as threatened under the CESA and ESA. Designated critical habitat includes the Sacramento River, Yolo Bypass, Cache Slough, and Miners Slough. Historically, Spring-run Chinook Salmon ascended to streams at the very highest elevations and headwaters throughout the Central Valley (Moyle 2002). However, current access to most historical spawning habitat is restricted because of dam construction. Spring-run Chinook Salmon exhibit a stream-type life history where adults enter natal tributaries as sexually immature fish and hold in the river over the summer while gonadal maturation takes place (DFG 1998; Moyle 2002). Spring-run Chinook Salmon enter the Sacramento River system between March and September and move upstream into the headwaters, where they hold in pools until they spawn between August and October (Moyle 2002). Juveniles typically emigrate from mid-November through June; however, some juveniles spend a year in the streams and emigrate as yearlings during the following October (Moyle 2002).

The *Central Valley Fall/Late Fall-run Chinook Salmon ESU* is a federal species of concern. Fall-run Chinook Salmon is the most widely distributed and most numerous run occurring in the Sacramento and San Joaquin Rivers and their tributaries (McEwan and Jackson 1996). Eggs generally hatch 6–12 weeks after spawning and newly emerged larvae remain in gravel substrates for an additional 2–4 weeks until the yolk is absorbed. Fall-run juveniles can rear in freshwater for up to 5 months before emigrating to the ocean. Fall-run Chinook Salmon historically spawned in Putah Creek. After decades of sparse occurrences, they returned to spawn in lower Putah Creek in recent years (Lower Putah Creek Coordinating Committee 2005).

c. Green Sturgeon

Green Sturgeon Southern DPS is listed as threatened under the ESA and a species of special concern under the CESA. Green Sturgeon is an anadromous species that spawns in freshwater in the Central Valley and returns to San Francisco Bay and nearshore marine waters to feed and mature. Adults are largely marine and migrate considerable distances along the Pacific coast. Green Sturgeon occur in the lower reaches of large rivers, namely the Sacramento, San Joaquin, Eel, Mad, Klamath, and Smith Rivers (Moyle et al. 1992). Green Sturgeon adults and juveniles occur throughout the upper Sacramento River, based on observations incidental to Winter-run Chinook Salmon monitoring at the Red Bluff Diversion Dam in Tehama County (NMFS 2005).

Green Sturgeon individuals migrate up the Sacramento River from February through July (Moyle 2002). Spawning occurs primarily in the upper Sacramento River from March through July, with peak spawning occurring mid-April through mid-June (Moyle et al. 1992). Spawning occurs in deep, fast water; females produce 60–140,000 eggs that are broadcast and fertilized over cobble substrate (Moyle 2002). Adults sexually mature after 13–20 years and then spawn every 2–5 years (Adams et al. 2007). Juveniles migrate to the ocean after rearing in estuarine habitat for approximately 4–6 years (Kohlhorst et al. 1991).

Green Sturgeon have been recorded in the toe drain of the Yolo Bypass and Cache Slough; it is highly likely that they occur within LIER.

d. Delta Smelt

Delta Smelt are endemic to the Delta estuary and inhabit freshwater portions of the Delta, the Sacramento and San Joaquin Rivers, and low-salinity areas of Suisun Bay. Substantial declines in delta Smelt abundance indices in recent years (<http://www.dfg.ca.gov/delta/data/fmwt/indices.asp>), as well as declines in the abundance of other pelagic fish species, have led to widespread concern about the pelagic fish community of the Bay-Delta estuary. Recent and ongoing analyses have focused on identifying the factors potentially influencing the status and abundance of Delta Smelt and other pelagic fish species in the estuary.



Source: USFWS

The CDFW fall midwater trawl surveys provide indices of adult Delta Smelt abundance during the late fall. Indices of Delta Smelt abundance have varied substantially among years. Abundance indices were highest from 1970 through 1980. This period was followed by a general decline in abundance extending through the mid-1980s (with the exception of 1980). Abundance from 1991 through 2000 was variable

but generally higher than during the prior decade. Abundance indices for Delta Smelt were persistently low from 2002 through 2013 and included some of the lowest indices on record.

Delta Smelt are relatively short (2–4 inches long) and have a 1-year life cycle, although some individuals may live for 2 years. Adult Delta Smelt migrate upstream into channels and sloughs of the Delta during the winter to prepare for spawning. Delta Smelt live their entire life cycle in the Bay-Delta estuary. Juveniles and adults typically inhabit open waters of the Delta.

Spawning occurs between February and July, with peak spawning occurring from April through mid-May (Moyle 2002). Females deposit adhesive eggs on substrates such as gravel and sand. Eggs hatch, releasing planktonic larvae that are passively dispersed downstream by river flow. Larval and juvenile Delta Smelt rear in the estuary for 6–9 months before beginning their upstream spawning movement into freshwater areas of the lower Sacramento and San Joaquin Rivers.

According to Sommer and Mejia (2013), the Napa River, a tributary to San Pablo Bay, is periodically occupied by Delta Smelt, usually during wet years. Hobbs et al. (2007) reported that occupation of the Napa River results in distinctive signatures in otoliths and the percentage of the Delta Smelt population utilizing the Napa River can be significant (e.g., 16% to 18% of the population in 1999).

Several studies have confirmed the importance of the Cache Slough Complex and the north Delta, including Liberty Island, as Delta Smelt habitat (Merz et al. 2011). Sommer et al. 2011 collected Delta Smelt in Cache Slough during all months of the year except August. In addition, expanded tow net and midwater trawl surveys have collected Delta Smelt in the Sacramento Deep Water Ship Channel from June through October (Baxter et al. 2010). The findings of these studies and surveys contradict the general belief that Delta Smelt utilized only the Cache Slough Complex and the north Delta for spawning, with juveniles leaving the area shortly after hatching (Sommer and Mejia 2013). Flooded islands were also considered poor-quality habitat because of aquatic vegetation and predator abundance (Grimaldo et al. 2004; Nobriga et al. 2005).

Delta Smelt may reside year round in the Liberty Island area because of the high diversity of habitats: channels of multiple sizes, broad shoals, tidal marshes, and dead-end sloughs (Lehman et al. 2010; McLain and Castillo 2010; Sommer and Mejia 2013). Key physical processes in Liberty Island, the Cache Slough Complex, and the north Delta that may contribute to year-round occupation include wind resuspension of sediments that generate higher turbidities than other parts of the Delta (Morgan-King and Schoellhamer 2013), and channels and shoals with long residence times that help generate relatively high levels of phytoplankton and zooplankton (Lehman et al. 2010; Nelson et al. 2011).

Juvenile and adult Delta Smelt are usually most abundant in the central and west Delta during the winter and early summer, as reflected in CVP and SWP fish salvage records. Juveniles and adults do not typically inhabit the south Delta during the summer when water temperatures exceed approximately 25 degrees Celsius. High water clarity tends to keep Delta Smelt out of the south Delta during the fall (Nobriga et al. 2008; Feyrer et al. 2007).

As described by Moyle (2002), environmental and biological factors affecting the abundance of Delta Smelt in the Delta include:

- ▶ changes in the seasonal timing and magnitude of freshwater inflow to the Delta and outflow from the Delta;
- ▶ impingement and entrainment of larval, juvenile, and adult Delta Smelt at numerous unscreened water diversions (primarily agricultural) located throughout the Delta;
- ▶ impingement, entrainment, and salvage mortality at CVP and SWP water export facilities;
- ▶ predation by Striped Bass and other fish species inhabiting the estuary;
- ▶ toxic substances and variation in the quality and availability of low-salinity habitat in the Delta and Suisun Bay in response to seasonal and interannual variability in hydrologic conditions in the Delta; and
- ▶ reduced food (prey) availability related to reduced primary production, which is related in part to a reduction in seasonally inundated wetlands, competition for food resources with nonnative fish and macroinvertebrates, and competition among native and nonnative zooplankton species.

In June 2007, the California Fish and Game Commission accepted a petition to change the CESA status of Delta Smelt from threatened to endangered. On January 20, 2010, Delta Smelt were officially listed as endangered under the CESA. The species is listed as threatened under the ESA. Critical habitat for Delta Smelt in the Delta has been designated by USFWS.

e. Longfin Smelt

Longfin Smelt is a small, planktivorous fish found in several Pacific coast estuaries from San Francisco Bay to Prince William Sound, Alaska. The species is a nektonic, anadromous smelt (family Osmeridae) found in California's bay, estuary, and nearshore coastal environments from San Francisco Bay north to Lake Earl near the Oregon border. The southernmost detection for the species was a single fish from Monterey Bay (Eschmeyer et al. 1983), although spawning has not been documented south of San Francisco Bay. The San Francisco estuary and the Delta support the largest Longfin Smelt population in California. A portion of this population is known to occupy waters near the Farallon archipelago. Most descriptions of Longfin Smelt life history in California focus on the San Francisco Bay and Delta populations. Longfin Smelt are more broadly distributed throughout the Bay-Delta estuary than Delta Smelt and are found in water with higher salinities. Longfin Smelt are most often concentrated in Suisun, San Pablo, and north San Francisco Bays outside of the spawning period (Moyle 2002).

Longfin Smelt have a short life span. Most reach maturity at 2 years of age, and can grow to 140 mm in length. Most live only 2 years, but 3-year-old smelt have been observed. During the second year of life, adults tend to inhabit the higher salinity western portion of the estuary system; occasionally they have been found in nearshore ocean surveys (Rosenfield and Baxter 2007). Adults spend their lives in bays, estuaries, and nearshore coastal areas and migrate into low-salinity or freshwater reaches of coastal rivers and tributary streams to spawn.

Longfin Smelt generally spawn during the second year of life, although some speculate that 1- and 3-year-olds also spawn (DFG 2009). Spawning occurs in the lower portions of the Sacramento and San

Joaquin Rivers and adjacent sloughs typically between November and June, with peak spawning occurring from February through April (Baxter et al. 1999; DWR 2009; Moyle 2002; Wang 1986). Outside of the spawning period, they are most often concentrated in Suisun, San Pablo, and north San Francisco Bays (Moyle 2002). Longfin Smelt spawn demersal, adhesive eggs in river channels of the Delta. Most adults die after spawning (i.e., they are semelparous, reproducing only once in a lifetime).

Fertilized eggs hatch after approximately 40 days of development (Dryfoos 1965; DWR 2009; Moyle 2002). Newly hatched larvae are 5–8 mm long, are buoyant, and are quickly swept downstream as part of the planktonic drift community into brackish nursery areas. Larvae are distributed near the surface of the water column, with the highest densities occurring in close association with the position of X2, which is defined by the 2-parts-per-thousand isohaline (Wang 1986; Dege and Brown 2004).

Competent-swimming young juveniles disperse toward more saline, deeper water habitats. Juveniles and subadults are widely distributed throughout the year in brackish and marine environments and typically in water more than 7 m deep (Rosenfield and Baxter 2007). Both life stages apparently have seasonal migrations, tending to move downstream during the summer months and upstream in the late fall and winter (Rosenfield 2010). The locations and movements of all life stages of Longfin Smelt are influenced by a wide range of hydrologic and environmental variables (Rosenfield 2010), all of which show high variation among and within years. Accordingly, temporal and spatial distributions of Longfin Smelt show high variation among and within years.

Longfin Smelt was one of the most common fish species in the Delta, although abundance has fluctuated widely in the past. Abundance has declined substantially since 1982, reaching its lowest levels during drought years. Abundance indices, although variable, show a general pattern of decline between 1967 and 2013; some of the lowest indices on record were from 2007 through 2013. Causes of decline are likely multiple and synergistic, including:

- ▶ reduced Delta outflow;
- ▶ increased impingement and entrainment losses to water diversions;
- ▶ reduced spawning and rearing habitat;
- ▶ reduced food availability;
- ▶ climatic variation;
- ▶ possibly toxic substances, although there is no known direct link between chemical concentration and larval mortality; and
- ▶ predation by introduced species.

On August 8, 2007, the Bay Institute, the Center for Biological Diversity, and the Natural Resources Defense Council petitioned the California Fish and Game Commission to list the Longfin Smelt as an endangered species under the CESA on an emergency basis. The commission rejected the request to list on an emergency basis, but forwarded the petition to DFG (now CDFW) for a 90-day review. The petition made the following points:

- ▶ Available scientific information and monitoring data indicate that the abundance of Longfin Smelt in all major estuaries in California (which is the southern extent of the species' range) has declined severely in the past two decades.
- ▶ In the San Francisco Estuary and the Delta, which supports the largest and southernmost population of Longfin Smelt, abundance has reached record low levels.
- ▶ In some smaller California estuaries to the north, the species may already be extinct.

Given these trends, it was determined that Longfin Smelt in California met the criterion for threatened or endangered status. On February 2, 2008, the California Fish and Game Commission accepted the petition, thereby designating the Longfin Smelt as a candidate species (with the same protections against take afforded to listed species) and initiating a year-long status review by DFG. On March 5, 2009, the California Fish and Game Commission determined that Longfin Smelt should be listed as threatened throughout its range in California. Longfin Smelt was officially listed as threatened under the CESA on April 9, 2010.

f. Sacramento Splittail

Sacramento Splittail has been delisted from the ESA but remains a species of special concern under the CESA. This large cyprinid (member of the minnow family) is endemic to California and occurs in sloughs, lakes, and rivers of the Central Valley (Moyle 2002). The species is tolerant of high-salinity habitat, but lower salinities are preferred (Moyle 2002). The Sutter and Yolo Bypasses apparently provide important spawning and rearing habitat (Sommer et al. 1997, 2001). Adults gradually move upstream in the winter and spring to forage and eventually spawn in inundated floodplains (Sommer et al. 1997). Sacramento Splittail migrate farther upstream in the Sacramento River during high-flow, wet years. Spawning occurs any time from late February to early July, with older fish reproducing first (Moyle 2002). Peak spawning occurs in March and April in areas having flooded vegetation; fertilized eggs adhere to flooded vegetation until the embryos hatch 3–7 days after fertilization (Moyle 2002).

In wet years, Sacramento Splittail are common throughout the Yolo Bypass, including Liberty Island (Sommer et al. 1997, 2001).

g. Hardhead

Hardhead is a species of special concern under the CESA. The large cyprinid resembles Sacramento pikeminnow and occupies low- to mid-elevation streams throughout the Sacramento–San Joaquin drainage; hardhead also occur in the Russian and Napa Rivers (Moyle 2002). Suitable habitat is characterized by clear, deep pools; runs with sand-gravel-boulder substrates; low flow velocities; and fairly high water temperatures (Moyle 2002). Hardhead generally are intolerant of disturbed and altered habitat and low levels of dissolved oxygen. The species strongly associates with Sacramento pikeminnow and Sacramento sucker; however, it tends to be absent from systems dominated by introduced species, especially members of the *Centrarchidae* (sunfish) family (Moyle 2002). Spawning occurs primarily in April and May, when large concentrations of fish deposit fertilized eggs on beds of gravel in riffles, runs, or the heads of pools (Moyle 2002). Juveniles rear along stream edges in dense vegetation or other cover and, as growth continues, eventually occupy deeper, midchannel habitat (Moyle 2002).

Despite widespread distribution, hardhead populations are increasingly isolated from one another, making them vulnerable to local extinctions (Moyle 2002). As a result, hardhead is much less abundant than it once was (Moyle 2002). Hardhead is no longer present in lower Putah Creek (Moyle et al. 1998), and the species' status within LIER is unknown.

h. Sacramento Perch

Sacramento Perch is a species of special concern under the CESA. It is the only member of the *Centrarchidae* (sunfish) family native to California. Historically, Sacramento Perch was found below 300 feet in elevation throughout the Central Valley, the Pajaro and Salinas Rivers, and Clear Lake (Moyle 2002). Along with the Sacramento Pikeminnow, it was the dominant piscivorous fish in waters of the Central Valley. However, Sacramento Perch has been extirpated from most of its former range because of the introduction of 11 species of centrarchids; Sacramento Perch do not compete well with other family members (Moyle 2002). This species formerly inhabited sloughs, slow-moving rivers, and lakes, but now occurs primarily in reservoirs and farm ponds (Moyle 2002). Systems currently hosting populations are characterized by an absence of other centrarchids and high alkalinities; other centrarchids are excluded by high alkalinities (Moyle 2002).

Sacramento Perch spawn for the first time at age 2 or 3 (Moyle 2002). Spawning occurs from late March through early August, when water temperatures are 18–29 degrees Celsius. Suitable spawning habitat is characterized by shallow water, relatively hard substrates, and heavy growth of aquatic macrophytes, filamentous algae, or rocks nearby (Moyle 2002). After eggs are deposited in a shallow depression, the males defend the nest until larvae are able to swim well enough to leave the nest (Moyle 2002).

Sampling during the 1980s and 1990s indicated that Sacramento Perch were no longer present in lower Putah Creek (Moyle et al. 1998). Reintroductions occurred in 1997, but establishment failed. However, a small population exists in a pond that drains into Putah Creek. Sacramento Perch have not been captured in the Yolo Bypass (Sommer et al. 2001). The species' status within LIER is unknown.

i. Pacific Lamprey

Pacific Lamprey is a species of concern under the ESA. Pacific Lamprey is an anadromous species that occurs in tributaries from Japan to Alaska to Baja California and spawns in gravel substrate (Moyle 2002). After spending approximately 3–4 years in the ocean, adults migrate into spawning streams in early March to late June, with some reports of upstream migration as early as January and February (Moyle 2002). Spawning habitat is characterized as wide, low-elevation streams with suitable gravels; pool tail-outs and low-gradient riffles are preferred spawning locations. Most Pacific Lamprey die after spawning, but a few have been known to survive and spawn again a year later (Moyle 2002). Eggs hatch in approximately 2–3 weeks and the juveniles, called ammocoetes, burrow tail first into mud or other soft substrates, where they filter feed on algae and other detritus. Ammocoetes rear in freshwater for approximately 5–7 years before returning to the ocean as adults (Moyle 2002). Pacific Lamprey are currently present in lower Putah Creek and have been captured in the Yolo Bypass (Moyle 2002; Sommer et al. 2001).

j. River Lamprey

River Lamprey is a species of special concern under CESA. Migrating individuals have been captured in trawl surveys and rotary screw traps in the Delta and have been reported from the American and Feather Rivers (Moyle et al. 2009). The species is anadromous and adults are predaceous during the ocean phase of the life cycle. Juveniles, called ammocoetes, spend approximately 3–5 years rearing in freshwater. After hatching, ammocoetes burrow tail first into soft substrates of backwaters and eddies, where they feed on drifting matter such as algae and microorganisms. When ammocoetes reach approximately 12 cm total length and several years of age, they begin to transform into adults during the summer. Metamorphosis takes 9–10 months, which is the longest transition of all the lampreys. During metamorphosis, River Lampreys assemble at river mouths before entering the ocean in late spring as adults. River Lampreys are believed to spend only 3–4 months in the ocean, where they grow rapidly by attaching to fish such as salmon and herring and feeding on muscle tissue. The lampreys may kill the prey, although feeding continues even after death. In the fall of the same year as ocean entry, adults return to natal streams and spawn from February to May.

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IV. MANAGEMENT GOALS AND ENVIRONMENTAL IMPACTS

The goals presented in this chapter provide broad guidance for long-term natural resource and public use management of Liberty Island Ecological Reserve. Where applicable, tasks to implement each goal are also described. It is important to note, however, that implementation of many of the tasks identified in this plan is dependent upon the availability of the necessary staff and an adequate operations and maintenance budget. Thus, additional resources may be required to accomplish the tasks identified in this chapter. Chapter V identifies the specific resources required to manage LIER in the future.

The goals and tasks of this LMP have been evaluated for their potential impacts on the environment in accordance with the provisions of CEQA and the CDFW (formerly DFG) LMP template (DFG 2011).

Chapter IV also defines the terms used and provides management direction and CEQA documentation for management actions on LIER. The goals and tasks stated here should guide all management decisions until the plan is revised and updated. It should also be noted that the adjacent Liberty Island Conservation Bank will be managed in accordance with its own banking agreement and bank management plan. Management of LIER will work to coordinate management activities with the conservation bank where applicable.

This chapter provides documentation required by federal and state laws pertinent to protection of endangered species. The potential environmental impacts of goals and tasks included in this LMP are also summarized in this chapter. The details of specific projects that may be developed consistently with this LMP are not yet known. Any future projects that may result in environmental effects will need to be evaluated to determine whether additional project-specific CEQA analysis is necessary. Permits, consultations, and/or approval actions may also be required to approve specific future projects. Examples of permits that may be required for the implementation of future projects include the following:

- ▶ *USACE*—Section 404 of the Clean Water Act, permit for discharge of dredge or fill material into waters of the United States; Section 10 Rivers and Harbors Act permit for work in navigable waters of the United States; approval of modification of USACE levees.
- ▶ *CDFW*—streambed alteration agreement (Section 1602 of the California Fish and Game Code).
- ▶ *DWR (Central Valley Flood Protection Board)*—encroachment permit to work on or adjacent to levees and in designated floodways, approval/authorization of new or restored levees.
- ▶ *California State Lands Commission*—consultation/permit regarding possible use of or impacts on submerged lands, including surrounding in-channel islands and lands underlying rivers and streams.
- ▶ *Central Valley RWQCB*—National Pollutant Discharge Elimination System construction stormwater permit (Notice of Intent to proceed under the statewide General Construction Permit); potential discharge permit for wastewater; general order for dewatering; Clean Water Act Section 401 certification if a Section 404 permit is required.
- ▶ *Yolo Solano Air Quality Management District*— for controlled burns, obtain an Agricultural Burn Permit and prepare a Local Smoke Management Plan (SMP) with the appropriate level of detail.

A. Definitions of Terms Used in This Plan

This LMP has been developed in accordance with CDFW's (formerly DFG's) *A Guide and Annotated Outline for Writing Land Management Plans* (DFG 2011).

1. **Element:** Any biological unit, public-use activity, or facility maintenance program, as defined below, for which goals have been prepared and presented within this plan.
2. **Biological Element:** An element consisting of species, habitats, or communities for which specific management goals have been developed within the plan.
3. **Research and Education Element:** An element describing scientific research and monitoring that supports the attainment of goals for biological and public use elements.
4. **Public-Use Elements:** Elements regarding any recreational, scientific, or other use activity appropriate to and compatible with the purposes for which the Liberty Island property was acquired.
5. **Facility Maintenance Element:** A general-purpose element describing the maintenance and administrative program that helps maintain orderly and beneficial management of the Liberty Island property.
6. **Management Coordination Element:** An element describing coordination with management programs supportive of and compatible with the activities of other public agencies.
7. **Biological Goal:** The statement of intended long-range results of management based upon the feasibility of maintaining, enhancing, or restoring species populations and/or habitat.
8. **Public Use Goal:** The statement of the desired type and level of public use compatible with the biological element goals within the plan.
9. **Tasks:** The individual projects or work elements which implement the goals and are useful in planning operation and maintenance budgets.

B. Biological Elements: Goals and Environmental Impacts

The environmental goals and potential impacts summarized in this section generally refer to LIER only and not to the entirety of Liberty Island. Some goals may refer to future management objectives for the entirety of Liberty Island. In such cases, the status of a goal as a future goal is specifically stated.

The ecosystems of LIER have been grouped into four biological elements: grassland and upland ecosystem, riparian ecosystem, marsh ecosystem, and aquatic ecosystem. Each biological element has its own set of goals and some goals have associated tasks. In addition, the ecosystems provide habitat for special-status plant and wildlife species, which allows for a final biological element addressing the management of special-status plant and wildlife species that may potentially occur on LIER.

At LIER, there are opportunities for maintaining, enhancing, and restoring riparian, emergent marsh, other wetlands, and aquatic ecosystems, including habitat for special-status plants and wildlife as well as game species:

- Special-status species (including Delta Smelt, Longfin Smelt, and Chinook Salmon) use aquatic habitats at LIER, and adjacent waters of the Sacramento River.

- ▶ Game fish species (including Striped Bass, Largemouth Bass, and Catfish) use aquatic habitats at LIER, and adjacent waters of the Sacramento River.
- ▶ Shorebirds and wading birds use intertidal habitats at LIER.
- ▶ One special-status plant species (Suisun Marsh aster) is known to occur in the intertidal zone and adjacent areas of emergent marsh and riparian ecosystems and additional special-status plant species have the potential to occur on-site.
- ▶ Tricolored blackbird, Swainson’s hawk, northern harrier, white-tailed kite, and osprey occur and potentially nest at LIER, and LIER supports potential foraging habitat for long-billed curlew and grasshopper sparrow.
- ▶ Numerous other special-status species (including giant garter snake, western pond turtle, California black rail) are potentially present at LIER.
- ▶ Waterfowl use LIER, especially the marsh ecosystems.
- ▶ The open water surrounding most of LIER limits disturbance by humans and pets, and other stressors of upland, riparian, and marsh systems, and aids with the management of these stressors.
- ▶ Because most of LIER is surrounded by open water, prescribed fire may be a feasible management technique.

There are also a number of important constraints on the management of LIER’s biological resources:

- ▶ Available staff and funding are limited.
- ▶ Access is limited—most of LIER is accessible only by boat, and most of the interior is accessible only by air boat (because of submerged navigational hazards).
- ▶ Himalayan blackberry dominates portions of the riparian areas.
- ▶ Water primrose dominates in waterways and areas of open water, and water hyacinth and Egeria are also increasing in cover.
- ▶ Water and aquatic organisms (including nonnative invasive species) move freely between the wildlife area’s aquatic ecosystems and adjacent waters of the Sacramento Deep Water Ship Channel and Cache Slough.
- ▶ Some management actions could potentially affect flood conveyance, water quality, or Delta hydrodynamics.

Goals for biological elements are generally based on CDFW requirements and the site-specific opportunities and constraints. The goals are also based on the California Fish and Game Code, the regulations and policies of the California Fish and Game Commission, and the goals and objectives of the California Bay-Delta Program’s Ecosystem Restoration Program (for which CDFW is the lead

implementing agency). CESA (Chapter 1.5 of the California Fish and Game Code) declares that all state agencies shall seek to conserve threatened and endangered species. In addition, it is the policy of the California Fish and Game Commission to protect and preserve all native species experiencing a significant decline that, if not halted, would lead to threatened or endangered designation in the future. Similarly, the Ecosystem Restoration Program of the California Bay-Delta Program includes a range of ecosystem goals, including achieving the recovery of at-risk native species dependent on the Delta, reversing downward population trends of native species that are not listed, and reducing populations of nonnative invasive species.

1. Biological Element: Grassland and Upland Ecosystem

a. Grassland and Upland Ecosystem Goal 1: Maintain ecological functions of remaining upland and grassland habitats.

Management of grassland and upland ecosystems will not be a priority at LIER because a relatively small amount of this habitat type exists there and because further erosion of levees is expected to convert portions of it to marsh and aquatic habitats over time. However, if the northern “stair-step” properties were to be transferred to CDFW in the future, these goals would apply. The remaining upland and grassland habitats provide potential habitat for special-status plant and wildlife species. Future conditions and continued inundation of the Island will be considered when proposed restoration activities in upland habitats are developed. Management activities in grassland and upland ecosystems are expected to be relatively passive and therefore are not expected to result in significant environmental impacts.

Tasks:

1. Conduct annual monitoring for grassland associated bird/wildlife species – list key species.

b. Grassland and Upland Ecosystem Goal 2: Prevent the introduction and spread of invasive species in upland and grassland habitats.

Although management of grassland and upland habitats is not the first priority at LIER, managing invasive species will be important to prevent the degradation of remaining upland habitat. Weed control activities may require use of herbicides or other vegetation management techniques such as mowing, grazing, and prescribed burns. These vegetation management techniques may result in potentially significant environmental impacts on air quality, special-status plants, nesting birds, and other wildlife species that utilize upland habitats on LIER.

Tasks:

1. As funding allows, conduct annual monitoring for invasive plant species within upland habitat, and prioritize for treatment.
2. Prepare a vegetation management plan for invasive weeds; the plan should include goal, target, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criterion, and monitoring/follow up recommendations.

3. As funding allows, conduct annual treatment of invasive weeds using control methods determined in vegetation management plan

Mitigation for Potential Impacts Associated with Grassland and Upland Ecosystem Goal 2

MM1: Any chemical weed control will be limited to herbicides that have been registered by the California Department of Pesticide Regulation (DPR), and will be applied according to label instructions and any applicable DPR regulations. All herbicide applications will be made according to written recommendations provided by CDFW's pest control adviser and under the supervision of CDFW personnel who are DPR-certified. If commercial herbicide applicators are used, they must be DPR-licensed.

MM2: Any vegetation removal will be performed outside of the bird nesting season (typically January–August) to avoid impacts on nesting birds protected by the California Fish and Game Code, the federal ESA, CESA, and the federal Migratory Bird Treaty Act (MBTA). If vegetation removal is required during the bird nesting season, a pre-activity survey will be required before initiation of vegetation removal to identify the location of nesting birds and avoid affecting them.

MM3: Before the removal of vegetation or application of herbicides, a preactivity survey for special-status plants will be conducted to identify special-status plant populations and avoid impacts. Surveys will focus on suitable habitat for special-status plants and will follow CDFW accepted methodology.

MM4: For prescribed burns, obtain burn permit from YSAQMD and prepare smoke management plan; implement plan as necessary.

2. Biological Element: Riparian Ecosystem

a. Riparian Ecosystem Goal 1: Maintain and enhance ecological functions of riparian habitats at LIER.

Riparian habitats at LIER provide habitat for a variety of special-status plant and wildlife species, including special-status raptors and cavity-nesting birds. Several of the riparian habitats also qualify as Natural Communities of Special Concern, as described under vegetation types above. Passive recruitment of riparian habitat will be maximized to the extent possible depending on changing hydrologic conditions at LIER. The focus of management in riparian habitats at LIER will be on increasing ecological functions of existing riparian habitat, not creating additional riparian habitat. Any additional riparian habitat created at LIER is expected to occur primarily through passive recruitment. Passive recruitment of riparian habitat at LIER is not expected to result in significant environmental impacts.

Tasks:

1. As funding allows, conduct annual monitoring for riparian associated bird/wildlife species.

b. Riparian Ecosystem Goal 2: Prevent the spread of and control invasive species within riparian habitat at LIER.

Management and control of invasive plant species, such as perennial pepperweed and arundo, in riparian habitats may be required to maintain and enhance ecological functions of the riparian systems at LIER and to protect suitability of existing riparian habitat for special-status plant and wildlife species (Riparian Ecosystem Goal 1). Weed control activities may require the use of herbicides or other vegetation management techniques such as mowing and vegetation removal. Vegetation management techniques may result in potentially significant environmental impacts on air quality, special-status plants, nesting birds, and other wildlife species.

Tasks:

1. As funding allows, conduct annual monitoring for invasive plant species within riparian habitat, and prioritize for treatment.
2. Prepare a vegetation management plan for invasive weeds; the plan should include goals, targets, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criteria, and monitoring/follow up recommendations.
3. As funding allows, conduct annual treatment of invasive weeds using control methods determined in vegetation management plan.

Mitigation for Potential Impacts Associated with Riparian Ecosystem Goal 2

MM1: Any chemical weed control will be limited to herbicides that have been registered by DPR, and will be applied according to label instructions and any applicable DPR regulations. All herbicide applications will be made according to written recommendations provided by CDFW's pest control adviser and under the supervision of CDFW personnel who are DPR-certified. If commercial applicators are used, they must be DPR-licensed.

MM2: Any vegetation removal or prescribed burning will be performed outside of the bird nesting season (typically January–August) to avoid impacts on nesting birds species protected by the California Fish and Game Codes, the federal ESA, CESA, and the federal MBTA. If vegetation removal or prescribed burning is required during the bird nesting season, a preactivity survey will be required before initiation of vegetation removal to identify the location of nesting birds and avoid affecting them.

MM3: Before the removal of vegetation or application of herbicides, a preactivity survey for special-status plants will be conducted to identify special-status plant populations and avoid impacts. Surveys will focus on suitable habitat for special-status plants and will follow CDFW accepted methodology.

MM4: For prescribed burns, obtain burn permit from YSAQMD and prepare smoke management plan; implement plan as necessary.

3. Biological Element: Marsh Ecosystem

a. Marsh Ecosystem Goal 1: Maintain and enhance ecological functions of marsh habitats at LIER.

Management emphasis will be placed on maintaining or enhancing the food web productivity of marsh habitats at LIER through passive habitat restoration and monitoring to support or improve habitat for aquatic species that inhabit the marsh and aquatic habitats within LIER, specifically special-status fish species. The marsh ecosystem will be maintained as highly productive habitat for aquatic organisms, including special-status fish and other wildlife species, by emphasizing the production of nutrients and prey. Management of marsh ecosystems will initially emphasize natural recruitment of emergent vegetation and attempt to maintain marsh habitat elements that are functioning well through monitoring. Passive management of marsh ecosystems within LIER is not expected to result in significant environmental impacts.

Tasks:

1. Allow ongoing research and monitoring of marsh ecosystems within LIER and use the results to identify future management activities that will maintain and enhance the long-term functioning of these ecosystems. The characteristics of well-functioning marsh elements within LIER will be identified to determine what management activities could be applied to other marsh habitats on LIER to restore the functions and values supporting special-status fish species.
2. As funding allows, conduct annual monitoring for marsh associated bird/wildlife species

b. Marsh Ecosystem Goal 2: Reduce invasive species within marsh habitats at LIER.

As funding allows, staff members will monitor LIER for invasive plant species and implement appropriate prevention, control, and eradication measures for new invasive populations within marsh habitat. Specifically, management techniques will be implemented to prevent, control, and eradicate invasive species, specifically water hyacinth, water primrose, Brazilian waterweed, purple loosestrife, and phragmites, within marsh habitats at LIER.

Weed control activities may require the use of herbicides or manual vegetation removal. Vegetation management techniques may result in environmental impacts on special-status plants, nesting birds, and other wildlife species.

Tasks:

1. As funding allows, conduct monitoring for invasive plant species with marsh habitats
2. Prepare a vegetation management plan for invasive weeds; the plan should include goals, targets, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criteria, and monitoring/follow up recommendations.

3. For aquatic weeds, coordinate with the California Division of Boating and Waterways to develop the management plan and control methods, to ensure a unified and efficient approach.
4. If feasible, work with California Division of Boating and Waterways to implement invasive weed control methods previously determined in vegetation management plan.

Mitigation for Potential Impacts Associated with Marsh Vegetation Management

MM1: Any chemical weed control will be limited to herbicides that have been registered by DPR and will be applied according to label instructions and any applicable DPR regulations. All herbicide applications will be made according to written recommendations provided by CDFW's pest control adviser and under the supervision of CDFW personnel who are DPR-certified. If commercial applicators are used, they must be DPR-licensed.

MM2: Any vegetation removal will be performed outside of the nesting bird season (February-August) to avoid impacts on nesting bird species protected by the federal MBTA, including special-status species such as tricolored blackbird that utilize marsh habitats. If vegetation removal is required during the bird nesting season, a preactivity survey will be required before initiation of vegetation removal to identify the location of nesting birds and avoid affecting them.

MM3: Before the removal of vegetation or application of herbicides, a preactivity survey for special-status plants will be conducted to identify special-status plant populations and avoid impacts. Surveys will focus on suitable habitat for special-status plants and will follow CDFW accepted methodology.

4. Biological Element: Aquatic Ecosystem

a. Aquatic Ecosystem Goal 1: Maintain and enhance ecological functions of aquatic ecosystems within LIER.

Maintaining and enhancing the ecological functions of aquatic ecosystems within LIER is expected to involve passive management, with the exception of managing invasive species (Aquatic Ecosystem Goal 3). The extent and location of aquatic ecosystems within LIER is expected to change over time. For example, aquatic habitat is expected to expand as a result of erosion and sea level rise associated with global climate change. In addition, some aquatic habitat is expected to be converted to marsh habitat as a result of natural deposition of silts over time. Passive management of aquatic ecosystems within LIER is not expected to result in significant environmental impacts.

Tasks:

1. As funding allows, conduct monitoring and research associated with the ecological functions and physical processes of the aquatic ecosystem.
2. Allow ongoing research that leads to an improved understanding of physical and biological components of aquatic ecosystems and the special-status fish species they support. Use the results of this research to identify and develop future management activities that will enhance long-term ecosystem functions and services of within

LIER and that could be applied to other aquatic habitat on LIER to restore special-status fish species.

b. Aquatic Ecosystem Goal 2: Maintain and enhance habitat for special-status fish species within aquatic ecosystems.

The primary objective for managing aquatic habitat within LIER will be maintain and/or enhance the habitat for special-status fish species consisting of Delta Smelt, Longfin Smelt, salmon species, Steelhead, and Green Sturgeon. CDFW staff members also will manage critical habitat for Central Valley Chinook Salmon, Central Valley Steelhead, and Delta Smelt. In addition, aquatic habitats will be maintained to provide essential fish habitat for Pacific Salmon FMP. Essential habitats within the aquatic ecosystem include mudflats, open water, shallow channels, deep river channels and breaches, and adjacent sloughs and cuts. Currently, passive management of aquatic ecosystems is expected. However, CDFW may incorporate management suggestions from ongoing research if it is determined to be feasible and necessary. Passive management of aquatic ecosystems within LIER is not expected to result in significant environmental impacts. Any future active management activities may result in potential impacts that would have to be analyzed.

Tasks:

1. As funding allows, conduct monitoring and research associated with the special-status fish species.
2. Allow and coordinate ongoing research associated with special-status fish. Use the results of the research to identify and develop future management activities designed to improve the aquatic ecosystem and associated habitat within the LIER and to benefit these species.

c. Aquatic Ecosystem Goal 3: Prevent, eradicate, and control invasive species within aquatic habitats within LIER.

As funding allows, staff members will monitor LIER for invasive species and implement appropriate prevention, control, and eradication measures for new invasive populations within aquatic habitat. Specifically, management techniques will target invasive species such as water hyacinth, water primrose, Brazilian waterweed, purple loosestrife, and phragmites within aquatic habitat within LIER.

Weed control activities may require the use of herbicides or manual vegetation removal. Vegetation management techniques may result in significant environmental impacts on special-status plants, nesting birds, and other wildlife species that utilize aquatic habitats.

Tasks:

1. As funding allows, conduct monitoring for invasive species within aquatic habitats
2. Prepare a vegetation management plan for invasive weeds; the plan should include goals, targets, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criteria, and monitoring/follow up recommendations.

3. For aquatic weeds, coordinate with the California Division of Boating and Waterways to develop the management plan and control methods, to ensure a unified and efficient approach.
4. If feasible, work with California Division of Boating and Waterways to implement invasive weed control methods previously determined in vegetation management plan.

Mitigation for Potential Impacts Associated with Aquatic Vegetation Management

MM1: Any chemical weed control will be limited to herbicides that have been registered by DPR and are applied according to label instructions and any applicable DPR regulations. All herbicide applications will be made according to written recommendations provided by CDFW's pest control adviser and under the supervision of CDFW personnel who are DPR-certified. If commercial applicators are used, they must be DPR-licensed.

MM2: Any vegetation removal will be performed outside of the nesting season (January–August) to avoid impacts on nesting bird species protected under the MBTA. If vegetation removal is required during the bird nesting season, a preactivity survey will be required before initiation of vegetation removal to identify the location of nesting birds and avoid affecting them.

MM3: Before the removal of vegetation or application of herbicides, a preactivity survey for special-status plants will be conducted to identify special-status plant populations and avoid impacts. Surveys will focus on suitable habitat for special-status plants and will follow CDFW accepted methodology.

5. Biological Element: Special-Status Plant and Wildlife Species

CDFW will maintain and enhance habitat for special-status plant and wildlife species known from or expected to occur in aquatic and upland habitats within LIER. Specific management for specific upland species will not be emphasized because some of the upland habitat is likely to return to marsh or other aquatic habitats over time. Management will typically focus on managing emergent aquatic (marsh) habitats and open-water habitats because these will likely be the primary habitat communities at LIER in the future. Management may include conducting long-term habitat monitoring and implementing feasible management techniques suggested by research conducted at LIER or other similar sites as budget and necessity allow.

a. Special-Status Plant and Wildlife Species Goal 1: Maintain habitat for special-status plant and wildlife species.

Any vegetation management or weed control conducted as part of managing LIER for special-status plant and wildlife species could potentially affect special-status plant or wildlife populations. Therefore, management activities could result in a significant environmental impact. However, management activities to avoid and minimize impacts are available. Vegetation management activities would likely fall under a categorical exemption under CEQA. Some potential mitigation measures are provided below.

Tasks:

1. As funding allows, conduct surveys for special-status plant and wildlife species.

Mitigation for Potential Impacts Associated with Management of Special-Status Plant and Wildlife Species Habitat

MM1: Any management of upland vegetation will be avoided during the bird nesting season (January–August) to the extent feasible.

MM2: Nesting-bird surveys will be conducted before any required management of upland vegetation that must occur during the nesting season. If breeding birds are documented, protective buffers will be established or management activities will be postponed until after the chicks have fledged.

MM3: Before the removal of vegetation or application of herbicides, a preactivity survey for special-status plants will be conducted to identify special-status plant populations and avoid impacts. Surveys will focus on suitable habitat for special-status plants and will follow CDFW accepted methodology.

C. Research and Education Elements: Goals and Environmental Impacts

Scientific research and monitoring contributes to sound management of upland, riparian, marsh, and aquatic ecosystems within LIER. Currently, fish populations, weather, and water quality are monitored at or near LIER. However, CDFW could improve the basic inventory data for LEIR. There also is no ongoing monitoring of invasive plant populations, special-status plant populations or their habitats, or any monitoring that could be used to evaluate the effects of public use on ecosystems at LIER. Thus, additional research and monitoring could benefit management and attainment of goals for biological elements.

At LIER, there are opportunities to conduct scientific research and monitoring. These opportunities include:

- ▶ performing baseline surveys of special-status plant and wildlife species that are currently present at LIER and determining potential threats to these populations;
- ▶ monitoring changes in the composition and extent of upland, riparian, marsh, and aquatic ecosystems over time as a result of changes in hydrology or other processes; and
- ▶ continuing to monitor changes in populations of special-status plant and wildlife species present at LIER over time.

There are also several important constraints on scientific research and monitoring of LIER:

- ▶ Available staff and funding are limited.
- ▶ Access is limited because most of LIER is accessible only by boat.
- ▶ Damage and theft of research equipment may occur.
- ▶ Aquatic plants (water hyacinth and egeria) are controlled by the California Department of Boating and Waterways.

1. Research and Education Element: Scientific Research and Monitoring

a. Scientific Research and Monitoring Goal 1: Support baseline research and surveys.

Management at LIER will support research and monitoring of LIER plant and wildlife populations that is compatible with the current uses, management, and purposes of the property. Baseline studies and surveys for occurrences of special-status plant and wildlife species, invasive species, and vegetation mapping will be supported as funding allows. Baseline surveys will inform future management practices at LIER. Any research data gathered from LIER will be shared within CDFW to inform management decisions on other properties. Surveys will be conducted according to approved survey protocols, including CDFW's protocols for conducting surveys for special-status plants and wildlife. No environmental impacts are expected from implementation of this goal.

Tasks:

1. As funding allows, continue allowing and coordinate and/or conduct baseline research and surveys that contribute to and aid in the development of new management goals for LIER.

b. Scientific Research and Monitoring Goal 2: Continue allowing access for aquatic ecosystem research.

LIER will support continued research on aquatic ecosystems within the Island by other agencies and research institutions. The primary goal of LIER is to provide a food web for special-status fish species. No environmental impacts are expected from implementation of this goal.

Tasks:

1. Allow and coordinate research being conducted on the aquatic ecosystem within LIER to better understand the physical and biological processes and food web dynamics.

c. Scientific Research and Monitoring Goal 3: Continue ongoing wildlife studies.

LIER will support continued bird counts, giant garter snake surveys, nesting raptor surveys, bat surveys, and other wildlife studies. No environmental impacts are expected from implementation of this goal.

Tasks:

1. As funding allows, continue allowing and coordinate and/or conduct wildlife surveys and research that contributes to and aids in the development of new management goals for LIER.

d. Scientific Research and Monitoring Goal 4: Encourage new academic research and collaboration.

CDFW will seek out new opportunities to collaborate with researchers and initiate new research that will inform CDFW and others on ecological issues involving the Delta, Delta aquatic ecosystems, and other

land management issues. No environmental impacts are expected from implementation of this goal or the associated tasks.

Tasks:

1. Identify partnerships with stakeholders, academic institutions, and land managers for instituting environmental studies at LIER. Potential new research may include pilot studies of habitat management.

e. Scientific Research and Monitoring Goal 5: Consider findings of current research when making adaptive management decisions.

Findings from scientific studies will be utilized and incorporated in adaptive management decisions at LIER. No environmental impacts are expected from implementation of this goal. Adaptive management techniques could potentially result in environmental impacts, but those impacts cannot be assessed until the techniques are proposed and analyzed.

Tasks:

1. Coordinate with researchers to obtain data and results of studies conducted within LIER.
2. Review and evaluate the results of scientific research and biological monitoring within LIER and use the results to improve or develop new management goals.

D. Public-Use Elements: Goals and Environmental Impacts

It is the policy of the California Fish and Game Commission that lands under its administration are available to the public for wildlife-dependent recreational use whenever such uses will not unduly interfere with the primary purpose for which such lands were acquired. Public use of LIER includes opportunities for fishing, hunting, wildlife viewing, and education opportunities. Waterfowl hunting occurs at LIER during the waterfowl season and sport fishing occurs year round. Public information about access to and allowed public use of LIER is expected to generally be accessed on the CDFW Web site.

1. Public-Use Element: Fishing

Fishing will be subject to applicable rules and regulations, including seasonal and other restrictions.

a. Fishing Goal 1: Provide opportunities for land-based fishing from levees.

CDFW will review the potential for land-based fishing from levees. This goal is dependent on continued public access to existing levee systems within LIER. No environmental impacts are expected from implementation of this goal or the associated tasks.

Tasks:

1. Update and maintain current information about land-based fishing on the CDFW website.
2. Install signage displaying fishing regulations.

3. Monitor or supervise fishing activities as needed.

b. Fishing Goal 2: Provide opportunities for water-based fishing from boats in the interior of LIER.

CDFW will provide access to allow water-based fishing from boats within LIER. Access to LIER may be limited by navigational hazards and other access issues that prevent access to some areas of LIER by boat. There may also be restrictions to avoid conflicts between water-based fishing and hunting activities. No environmental impacts are expected from implementation of this goal or the associated tasks.

Tasks:

1. Update and maintain current information about water-based fishing on the CDFW website.
2. Monitor or supervise fishing activities as needed.

2. Public-Use Element: Hunting

Waterfowl hunting is one of the major uses of LIER from October through February. The area is open to the public and there is currently no fee to hunt.

a. Hunting Goal 1: Manage upland habitats in a way that is compatible with use by upland game species.

CDFW will manage habitat for upland game species to the extent that it does not conflict with management of habitats for other species that take priority based on the purposes for which Liberty Island was acquired. No environmental impacts are expected from implementation of this goal.

b. Hunting Goal 2: Develop and implement a hunting plan.

CDFW will develop a hunting plan pursuant to current adopted CDFW regulations/codes that addresses land-based hunting on the northern portion of the Island and water-based hunting on open water and within marsh habitat. Because this activity is currently occurring within LIER, no environmental impacts are expected from implementation of this goal.

Tasks:

1. Update and maintain current information about hunting on the CDFW website.
2. As needed, coordinate with law enforcement staff to develop a hunting plan.
3. Coordinate with hunting groups and stakeholders during development of hunting plan.
4. Monitor and supervise hunting activities as needed.

3. Public-Use Element: Minimization of Competition and Conflicts

Public use of LIER may conflict with ongoing research activities. In some cases, public use also may be incompatible with the primary goal of managing and protecting aquatic habitats for special-status species. To that extent, LIER staff members will manage public-use opportunities to minimize the potential for conflict between these two activities.

a. Minimization of Competition and Conflicts Goal 1: Limit conflicts between users and facilitate compatibility between public uses.

LIER staff will manage LIER to minimize the potential for conflict between researchers and other users, conflict between hunting and nature viewing, and conflict between fishermen and hunters. Because these activities are currently occurring within LIER, no additional environmental impacts are expected from implementation of this goal.

Tasks:

1. Direct researchers to conduct their activities outside of hunting seasons, if possible.
2. Update CDFW website to notify researchers and public about hunting seasons and research activities.

4. Public-Use Element: Native American Activities

Native Americans may wish to utilize LIER periodically for activities such as traditional food gathering, ceremonies, or other activities. LIER staff members will evaluate these requests on a case-by-case basis.

a. Native American Activities Goal 1: Evaluate requests by Native Americans for specific cultural use of the area.

CDFW will evaluate Native American requests to utilize LIER for activities on a case-by-case basis. Consideration will be given to the potential for conflict with the primary goals of habitat preservation and management of LIER for special-status species' habitats and the potential to conflict with other public uses on the site. No environmental impacts are expected from implementation of this goal.

5. Public-Use Element: Cultural Resources

No archaeological sites were identified. Potential cultural resources within LIER include old pumps, sheds, and machinery used during farming operations, and portions of a historic-era levee that once surrounded Liberty Island. Large segments of the levee, constructed around 1917–1918, were destroyed after the breach, particularly around the south end of the Island. The remaining portions of historic-era levee are located on the north, east, and west sides of the Island and include an approximately 2.2-mile segment at the northeast corner of the Island that has been recorded. The levee was constructed from materials dredged from the surrounding channels, creating an earthen berm. The remaining levee segments are now covered in blackberries, cottonwoods, willows, and other riparian vegetation. These resources have not been evaluated for potential eligibility for the CRHR or the NRHP.

a. Cultural Resources Goal 1: Evaluate the Liberty Island levee segment, pumps and sheds, and associated resources for eligibility for listing in the National Register of Historic Places and the California Register of Historical Resources.

Qualified CDFW staff members or designated associates who meet the Secretary of the Interior's Standards for architectural history or history will conduct a cultural resources survey and evaluate the levees, pumps, sheds, machinery, and associated agricultural resources for their potential eligibility for the NRHP and the CRHR to determine whether the structures meet the criteria for listing and would be considered historical resources for the purposes of CEQA.

Tasks:

1. As deemed necessary, conduct cultural resource surveys to evaluate whether the levees, pumps, sheds, machinery, and associated agricultural resources are considered historical resources

b. Cultural Resources Goal 2: Maintain information on cultural resources.

Qualified CDFW staff members or designated associates who meet the Secretary of the Interior's Standards for archaeology and history will maintain information on existing cultural resources on LIER, should any exist. Habitat management and public uses will be evaluated for their potential to affect existing cultural resources. Specific management activities could potentially affect existing cultural resources. Management activities that have the potential to affect these resources are not currently known. Only a small percentage of LIER has undergone cultural resource surveys, so the potential exists for additional cultural resources, including prehistoric cultural resources, to exist at LIER. Additional environmental analysis will be required if management activities are determined to potentially affect these resources. Efforts to maintain information on cultural resources will include archaeological surveys for management activities that include ground-disturbing components.

Tasks:

1. Maintain existing documentation on cultural resources

c. Cultural Resources Goal 3: Catalog and preserve cultural and historic resources.

Qualified CDFW staff members or designated associates who meet the Secretary of the Interior's Standards for archaeology and history will catalog and preserve cultural resources at LIER that are subject to impacts by current or future land management or public-use activities. No environmental impacts are expected from implementation of this goal.

Tasks:

1. Preserve cultural and historic resources if present.

6. Public-Use Element: Safety

LIER contains elements that may potentially pose a safety hazard to the general public. For example, the flooding of the Island has produced submerged infrastructure that potentially poses navigational hazards to boaters and fishermen.

a. Safety Goal 1: Catalog and remove hazards from LIER.

CDFW or contractors will catalog existing objects that represent potential health and safety hazards to CDFW staff members and the general public and will categorize those objects that are feasible for removal and prioritize objects for removal. As feasible, CDFW will remove hazards.

Tasks:

1. Catalog and remove hazardous objects within LIER; potential items include old screw gates that appear in the open water at low tides and old farm equipment and structures located on uplands.

b. Safety Goal 2: Educate users on how to use LIER safely.

CDFW or contractors will provide important safety information on the LIER Web site that includes a warning for navigational hazards and information about hunting season and other uses. No environmental impacts are expected from implementation of this goal.

Tasks:

1. Update and maintain safety information on the CDFW website and, as feasible, identify navigational hazards to boats and presence/absence of boat launches at LIER.

c. Safety Goal 3: Identify emergency responders.

CDFW will identify appropriate emergency responders for LIER. Potential emergency responders include the Solano County Sheriff's Department or the Coast Guard. No environmental impacts are expected from implementation of this goal.

Tasks:

1. Update and maintain current information about emergency responders on the CDFW website.

7. Public-Use Element: Unauthorized Public Use

Unauthorized uses can damage LIER ecosystems, affect special-status and game species and their habitats, and interfere with authorized uses. The remote location of LIER limits the extent and management of unauthorized uses. The limited availability of staff and funding substantially constrains management of unauthorized uses.

a. Unauthorized Public Use Goal 1: Discourage unauthorized use.

CDFW and CDFW law enforcement personnel will discourage unauthorized or illegal uses such as camping, dumping trash, horseback riding, bike riding, fires, and permanent duck blinds. No environmental impacts are expected from implementation of this goal.

Tasks:

1. Update and maintain unauthorized use information on the CDFW website.
2. If feasible, post signage on LIER to list the unauthorized uses.
3. As needed, coordinate with local law enforcement to patrol the area.

E. Facility Maintenance Elements: Goals and Environmental Impacts

There are currently no CDFW-owned or maintained recreation facilities on the Island. Because of the location of LIER within a flood bypass, it is not anticipated that any permanent recreation facilities will be planned for LIER. There are also a number of important constraints on construction and maintenance of facilities at LIER:

- ▶ Available staff and funding are limited.
- ▶ Access is limited because most of LIER is accessible only by boat.
- ▶ Construction of facilities could affect conveyance of flood waters.
- ▶ Construction, maintenance, and removal of facilities could affect water quality.
- ▶ Construction and maintenance of facilities could result in effects on ecosystems, including effects on special-status species and their habitats.

1. Facility Maintenance Element: Administration

LIER is currently managed by staff members who have duties at other CDFW properties in addition to unstaffed lands. Data on administrative budgets are needed.

a. Administration Goal 1: Ensure appropriate financial management.

CDFW will maintain current data on administrative needs such as budget, staff, and expenditures. No environmental impacts are expected from implementation of this goal.

Tasks:

1. Maintain current data on administrative needs such as budget, staff, and expenditures.

b. Administration Goal 2: Coordinate staff members.

Anticipated staff positions at LIER may include an environmental scientist and habitat assistant and potentially scientific or seasonal aides. CDFW wildlife officers will conduct routine patrols at LIER. Duties of the environmental scientist will include coordinating access to LIER, overseeing public use, and completing site surveys. Some LIER tasks will likely be completed by designated contractors. No environmental impacts are expected from the implementation of this goal.

Tasks:

1. Coordinate access to LIER with public and private researchers, contractors, public and academic groups, and other groups visiting the reserve.

c. Administration Goal 3: Organize and manage site data.

CDFW will employ an environmental scientist to organize and manage site data to be accessible to CDFW staff members and other individuals such as researchers cleared to receive such data. No environmental impacts are expected from implementation of this goal.

Tasks:

1. Organize and manage data collected and generated from studies conducted within LIER and manage data access with external groups.

2. Facility Maintenance Element: Fire Management

Although most of LIER is covered by water, wildfires may occur in upland areas. These fires are typically ignited by users and may alter upland, riparian, and marsh ecosystems; affect facilities and habitat; and endanger human safety and the property of adjacent landowners. The fires may result in both adverse and beneficial effects on the attainment of the goals of this LMP. For example, fires have been shown to increase the diversity of marsh vegetation, and may contribute to attainment of the goals for the marsh element. Similarly, fire may improve waterfowl habitat and increase access and visibility for hunters, and through these effects, may support public-use goals. Conversely, fires may damage facilities, thus interfering with the attainment of goals for public use and facilities.

At LIER, there are opportunities for managing the fire regime. Open water along most boundaries limits the locations where fire could spread from LIER to adjacent lands. Consequently, a wider range of fire management activities may be feasible.

There are also several constraints on fire management at LIER:

- ▶ Available staff and funding are limited.
- ▶ Access is limited, as most of LIER is accessible only by boat.
- ▶ Fire management could cause adverse effects on air quality, special-status, and game species habitats (e.g., loss of larger trees, spread of invasive species), public safety, facilities, and public use.

a. Fire Management Goal 1: Prepare a fire management plan.

CDFW will develop a fire management plan including coordination with local fire management agencies. The Yolo County portion of Liberty Island is located within the “No Man’s Land” Fire Protection District. The Solano County portion may be under the jurisdiction of the California Department of Forestry and Fire Protection. Fire management activities will focus on postfire activities and prevention, and 1995 procedures for fires and wildlands. LIER is also under the jurisdiction of the Yolo Solano Air Quality District in regard to air quality impacts associated with fire management activities. No environmental impacts are expected from implementation of this goal. However, fire management activities may potentially result in environmental impacts and would have to be evaluated at the time they are formulated.

Tasks:

1. Develop and implement a fire management plan that includes fire response activities; as needed, coordinate with local and State fire management agencies and the Yolo Solano Air Quality District during development of the plan.
2. Maintain regular contact and coordinate with local and State fire management agencies about access (routes, gates, etc.) and planned activities.

3. Facility Maintenance Element: Facilities Management

Public access to LIER is currently obtained via boat or from an access road via Shag Slough Bridge off of Liberty Island Road. It is unclear whether Yolo County will be interested in maintaining this access road and bridge in the future. This decision will affect whether CDFW will allow public-use features such as designated parking locations in the future.

CDFW does not have designated equipment just for LIER. Any equipment such as vehicles, boats, and herbicide application equipment is shared with other properties owned by CDFW. There are no plans to acquire designated equipment for LIER or store equipment at LIER in the future.

a. Facilities Management Goal 1: Provide access points for the general public and CDFW staff members.

Tasks:

1. Update and maintain CDFW website with public access information.

Liberty Island Road, which parallels Shag Slough, is managed by Solano County, and the county will determine whether parking is allowed on Liberty Island Road. No environmental impacts are expected from implementation of this goal.

b. Facilities Management Goal 2: Manage trails.

There are existing trails along the west side of LIER, extending north and south along Shag Slough. CDFW does not currently maintain these trails. Given the changing landscape and degradation of levees at LIER, CDFW has no plans to maintain existing trails or to construct new trails for public use. CDFW

will work to identify access points from existing trails to marshes and other habitat areas, and to create destinations for users in an effort to limit dispersed access that may result in habitat degradation. This goal is not expected to result in significant environmental impacts.

Tasks:

1. Identify access points from existing levees and parking areas and appropriate and inappropriate areas and habitats for public access via trails in an effort to minimize habitat degradation.

c. Facilities Management Goal 3: Erect signage.

CDFW will erect signage to guide users regarding rules and regulations at LIER. Potential signage could include a kiosk, rules and regulations, and ecological reserve signs around the perimeter. CDFW also may provide information signage at launching points like Arrowhead Harbor Marina on Miner Slough or at launch sites in Rio Vista to familiarize the public with the resources available at LIER. This goal is not expected to result in significant environmental impacts.

Tasks:

1. Install and maintain signage at LIER to provide information on the rules, regulations, safety, wildlife and habitats, and other important information.

d. Facilities Management Goal 4: Review operations.

CDFW is not considering construction of improved visitor facilities at this time. CDFW will work with Solano County to review opportunities for placement of waste receptacles/waste pickup by the county. CDFW will also consider the need for on-site restrooms. However, all of these considerations are contingent upon availability of funding and depend on need. This goal is not expected to result in significant environmental impacts.

Tasks:

1. As funding allows, coordinate with Solano and Yolo counties to develop waste management and the need for public restrooms at LIER.

e. Facilities Management Goal 5: Maintain levees.

CDFW will coordinate with RD 2093 on required levee maintenance, but the levees could be dissolved in the future and CDFW prefers to leave the Island in its current state. Levee work may include the stabilization of remaining levees to prevent damage to sensitive habitats within LIER. Levee maintenance may result in environmental impacts. The extent of required levee maintenance will have to be determined before potential environmental impacts can be evaluated.

Tasks:

1. As necessary, coordinate with RD 2093 on any levee improvements or repairs.

f. Facilities Management Goal 6: Coordinate with Solano County on the status of the Shag Slough Bridge.

The Shag Slough Bridge currently allows access to LIER. Maintenance of the bridge is currently the responsibility of Solano County. It is unclear whether the county will continue to maintain the bridge. CDFW will consult with Solano County regarding the need for CDFW to access LIER from the Shag Slough Bridge. Bridge maintenance activities or removal have the potential to result in significant environmental impacts. However, Solano County would be required to conduct any CEQA analysis of potential environmental impacts and provide any necessary mitigation.

Tasks:

1. Consult with Solano County about future maintenance and work on the Shag Slough Bridge.

4. Facility Maintenance Element: Removal of Hazardous Structures

LIER contains potentially hazardous structures that remain after the failure of the levees. This includes underwater structures like old screw gates that are potentially hazardous to the general public, primarily boaters, or to wildlife species. Structures that are suitable and feasible for removal should be removed to the extent possible. Any features designated for removal will be assessed for historic value before removal. It should be noted that it may not be possible to remove all hazardous structures from LIER, or removal may result in environmental impacts determined to outweigh the benefits of leaving the hazards in place.

a. Removal of Hazardous Structures Goal 1: Remove Hazardous Structures.

CDFW will have a goal of removing structures that represent a hazard to the general public or wildlife. Limitations on completing this goal will be determined based on the following considerations: the potential to locate all potential hazards, the feasibility of hazard removal, available funding for hazard removal, and the potential to remove a hazard without causing significant environmental impacts. It is not possible to analyze potential environmental impacts associated with removal of hazardous structures because the extent of removal and the type of structures that would be considered for removal by CDFW are unknown. Potential impacts associated with this activity would need to be analyzed on a project-by-project basis.

Tasks:

1. Survey LIER for hazardous structures, equipment, and other objects on land and within the water.
2. Develop a strategy and remove hazardous objects within LIER; potential items include old screw gates that appear in the open water at low tides and pose risks to boaters and old farm equipment and structures located on uplands.

F. Management and Coordination Elements: Goals and Environmental Impacts

The ability to attain the goals of this LMP depends on the implementation of supporting regulations and management practices. Attainment of the goals also can be supported by coordinating management efforts with tenants, neighbors, local agencies, and other state agencies.

An important step toward attaining the goals of this LMP is to conduct an ongoing review of current regulations and management practices for their consistency with and support of the goals of this LMP, and to update the goals of this LMP as appropriate. Based on this review, regulations and management practices could be revised if necessary to better support attainment of the goals. The information synthesized in the LMP and the management framework of the LMP goals provide an opportunity for such a review and revision of regulations and management practices to better support CDFW's management goals.

The activities of neighbors and a number of state and local agencies influence ecosystems at LIER. These activities may occur within or adjacent to the LIER and are conducted for a wide range of purposes. The entities planning and conducting these activities may not be aware of related activities, effects at LIER, or CDFW's management goals for LIER. Therefore, management coordination could reduce the adverse consequences of these actions and increase the beneficial effects resulting from the actions of these other entities.

At LIER, there are opportunities for management coordination. These opportunities include:

- ▶ Sacramento-Yolo and Solano County Mosquito and Vector Control District mosquito abatement;
- ▶ Yolo and Solano County Sheriff's Departments and the U.S. Coast Guard law enforcement;
- ▶ Yolo and Solano County Health Department;
- ▶ State Water Resources Control Board;
- ▶ Delta Protection Commission and Department of Boating and Waterways Delta-wide recreational planning;
- ▶ Delta Stewardship Council and the Delta Science Program;
- ▶ Sacramento Area Flood Control Agency;
- ▶ USFWS, USACE (owners of Little Holland Tract), and Port of Sacramento (owners of Prospect West);
- ▶ State and Federal Water Contractors Agency (owners of Yolo Ranch), Wildlands, and Trust for Public Land;
- ▶ California Department of Food and Agriculture regional invasive plant control efforts;

- ▶ California Department of Forestry and Fire Protection and local fire protection districts (i.e., Delta Fire Protection District) fire management planning;
- ▶ CALFED, particularly the Ecosystem Restoration Program, and now described in Chapter 4 (“Protect, Restore, and Enhance the Delta Ecosystem”) of the *Delta Plan* (DSC 2013);
- ▶ regional and local organizations and agency land use, recreation, and water supply planning; and
- ▶ adjacent or neighboring private landowners.

There are also major constraints on management coordination of LIER. The most substantial constraint is the lack of staff and funding to perform this coordination. Coordination also requires that other agencies be willing to participate in management coordination and have the staff and funding available to do so.

1. Management and Coordination Element: Management Review and Coordination

a. Management Review and Coordination Goal 1: Ensure that regulations and management practices at LIER support attainment of LMP goals.

This goal is based on the purpose of this LMP, which includes guiding management of the habitats, species, and programs described in the LMP to achieve CDFW’s mission to protect and enhance wildlife values, and serving as a guide for appropriate public uses of LIER. This goal is not expected to result in significant environmental impacts.

Tasks:

1. Review, and as necessary revise, regulations and management practices at LIER to be consistent with and support attainment of the goals of this LMP. Adapt goals and tasks in the LMP to comply with new or revised regulations.

2. Management and Coordination Element: State and Federal Agencies

CDFW will periodically perform activities outlined in this LMP that may require coordination and approval from various state and federal agencies.

a. State and Federal Agencies Goal 1: Coordinate with neighboring restoration activities or other management activities in the area.

CDFW will work with state and federal agencies when directing restoration activities in the vicinity of LIER. Restoration coordination will focus on defining the process for and frequency of coordination with other planning efforts, and on identifying funding sources for any planned restoration activities. Future potential restoration plans in the vicinity of LIER include the BDCP, the *Delta Plan*, and others. This goal is not expected to result in significant environmental impacts.

Tasks:

1. Review, coordinate, and provide comments and recommendations of state and federal plans and proposed projects, as appropriate, for determining the consistency of such plans

with the management goals of LIER. Future plans include but may not be limited to BDCP, the Delta Plan, and others.

3. Management and Coordination Element: Flood Control Agencies

Flood control agencies that have jurisdiction over LIER include the Central Valley Flood Protection Board (CVFPB) and RD 2093. RD 2093 is the district in charge of reclamation of Liberty Island. California reclamation districts are legal subdivisions in California's Central Valley that are responsible for managing and maintaining the levees, freshwater channels, or sloughs and canals, pumps, and other flood protection structures in the area. RD 2093 will remain in effect as long as there are other property owners on Liberty Island.

a. Flood Control Agencies Goal 1: Coordinate with the CVFPB.

CDFW will coordinate with the CVFPB for any activities that have the potential to alter the frequency, duration, or intensity of flooding in the vicinity of LIER or any other activities that potentially fall under the jurisdiction of the CVFPB. This goal is not expected to result in significant environmental impacts, although the management activities associated with this notification may result in environmental impacts that would have to be evaluated.

Tasks:

1. Coordinate with CVFPB about future activities that could alter the frequency, duration, and intensity of flooding at LIER.

4. Management and Coordination Element: Local Agencies

Local agencies that have overlapping jurisdiction at LIER include Solano County, RD 2093, and the Port of Sacramento. CDFW will coordinate with these and other local agencies for management activities that have the potential to affect elements under their jurisdiction.

a. Local Agencies Goal 1: Coordinate with local agencies that have overlapping or adjacent jurisdictions with LIER.

CDFW will coordinate with local agencies including applicable counties, the Yolo Natural Heritage Foundation, adjacent reclamation districts, the Port of Sacramento, and others that may be required to conduct management activities that may potentially affect LIER and its resources or habitats. No significant environmental impacts are expected to be associated with implementation of this goal, although the management activities associated with this notification may result in environmental impacts that would have to be evaluated.

Tasks:

1. Coordinate with Yolo Natural Heritage Foundation, RD 2093, Port of Sacramento, Yolo Solano Air Quality Management District, Solano County Mosquito Abatement District, Sacramento-Yolo Mosquito and Vector Control District, and other local agencies for determining consistency between their projects, plans, and operations and the management goals of LIER.

5. Management and Coordination Element: Law Enforcement

Law enforcement agencies with jurisdiction in the vicinity of LIER include the CDFW law enforcement division, Yolo County Sheriff's Department, Solano County Sheriff's Department, and U.S Coast Guard.

a. Law Enforcement Goal 1: Coordinate with law enforcement and emergency responders.

Any law enforcement activity required at LIER will be coordinated among applicable law enforcement agencies to minimize cost expenditures and emphasize specific resources available to respective law enforcement agencies. CDFW will meet with law enforcement staff members from the Solano and Yolo County Sheriff's Departments and other agencies as appropriate to coordinate law enforcement activities and explore options for cooperative programs. No significant environmental impacts are expected to be associated with implementation of this goal.

Tasks:

1. Pursue joint funding requests with other law enforcement entities to address law enforcement concerns while maximizing the efficiency of funds for law enforcement purposes.

6. Management and Coordination Element: Neighbors

Adjacent property owners could be affected by management activities or policies implemented by LIER staff members.

a. Neighbors Goal 1: Coordinate with adjacent landowners.

CDFW will coordinate with adjacent landowners on any management or other activity that may potentially affect the use of their property. This may include vegetation management activities such as prescribed burns or emergency situations that may affect their properties. LIER staff members will meet or correspond with adjacent landowners and tenants as needed to maintain communication about the management needs of LIER and the access needs of adjacent landowners, and to convey useful information regarding activities. This goal is not expected to result in environmental impacts.

Tasks:

1. Correspond with adjacent landowners, tenants, and managers as needed to maintain communication about the management needs of LIER and how it may affect access or operations on their land. This may include vegetation management activities such as prescribed burns or invasive weed control.

V. OPERATIONS AND MAINTENANCE SUMMARY

The purpose of this chapter is to describe the staffing and other resources required to perform the operations and maintenance associated with this LMP. The implementation of this LMP will require staffing and resources to perform the tasks that are described in Chapter IV, “Management Goals and Environmental Impacts.”

In addition to financial resources, this LMP will require regular management to keep it current and revised as necessary. The resources and uses of the wildlife area and of the surrounding region will change, as will the policies and programs guiding resource management. In response to ongoing management and environmental change in the wildlife areas and surrounding region, management priorities may change and the LMP may need to be updated. Procedures to help keep this LMP current and relevant are included in Chapter 6, “Future Revisions to This Plan.”

A. Operations and Maintenance Tasks to Implement Plan

Table 5-1, at the end of this chapter, summarizes goals and tasks identified in Chapter IV, “Management Goals and Environmental Impacts,” and the personnel required to implement them.

B. Existing Staff and Additional Personnel Needs Summary

No new staff will be specifically allocated to LIER, so the work necessary to implement the tasks identified in this LMP will be shared by existing CDFW staff. To adequately implement this LMP will require more than one personnel/year (PY) of a seasonal/scientific aide, environmental scientist, wildlife habitat assistant, and a fish and wildlife officer.

The Department staff positions (environmental scientist, wildlife habitat assistant, and seasonal aid) are shared among dozens of Wildlife Areas and Ecological Reserves throughout Region 3. The current allocation of these positions to LIER is insufficient to implement the tasks identified in this LMP. An increase in staffing seems to be in the best interests of appropriate management. Table 5-1 indicates staff members who will need to designate hours to implement each task of the LMP (described in Chapter 4).

1. Site Management—Environmental Scientist Position

Continued day-to-day operations will require 0.50 PY of an Environmental Scientist position to be assigned to LIER. This individual acts as the area manager for the ecological reserve and divides his/her time among managing five wildlife areas and four ecological reserves throughout the Delta. This individual is responsible for performing administration, planning, and coordination of management and for the basic communication, monitoring, and support functions that are required for operation and maintenance of the wildlife areas.

2. Site Management, Operations, Maintenance, and Monitoring—Wildlife Habitat Assistant Position

Implementation of the LMP requires the allocation of 0.25 PY of a wildlife habitat assistant to the LIER. The wildlife habitat assistant’s tasks include basic communication, planning, and support functions that are required for operation and maintenance of the wildlife areas. Further tasks include species and habitat

monitoring, development of specific habitat enhancement projects, developing control measures for invasive species, management review and coordination, and compliance with Federal and State environmental and reporting regulations. The individual will assist other Department staff and volunteers performing maintenance and other tasks required to implement this LMP.

3. Operations and Maintenance Support—Seasonal Aide/Scientific Aide Positions

Currently there are no seasonal/scientific aides assigned to LIER. However, the creation of one position would be valuable to the implementation of the LMP. LIER would benefit from the allocation of one seasonal aide or scientific aide position totaling approximately 0.50 PY. Under the direction of the environmental scientist, the seasonal aide or scientific aide will be required to perform routine maintenance tasks and manual labor related to signing, fencing, access, removal of trash, control of invasive, nonnative species, and habitat improvement projects. The seasonal aide or scientific aide will also participate in habitat restoration activities, collection of habitat and wildlife data, and other monitoring activities.

4. Law Enforcement—Wildlife Officer Position

To protect fish and wildlife resources and ecosystems, patrol of Liberty Island Ecological Reserve by a wildlife officer will be required. The officer will provide a presence to deter violations and will deal with fish and game violations and enforce other wildlife area regulations, including those related to authorized and unauthorized uses. Wildlife officers patrol an assigned district, consisting of a county or a portion of a county. They patrol multiple Wildlife Areas and Ecological Reserves as part of their overall responsibilities.

C. Operations and Maintenance Summary

This section summarizes the estimated staffing requirements (Table 5-1) associated with management of the LIER and provides more specific information required for annual budget preparation.

Table 5-1. Summary of Staffing to Implement the Land Management Plan							
Goals	Tasks						Annual/ Periodical
		WHA	BIO	MS	WO	ARCH	
Biological Element							
Grassland and Upland Ecosystem Goal 1: Maintain ecological functions of remaining upland and grassland habitats.	Task 1.1. Conduct annual monitoring for grassland associated bird/wildlife species – list key species	-	X	-	-	-	A
Grassland and Upland Ecosystem Goal 2: Prevent the introduction and spread of invasive species in upland and grassland habitats.	Task 2.1. As funding allows, conduct annual monitoring for invasive plant species within upland habitat, and prioritize for treatment.	-	X	-	-	-	A
	Task 2.2. Prepare a vegetation management plan for invasive weeds; the plan should include goal, target, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criterion, and monitoring/follow up recommendations.	-	X	-	-	-	P
	Task 2.3. As funding allows, conduct annual treatment of invasive weeds using control methods determined in vegetation management plan.	X	X	-	-	-	A
Riparian Ecosystem Goal 1: Maintain and enhance ecological functions of riparian habitats at LIER.	Task 1.1. As funding allows, conduct annual monitoring for riparian associated bird/wildlife species.	-	X	-	-	-	A
Riparian Ecosystem Goal 2: Prevent the spread of and control invasive species within riparian habitat at LIER.	Task 2.1. As funding allows, conduct annual monitoring for invasive plant species within riparian habitat, and prioritize for treatment.	-	X	-	-	-	-
	Task 2.2. Prepare a vegetation management plan for invasive weeds; the plan should include goals, targets, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criteria, and monitoring/follow up recommendations.	-	X	-	-	-	P
	Task 2.3. As funding allows, conduct annual treatment of invasive weeds using control methods determined in vegetation management plan.	X	-	-	-	-	A
Marsh Ecosystem Goal 1: Maintain and enhance ecological functions of marsh habitats at LIER.	Task 1.1. Allow ongoing research and monitoring of marsh ecosystems within LIER and use the results to identify future management activities that will maintain and enhance the long-term functioning of these ecosystems. The characteristics of well-functioning marsh elements within LIER will be identified to determine what management activities could be applied to other marsh habitats on LIER to restore the functions and values supporting special-status fish species.	-	X	-	-	-	A

Table 5-1. Summary of Staffing to Implement the Land Management Plan							
Goals	Tasks						Annual/ Periodical
		WHA	BIO	MS	WO	ARCH	
Marsh Ecosystem Goal 1 con't.	Task 1.2. As funding allows, conduct annual monitoring for marsh associated bird/wildlife species.	X	X	-	-	-	A
Marsh Ecosystem Goal 2: Reduce invasive species within marsh habitats at LIER.	Task 2.1. As funding allows, conduct monitoring for invasive plant species with marsh habitats.	X	X	-	-	-	A
	Task 2.2. Prepare a vegetation management plan for invasive weeds; the plan should include goals, targets, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criteria, and monitoring/follow up recommendations.	-	X	-	-	-	P
	Task 2.3. For aquatic weeds, coordinate with the California Division of Boating and Waterways to develop the management plan and control methods, to ensure a unified and efficient approach.	-	X	-	-	-	P
	Task 2.4. If feasible, work with California Division of Boating and Waterways to implement invasive weed control methods previously determined in vegetation management plan.	X	X	-	-	-	A
Aquatic Ecosystem Goal 1: Maintain and enhance ecological functions of aquatic ecosystems within LIER.	Task 1.1. As funding allows, conduct monitoring and research associated with the ecological functions and physical processes of the aquatic ecosystem.	-	X	X	-	-	P
	Task 1.2. Allow ongoing research that leads to an improved understanding of physical and biological components of aquatic ecosystems and and the special-status fish species they support. Use the results of this research to identify and develop future management activities that will enhance long-term ecosystem functions and services of within LIER and that could be applied to other aquatic habitat on LIER to restore special-status fish species.	-	X	-	-	-	A
Aquatic Ecosystem Goal 2: Maintain and enhance habitat for special-status fish species within aquatic ecosystems.	Task 2.1. As funding allows, conduct monitoring and research associated with the special-status fish species.	-	X	X	-	-	P
	Task 2.2. Allow and coordinate ongoing research associated with special-status fish. Use the results of the research to identify and develop future management activities designed to improve the aquatic ecosystem and associated habitat within the LIER and to benefit these species.	-	X	-	-	-	A
Aquatic Ecosystem Goal 3: Prevent, eradicate, and control invasive species within aquatic habitats within LIER.	Task 3.1. As funding allows, conduct monitoring for invasive species within aquatic habitats.	X	X	-	-	-	A
	Task 3.2. Prepare a vegetation management plan for invasive weeds; the plan should include goals, targets, descriptions of the various control methods based on best available research, ratings of weeds for treatment, success criteria, and monitoring/follow up recommendations.	X	X	-	-	-	P

Table 5-1. Summary of Staffing to Implement the Land Management Plan							
Goals	Tasks						Annual/ Periodical
		WHA	BIO	MS	WO	ARCH	
Aquatic Ecosystem Goal 3 con't.	Task 3.3. For aquatic weeds, coordinate with the California Division of Boating and Waterways to develop the management plan and control methods, to ensure a unified and efficient approach.	-	X	-	-	-	P
	Task 3.4. If feasible, work with California Division of Boating and Waterways to implement invasive weed control methods previously determined in vegetation management plan.	X	X	-	-	-	A
Special-Status Plant and Wildlife Species Goal 1: Maintain habitat for special-status plant and wildlife species.	Task 1.1. As funding allows, conduct surveys for special-stats plant and wildlife species.	X	X	-	-	-	A
Research and Education Element							
Scientific Research and Monitoring Goal 1: Support baseline research and surveys.	Task 1.1. As funding allows, continue allowing and coordinate and/or conduct baseline research and surveys that contribute to and aid in the development of new management goals for LIER.	-	X	-	-	-	A
Scientific Research and Monitoring Goal 2: Continue allowing access for aquatic ecosystem research.	Task 2.1. Allow and coordinate research being conducted on the aquatic ecosystem within LIER to better understand the physical and biological processes and food web dynamics.	-	X	-	-	-	A
Scientific Research and Monitoring Goal 3: Continue ongoing wildlife studies.	Task 3.1. As funding allows, continue allowing and coordinate and/or conduct wildlife surveys and research that contributes to and aids in the development of new management goals for LIER.	X	X	-	-	-	A
Scientific Research and Monitoring Goal 4: Encourage new academic research and collaboration.	Task 4.1. Identify partnerships with stakeholders, academic institutions, and land managers for instituting environmental studies at LIER. Potential new research may include pilot studies of habitat management.	-	X	-	-	-	P
Scientific Research and Monitoring Goal 5: Consider findings of current research when making adaptive management decisions.	Task 5.1. Coordinate with researchers to obtain data and results of studies conducted within LIER.	-	X	-	-	-	A
	Task 5.2. Review and evaluate the results of scientific research and biological monitoring within LIER and use the results to improve or develop new management goals.	-	X	-	-	-	P

Table 5-1. Summary of Staffing to Implement the Land Management Plan							
Goals	Tasks						Annual/ Periodical
		WHA	BIO	MS	WO	ARCH	
Public-Use Elements							
Fishing Goal 1: Provide opportunities for land-based fishing from levees.	Task 1.1. Update and maintain current information about land-based fishing on the CDFW website.	-	X	-	-	-	P
	Task 1.2. Install signage displaying fishing regulations.	X	-	-	-	-	P
	Task 1.3. Monitor or supervise fishing activities as needed.	X	X	-	X	-	A
Fishing Goal 2: Provide opportunities for water-based fishing from boats in the interior of LIER.	Task 2.1. Update and maintain current information about water-based fishing on the CDFW website.	-	X	-	-	-	P
	Task 2.2. Monitor or supervise fishing activities as needed.	X	X	-	X	-	A
Hunting Goal 1: Manage upland habitats in a way that is compatible with use by upland game species.	No tasks associated with this goal.	-	-	-	-	-	-
Hunting Goal 2: Develop and implement a hunting plan.	Task 2.1. Update and maintain current information about hunting on the CDFW website.		X				P
	Task 2.2. As needed, coordinate with law enforcement staff to develop a hunting plan.	-	X	-	X	-	P
	Task 2.3. Coordinate with hunting groups and stakeholders during development of hunting plan.	-	X	-	-	-	P
	Task 2.4. Monitor and supervise hunting activities as needed.	X	X	-	X	-	A
Minimization of Competition and Conflicts Goal 1: Limit conflicts between users and facilitate compatibility between public uses.	Task 1.1. Direct researchers to conduct their activities outside of hunting seasons, if possible.	-	X	-	-	-	P
	Task 1.2. Update CDFW website to notify researchers and public about hunting seasons and research activities.	-	X	-	-	-	P
Native American Activities Goal 1: Evaluate requests by Native Americans for specific cultural use of the area.	No tasks associated with this goal.	-	-	-	-	-	-

Table 5-1. Summary of Staffing to Implement the Land Management Plan							
Goals	Tasks						Annual/ Periodical
		WHA	BIO	MS	WO	ARCH	
Cultural Resources Goal 1: Evaluate the Liberty Island levee segment, pumps and sheds, and associated resources for eligibility for listing in the National Register of Historic Places and the California Register of Historical Resources.	Task 1.1. As deemed necessary, conduct cultural resource surveys to evaluate whether the levees, pumps, sheds, machinery, and associated agricultural resources are considered historical resources.	X	X	-	-	X	P
Cultural Resources Goal 2: Maintain information on cultural resources	Task 2.1. Maintain existing documentation on cultural resources.	-	X	-	-	X	P
Cultural Resources Goal 3: Catalog and preserve cultural and historic resources.	Task 3.1. Preserve cultural and historic resources if present.	-	-	-	-	X	P
Safety Goal 1: Catalog and remove hazards from LIER.	Task 1.1. Catalog and remove hazardous objects within LIER; potential items include old screw gates that appear in the open water at low tides and old farm equipment and structures located on uplands.	X	X	-	-	-	P
Safety Goal 2: Educate users on how to use LIER safely.	Task 2.1. Update and maintain safety information on the CDFW website and, as feasible, identify navigational hazards to boats and presence/absence of boat launches at LIER.	-	X	-	-	-	P
Safety Goal 3: Identify emergency responders.	Task 3.1. Update and maintain current information about emergency responders on the CDFW website.	-	X	-	-	-	P
Unauthorized Public Use Goal 1: Discourage unauthorized use.	Task 1.1. Update and maintain unauthorized use information on the CDFW website.	-	X	-	-	-	P
	Task 1.2. If feasible, post signage on LIER to list the unauthorized uses.	X	X	-	-	-	P
	Task 1.3. As needed, coordinate with local law enforcement to patrol the area.	-	X	-	-	-	A
Facility Maintenance Elements							
Administration Goal 1: Ensure appropriate financial management.	Task 1.1. Maintain current data on administrative needs such as budget, staff, and expenditures.	-	X	-	-	-	A
Administration Goal 2: Coordinate staff members.	Task 2.1. Coordinate access to LIER with public and private researchers, contractors, public and academic groups, and other groups visting the reserve.	X	X	-	-	-	A

Table 5-1. Summary of Staffing to Implement the Land Management Plan							
Goals	Tasks						Annual/ Periodical
		WHA	BIO	MS	WO	ARCH	
Administration Goal 3: Organize and manage site data.	Task 3.1. Organize and manage data collected and generated from studies conducted within LIER and manage data access with external groups.	-	X	-	-	-	P
Fire Management Goal 1: Prepare a fire management plan.	Task 1.1. Develop and implement a fire management plan that includes fire response activities; as needed, coordinate with local and State fire management agencies and the Yolo Solano Air Quality District during development of the plan.	-	X	-	-	-	P
	Task 1.2. Maintain regular contact and coordinate with local and State fire management agencies about access (routes, gates, etc.) and planned activities.	-	X	-	-	-	A
Facilities Management Goal 1: Provide access points for the general public and CDFW staff members.	Task 1.1. Update and maintain CDFW website with public access information.	X	X	-	-	-	P
Facilities Management Goal 2: Manage trails.	Task 2.1. Identify access points from existing levees and parking areas and appropriate and inappropriate areas and habitats for public access via trails in an effort to minimize habitat degradation.	X	X	-	-	-	P
Facilities Management Goal 3: Erect signage.	Task 3.1. Install and maintain signage at LIER to provide information on the rules, regulations, safety, wildlife and habitats, and other important information.	X	X	-	-	-	P
Facilities Management Goal 4: Review operations.	Task 4.1. s funding allows, coordinate with Solano and Yolo counties to develop waste management and the need for public restrooms at LIER.	-	X	-	-	-	P
Facilities Management Goal 5: Maintain levees.	Task 5.1. As necessary, coordinate with RD 2093 on any levee improvements or repairs.	-	X	-	-	-	P
Facilities Management Goal 6: Coordinate with Solano County on the status of the Shag Slough Bridge.	Task 6.1. Consult with Solano County about future maintenance and work on the Shag Slough Bridge.	-	X	-	-	-	P
Removal of Hazardous Structures Goal 1: Remove Hazardous Structures.	Task 1.1. Survey LIER for hazardous structures, equipment, and other objects on land and within the water.	X	X	-	-	-	P
	Task 1.2. Develop a strategy and remove hazardous objects within LIER; potential items include old screw gates that appear in the open water at low tides and pose risks to boaters and old farm equipment and structures located on uplands.	X	X	-	-	-	P

Table 5-1. Summary of Staffing to Implement the Land Management Plan							
Goals	Tasks						Annual/ Periodical
		WHA	BIO	MS	WO	ARCH	
Management and Coordination Elements							
Management Review and Coordination Goal 1: Ensure that regulations and management practices at LIER support attainment of LMP goals.	Task 1.1. Review, and as necessary revise, regulations and management practices at LIER to be consistent with and support attainment of the goals of this LMP. Adapt goals and tasks in the LMP to comply with new or revised regulations.	-	X	-	-	-	A
State and Federal Agencies Goal 1: Coordinate with neighboring restoration activities or other management activities in the area.	Task 1.1. Review, coordinate, and provide comments and recommendations of state and federal plans and proposed projects, as appropriate, for determining the consistency of such plans with the management goals of LIER. Future plans include but may not be limited to BDCP, the Delta Plan, and others.	-	X	-	-	-	P
Flood Control Agencies Goal 1: Coordinate with the CVFPB.	Task 1.1. Coordinate with CVFPB about future activities that could alter the frequency, duration, and intensity of flooding a LIER.	-	X	-	-	-	P
Local Agencies Goal 1: Coordinate with local agencies that have overlapping or adjacent jurisdictions with LIER.	Task 1.1. Coordinate with Yolo Natureal Heritage Foundation, RD 2093, Port of Sacramento, Yolo Solano Air Quality Management District, Solano County Mosquito Abatement District, Sacramento-Yolo Mosquito and Vector Control District, and other local agencies for determining consistency between their projects, plans, and operations and the management goals of LIER.	-	X	-	-	-	P
Law Enforcement Goal 1: Coordinate with law enforcement and emergency responders.	Task 1.1. Pursue joint funding requests with other law enforcement entities to address law enforcement concerns while maximizing the efficiency of funds for law enforcement purposes.	-	-	-	X	-	P
Neighbors Goal 1: Coordinate with adjacent landowners.	Task 1.1. Correspond with adjacent landowners, tenants, and managers as needed to maintain communication about the management needs of LIER and how it may affect access or operations on their land. This may include vegetation management activities such as prescribed burns or invasive weed control.	X	X	-	-	-	A
Note: ARCH = Archaeologist, BIO = Biologist, MS = Monitoring Staff (CDFW staff members as part of the IEP who will conduct monitoring.) PI = previously indicated, WHA = Wildlife Habitat Assistant, WO = Wildlife Officer							

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VI. CLIMATE CHANGE STRATEGIES

According to *California Wildlife Conservation Challenges, California's Wildlife Action Plan* (DFG 2005), climate change is one of four detrimental impacts threatening wildlife diversity in California. The other three are population growth and development, water management conflicts, and invasive species. During the past several years, there has been a greater effort to address climate change in land management documents and to develop adaptation strategies. These efforts typically have been mandated by either legislation or various executive orders. CDFW is undertaking an update to the state's Wildlife Action Plan; the updated plan is expected to be published in 2015 and will include information and strategies on climate change.

The California Natural Resources Agency has developed a climate change adaptation strategy to implement the Global Warming Solutions Act (Assembly Bill [AB] 32). The purpose of this strategy is to:

Collect, synthesize, and communicate to the greatest extent possible, how sea level rise; temperature rise and duration; and precipitation changes due to climate change will exacerbate existing fire, flood, water quality, air quality, habitat loss, human health, and drought risks; and how they will impact the state's economy, infrastructure, human populations, and environment. In concert with AB 32 objectives and ongoing climate science predictions, adaptation strategies shall focus on a 50-year climate impact timeline. This effort will rely heavily on research funded through the California Energy Commission's Public Interest Energy Research (PIER) program.

Projected climate change threats for California include higher temperatures and amplified drought periods, which can lead to increased catastrophic wildland fires. Invasive weeds, invertebrates, and other nonnative species that rely on disturbance and stressed ecosystems can gain an advantage over native communities. Earlier snowmelt and consequent flooding can adversely affect vulnerable levee systems and affect water availability and management. Engineering solutions to address subsequent erosion, infrastructure, and public safety could have detrimental effects on estuaries and coastal wetlands, such as those being managed by CDFW within LIER. Additionally, sea level rise and fluctuating rainfall need to be considered within CDFW's restoration programs and for the management of wildlife, vegetation, and fisheries resources within LIER.

Managers of wildlife areas and ecological reserves currently integrate climate change strategies into the proposed goals, operations, and maintenance tasks for their respective sites. Strategies for LIER are included in Chapter IV in Section IV.B, "Biological Elements: Goals and Environmental Impacts," and Section IV.C, "Public-Use Elements: Goals and Environmental Impacts." Proposed actions include monitoring and controlling invasive species in upland, wetland, and aquatic or open-water habitats; maintaining and enhancing habitat for special-status plant, fish, and wildlife species; and conducting and supporting scientific research within upland, wetland, and aquatic habitats and on the species that inhabit them. CDFW also supports research that will determine the most appropriate survey protocols to identify new or troubling patterns and trends within a species or vegetation community. Future phenological changes in plants and wildlife, together with potential range shifts and migration patterns, will affect

management decisions for seasons and harvest models for game species. The ongoing results would be expected to ensure sound management of species and ecosystems within LIER.

Two other potential actions are not included in these chapters and are dependent on funding. First, larger buffer zones could be created around wetlands to attenuate flooding effects associated with increased runoff and sea level rise. In addition, interpretive programs could be implemented to educate the public about climate changes and its effects on local and regional wildlife and their habitat.

LIER could contribute to the protection and recovery of listed fish and wildlife species, and other special-status species covered under regional HCPs/NCCPs. CDFW also could become actively involved in reducing “nonclimatic stressors” such as runoff from nonpoint pollution, trash, and other hazardous materials. Public health and safety and the maintenance of infrastructure (e.g., levees, roads, parking lots and interpretive centers) on CDFW lands are considered in every program offered to the public.

Critical to all these efforts is the continuing education of land managers and their staff with regard to climate change. Providing managers with the best scientific information available to enable adaptive management and sound decision making with regard to a changing climate is crucial. The science of climate change and its potential effects on natural resources has to be conveyed in a timely matter to anticipate future needs. Focus should be maintained on planning for both the current effects of climate change and projected impacts. Continued effective and efficient use of CDFW operational budgets is essential and outside funding opportunities should be maximized.

VII. FUTURE REVISIONS TO THIS PLAN

All planning documents eventually become dated and require revision so they can continue to provide practical direction for management and operational activities. The revision of planning documents is often neglected because of budgetary or staff constraints, or other more pressing priorities. This chapter defines a hierarchy of revision procedures with the level of effort proportionate to the level of proposed change.

This LMP reflects the best information available during the planning process, but it is expected that new information will become available over time and that revision will be necessary to keep this LMP current. Such new information may include the following elements:

- ▶ Land acquisition adjacent to or in the vicinity of LIER
- ▶ Management of water and related facilities in the Delta
- ▶ Adoption of large-scale resource management plans that affect the region
- ▶ Feedback generated by adaptive management of LIER
- ▶ Scientific research that directs improved techniques for habitat, land, and recreation management
- ▶ New legislative or policy direction that affects LIER

When new information dictates updating this LMP, an established process should be followed. Additional public and agency outreach and input may also be necessary, depending on the nature of the proposed change to the management goals and strategies established by this LMP.

A. Minor Revisions

Minor revisions may include adding new property to LIER or incorporating limited changes to the goals and tasks from adaptive management, new scientific information, or new legislative direction. This procedure will be applicable to minor revisions that meet the following criteria:

- ▶ No change is proposed to the overall purposes of the LIER.
- ▶ CEQA documentation is prepared and adopted, as appropriate.
- ▶ Appropriate consultation within CDFW occurs.
- ▶ Appropriate consultation with other agencies occurs, as necessary.
- ▶ Adjoining neighbors are consulted if the revisions are related to a specific location or the acquisition of additional area.

Minor revisions to this LMP may be made by CDFW using available resources; revisions may require approval by the Regional Manager. If land acquisitions do not change existing management of LIER, the new land can be integrated into the current LMP via a memo from the Regional Manager to the Director. Supporting documentation containing information about the new land will be attached to the existing LMP and provided to the Lands Program/Wildlife Branch for its files.

B. Major Revisions

Major revisions or a new LMP may be needed if new policy direction requires a procedure comparable to the initial LMP planning process. The procedure for major revisions will meet the following criteria:

- ▶ Substantial revisions are proposed to LIER, or the adoption of a complete new plan is proposed.
- ▶ Appropriate CEQA documentation is prepared and adopted, as appropriate.
- ▶ Appropriate consultation within CDFW occurs.
- ▶ Appropriate consultation with other agencies occurs, as appropriate.
- ▶ A public outreach program is conducted proportionate to the level of the proposed revisions.

Major revisions or a new LMP may be by CDFW using available resources; they require prior approval by the Regional Manager and approval by the Director of CDFW. If the appropriate procedure for a particular proposed revision is not apparent, the Regional Manager shall determine which procedures to use, in consultation with CDFW's Lands Program. Adopting the revised LMP may require additional CEQA analysis if the revisions present substantive changes. A new LMP and additional CEQA analysis would require the review and approval of the Deputy Director.

C. Five-Year Plan Status Reports

Periodic evaluation is important to help ensure that the tasks and goals, and the overall purposes, of the plan are met. The management goals in Chapter IV contain many monitoring tasks that allow for evaluating the adequacy of the current management strategies and that cumulatively demonstrate the success of the overall management effort. Periodic and detailed analysis of these data will, however, be necessary to assess the status of this LMP.

A comprehensive review of the achievement of the goals of the LMP should be prepared every 5 years after the adoption of this LMP. A status report documenting this review should include:

- ▶ an evaluation of the achievement of the purposes and goals of this LMP;
- ▶ an evaluation of the completion, as appropriate, of each task contained in this LMP;
- ▶ an evaluation of the effectiveness of the CDFW coordination efforts with the Delta Stewardship Council, local governments, and other land management and regulatory and management agencies with major roles in the Delta;
- ▶ notation of important new scientific information that has bearing on the management of LIER; and
- ▶ recommendations for revisions to LIER to incorporate new information and improve its effectiveness.

The status reports should be prepared by the Area Manager. They should be submitted to CDFW's Lands Program for review and comment, approved by the Regional Manager, and submitted to the Director of CDFW. These reports should serve as a basis for revision of this LMP and appropriate adjustments to ongoing management practices.

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APPENDIX A

Public Outreach Summary

APPENDIX B

Environmental Review

ENVIRONMENTAL CHECKLIST

PROJECT INFORMATION		
1. Project Title:	Liberty Island Ecological Reserve, Land Management Plan	
2. Lead Agency Name and Address:	California Department of Fish and Wildlife Region 3 Bay Delta 7329 Silverado Trail Napa, CA 94558	
3. Contact Person and Phone Number:	Ryan Carrothers (530) 757-1813	
4. Project Location:	Solano and Yolo Counties, California	
5. Project Sponsor's Name and Address:	Same as above	
6. General Plan Designation:	Agriculture with Resource Conservation Overlay, Agricultural with Delta Protection Overlay	
7. Zoning:	Exclusive Agricultural, Agricultural General, Agricultural Preserve	
8. Description of Project:	The project is the proposed land management plan (LMP or proposed LMP) for the Liberty Island Ecological Reserve (LIER). The project site includes both LIER and the northern section of Liberty Island not currently owned by the California Department of Fish and Wildlife (CDFW). The main objectives of the proposed LMP are to provide the potential for habitat enhancement, floodplain management, and recovery of endangered species. See Chapter II, "Property Description," of the LMP for additional information.	
9. Surrounding Land Uses and Setting: (Briefly describe the project's surroundings)	See Chapter II, "Property Description," of the LMP.	
10. Other public agencies whose approval is required: (e.g., permits, financing approval, or participation agreement)	None	
ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:		
The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.		
<input type="checkbox"/> Aesthetics	<input type="checkbox"/> Agriculture & Forestry Resources	<input type="checkbox"/> Air Quality
<input type="checkbox"/> Biological Resources	<input type="checkbox"/> Cultural Resources	<input type="checkbox"/> Geology & Soils
<input type="checkbox"/> Greenhouse Gas Emissions	<input type="checkbox"/> Hazards & Hazardous Materials	<input type="checkbox"/> Hydrology & Water Quality
<input type="checkbox"/> Land Use & Planning	<input type="checkbox"/> Mineral Resources	<input type="checkbox"/> Noise
<input type="checkbox"/> Population & Housing	<input type="checkbox"/> Public Services	<input type="checkbox"/> Recreation
<input type="checkbox"/> Transportation/Traffic	<input type="checkbox"/> Utilities & Service Systems	<input type="checkbox"/> Mandatory Findings of Significance
<input checked="" type="checkbox"/> None		

DETERMINATION (To be completed by the Lead Agency)

On the basis of this initial evaluation:

- I find that the proposed project **COULD NOT** have a significant effect on the environment, and a **NEGATIVE DECLARATION** will be prepared.
- I find that although the proposed project **COULD** have a significant effect on the environment, there **WILL NOT** be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A **MITIGATED NEGATIVE DECLARATION** will be prepared.
- I find that the proposed project **MAY** have a significant effect on the environment, and an **ENVIRONMENTAL IMPACT REPORT** is required.
- I find that the proposed project **MAY** have a “potentially significant impact” or “potentially significant unless mitigated” impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An **ENVIRONMENTAL IMPACT REPORT** is required, but it must analyze only the effects that remain to be addressed.
- I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier **EIR** or **NEGATIVE DECLARATION** pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier **EIR** or **NEGATIVE DECLARATION**, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Scott Wilson

Signature

July 3, 2015

Date

Scott Wilson

Printed Name

Regional Manager

Title

California Department of Fish and Wildlife

Agency

EVALUATION OF ENVIRONMENTAL IMPACTS

1. A brief explanation is required for all answers except “No Impact” answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A “No Impact” answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A “No Impact” answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).
2. All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
3. Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. “Potentially Significant Impact” is appropriate if there is substantial evidence that an effect may be significant. If there are one or more “Potentially Significant Impact” entries when the determination is made, an EIR is required.
4. “Negative Declaration: Less Than Significant With Mitigation Incorporated” applies where the incorporation of mitigation measures has reduced an effect from “Potentially Significant Impact” to a “Less Than Significant Impact.” The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from “Earlier Analyses,” as described in (5) below, may be cross-referenced).
5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
 - a) Earlier Analysis Used. Identify and state where they are available for review.
 - b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
 - c) Mitigation Measures. For effects that are “Less than Significant with Mitigation Measures Incorporated,” describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.
6. Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.
7. Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.
8. This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project’s environmental effects in whatever format is selected.
9. The explanation of each issue should identify:
 - a) the significance criteria or threshold, if any, used to evaluate each question; and
 - b) the mitigation measure identified, if any, to reduce the impact to less than significance.

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ENVIRONMENTAL CHECKLIST

3.1 Aesthetics

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
I. Aesthetics. Would the project:				
a) Have a substantial adverse effect on a scenic vista?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

- a) **Less-than-significant impact.** The project site is located in the Sacramento–San Joaquin Delta (Delta) and contains views of marsh, agriculture, and open water. On a clear day, distant views are available toward the coastal mountains to the west and the Sierra Nevada to the east. Implementing the proposed LMP would preserve existing native vegetation and natural visual resources, and would not involve the construction of any new permanent buildings or structures. Improvements that could result from the proposed LMP, such as signage, would be small in scale. Therefore, implementing the proposed LMP would not substantially affect scenic vistas.
- c) **Less-than-significant impact.** Implementing the proposed LMP would require the use of a barge and crane to remove abandoned structures within LIER, but this activity would be short term and small in scale. Further, the presence of barges and other construction equipment is consistent with existing agricultural practices and boating in the Delta. Although invasive vegetation would be removed to restore habitats, remaining vegetation would be preserved, and disturbed areas would be revegetated by natural recruitment. It is anticipated that management tasks included in the proposed LMP would improve aesthetic conditions at the project site. Therefore, implementing the proposed LMP would not substantially degrade the existing visual character or quality of LIER and its surroundings.
- b), d) **No impact.** No outdoor lighting would be installed as part of the proposed LMP; therefore, there would be no new sources of light or glare. No rock outcroppings or historic buildings would be affected, nor is the project site located near a designated scenic highway (Caltrans 2011). Therefore, implementing the proposed LMP would not adversely affect scenic resources.

3.2 Agriculture and Forestry Resources

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

Discussion

a), e) **No impact.** As described in Chapter II, “Property Description,” of the proposed LMP, the project site was in agricultural production until 1997, when levees protecting the island failed and the island flooded. As a result, most of the project site is open water with some marsh, grassland, and riparian vegetation. No farming or ranching operations currently occur on the property.

LIER is designated “Water” by the California Department of Conservation’s Division of Land Resource Protection and the northern section is designated “Other Land”; neither of these classifications represent important farmland, and therefore implementing the proposed LMP would not convert important farmland to nonagricultural use (DOC 2011a, 2011b). Management tasks associated with the proposed LMP include restoration or habitat enhancement activities, the

removal of abandoned structures or other remnants of human activities, levee maintenance, and placement of signage. These management tasks would not cause changes in the physical environment that could result in the conversion of agricultural land, including important farmland, to nonagricultural uses, or in conversion of forestland to nonforest uses. Implementing the proposed LMP would not affect the continuation of agricultural operations in other areas outside of the project site.

- b) No impact.** LIER is designated “Prime Agricultural Land” under the Williamson Act and “Agriculture with a Resource Conservation Overlay” in the *Solano County General Plan* (DOC 2013; Solano County 2008). The northern section is not designated land under the Williamson Act, but is designated “Agricultural with a Delta Protection Overlay” by the *Yolo County General Plan* (DOC 2012; Yolo County 2009). However, as mentioned previously, most of the project site is now open water and thus is not considered agricultural land. Implementing the proposed LMP would conserve remaining land resources (e.g., grassland and upland, marsh, riparian habitats) and would not result in the building of any new permanent buildings or structures. Therefore, implementing the proposed LMP would not conflict with existing zoning for agricultural use or a Williamson Act contract.
- c), d) No impact.** The proposed LMP does not conflict with existing zoning for forest land or timberland, and its implementation would not result in the loss of forest land or conversion of forest land to nonforest uses.

3.3 Air Quality

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
III. Air Quality.				
Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make the following determinations.				
Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d) Expose sensitive receptors to substantial pollutant concentrations?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e) Create objectionable odors affecting a substantial number of people?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion

- a) **No impact.** Implementing the proposed LMP would not involve any construction activities, namely earthmoving or the building of new permanent structures. Further, no long-term operational emissions from limited activities on the project site are anticipated and no increase in automobile or boat trips to and from LIER are anticipated to occur with implementation of the LMP when compared with current conditions. Thus, implementing the proposed LMP would not conflict with any applicable air quality plans.
- b), c) **Less-than-significant impact.** Implementing the proposed LMP would involve the limited use of a barge and crane to remove abandoned structures within the project site, producing localized, temporary emissions; however, these impacts would be short term and would not cause a net increase in ambient air pollutant concentrations. Prescribed burns and herbicide application may also be conducted as part of the restoration and habitat enhancement activities proposed in the LMP. If prescribed burns would be conducted, registering with the statewide Prescribed Fire Information Reporting System, coordinating burns with the Yolo-Solano Air Quality Management District, and obtaining an Agricultural Burn Permit and preparing and implementing an associated Local Smoke Management Plan would be sufficient to prevent air pollutant emissions from contributing to an air quality violation. As a result, this impact of the proposed LMP on air quality would be less than significant.
- d) **Less-than-significant impact.** The project site is located in a rural agricultural area in the Delta, and there are no sensitive receptors in the vicinity. The management tasks proposed by the LMP

are not expected to generate pollutants at sufficient concentrations to be noticeable at any rural residences, particularly given the area's agricultural nature. Because no future site development is proposed and the area is rural/agricultural in nature, a less-than-significant impact on sensitive receptors would occur.

- e) **Less-than-significant impact.** The project site is located in a rural agricultural area in the Delta, far from substantial populations. The management tasks in the proposed LMP are not expected to generate long-term, objectionable odors that would adversely affect rural residences, particularly given the area's agricultural nature. Any prescribed burns that might be conducted would produce temporary periods of smoke in the project area. However, given the limited duration and extent of the burns and the small number of people in the area, and the fact that a smoke management plan would be implemented, implementing the proposed LMP would result in a less-than-significant impact from odors on a substantial number of people.

3.4 Biological Resources

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

Discussion

a), b), c) Less-than-significant impact. The primary goal of the LMP is to enhance habitat for the benefit of Delta native fishes, including those that are listed under the federal or California Endangered Species Act (or both) and for other special-status species. Implementing the proposed LMP would continue to provide habitat for common and special-status wildlife species including raptors, waterfowl, and migratory songbirds. The potential exists for temporary impacts on wildlife and sensitive habitats during implementation of the proposed management tasks (e.g., restoration or habitat enhancement activities, the removal of abandoned structures or other remnants of human activities, levee maintenance, placement of signage). Nonetheless, the proposed LMP would provide a net benefit to wildlife, fisheries, and sensitive habitats.

Special-status plant species and sensitive habitats are known to occur or have the potential to occur on the project site. However, with implementation of measures 1(b) MM3, 2(b) MM3, 4 MM3, 5(c) MM3, and 6 MM3 in the proposed LMP, impacts on these species and habitats would be less than significant, as impacts would be avoided or minimized

As described in Section III.E.1, “Special-Status Plant Species,” of Chapter III, “Habitat Description,” there is an account of Northern California black walnut (*Juglans hindsii*) on the

remnant levees within the project site. Native Northern California black walnut is believed to be extirpated from Solano and Yolo counties, however (CNPS 2014). Any specimens that have been identified may be hybrids between Northern California black walnut and another walnut species, such as English walnut (*Juglans regia*), Eastern black walnut (*J. nigra*), or Arizona walnut (*J. major*) (Kirk 2003; CNPS 1978). Only two known genetically pure native populations of *J. hindsii* are still in existence (in Napa and Contra Costa Counties), but the species has become widely naturalized in riparian areas throughout the Central Valley (Kirk 2003; CNPS 2014). As described in the same chapter of the LMP, Mason's lilaeopsis, a plant state listed as rare has been documented by CDFW on remnant levees on the eastern side of LIER. Delta mudwort, a CRPR 2B.1 species has been documented on an in-channel island in Liberty Cut, and Suisun marsh aster, federally listed as endangered, and a CRPR list 1B.1 species was incidentally observed on the northern "stair-step" during preparation of the LMP. These and other special-status plant species could be adversely affected by ground and vegetation disturbing management activities, if present in the affected areas. However, the LMP contains measures 1(b) MM3; 2(b) MM3 and 3(b) MM3 and 4(c) MM3 aimed at the protection of special-status plants. With implementation of these measures, potential impacts on special-status plant species would be less than significant.

Some special-status wildlife species have the potential to occur in the project site, but the proposed LMP contains several measures: 1(b) MM1, 1(b) MM2, 2(b) MM1, 2(b) MM2, 4 MM1, 4 MM2, 5(c) MM1, 5(c) MM2, 6 MM1, and 6 MM2. With implementation of these measures, potential impacts on special-status wildlife species would be less than significant.

In addition, proposed management tasks would be implemented in conformance with regulatory requirements such as CDFW regulations, U.S. Fish and Wildlife Service regulations, State Water Resources Control Board regulations, Section 404 of the Clean Water Act, and any applicable plans or ordinances protecting biological resources.

- d) **No impact.** The proposed LMP includes protection or habitat enhancement as primary goals for both wildlife and their habitat. It also would ensure that actions comply with the federal and California Endangered Species Acts and other applicable regulations to protect special-status species and wildlife. Implementing the proposed LMP would not result in disruptions to or adverse impacts on the movement of resident or migratory fish or wildlife species.
- e) **No impact.** As discussed in the response to question c) above, proposed management tasks would be implemented in conformance with regulatory requirements and applicable plans or ordinances protecting biological resources. Implementing the proposed LMP would not conflict with any local policies or ordinances protecting biological resources.
- f) **No impact.** The proposed LMP would not conflict with the provisions of approved local, regional, or state habitat conservation plans (HCPs), such as the Solano Multispecies HCP or the Yolo Natural Heritage Program HCP, once adopted.

3.5 Cultural Resources

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
V. Cultural Resources. Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d) Disturb any human remains, including those interred outside of formal cemeteries?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion

a), b), c), d) Less-than-significant impact. No archaeological sites have been identified within LIER.

However, potential cultural resources within LIER include old pumps, sheds, and machinery used during farming operations, and portions of a historic-era levee that once surrounded Liberty Island. These resources have not been evaluated for potential eligibility for the California Register of Historical Resources (CRHR) or the National Register of Historic Places (NRHP).

Although implementing the proposed LMP would not require construction or major excavation; implementing some of the management tasks associated with the proposed LMP would include restoration or habitat enhancement activities, the removal of abandoned structures or other remnants of human activities, levee maintenance, and placement of signage. The proposed LMP contains Cultural Resources Goals 1, 2, and 3 which would require: 1) a cultural resources survey to evaluate the Liberty Island levee segment, pumps and sheds, and associated resources for eligibility for listing in the NRHP and the CRHR; 2) maintenance of cultural resources information by qualified CDFW staff members or designated associates who meet the Secretary of the Interior’s Standards for archaeology and history and evaluation of management and public uses for their potential to affect existing cultural resources including archaeological surveys for management activities that include ground-disturbing components; and 3) cataloging and preservation of cultural resources that are subject to impacts by current or future land management or public-use activities. If inventories identified significant cultural resources, these resources would be cataloged and preserved, consistent with Goal 3. Therefore, cultural resources of significance, if present, would be protected from adverse effects. With implementation of the cultural resources goals and associated tasks, adoption of the proposed LMP would not adversely affect cultural resources. Although not anticipated, the discovery of human remains would be handled according to California Public Resources Code Section 5097.9.

Geology and Soils

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VI. Geology and Soils. Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to California Geological Survey Special Publication 42.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
ii) Strong seismic ground shaking?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
iii) Seismic-related ground failure, including liquefaction?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
iv) Landslides?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Result in substantial soil erosion or the loss of topsoil?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994, as updated), creating substantial risks to life or property?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

- a), c), d) No impact.** No construction is proposed as part of the LMP, nor would any be required with implementation of any of the LMP goals or management tasks. Therefore, implementing the proposed LMP would not change the current exposure of people to geologic hazards or expansive soils.
- b) Less-than-significant impact.** Implementing some of the management tasks described in the proposed LMP would involve ground disturbance (e.g., restoration or habitat enhancement activities, the removal of abandoned structures or other remnants of human activities, levee maintenance, placement of signage). These projects, however, would be conducted in conformance with regulatory requirements regarding soil erosion; any associated impacts would be less than significant.
- e) No impact.** No construction of septic tanks or alternative wastewater disposal systems is proposed as part of the LMP, nor would any be required as a result of implementation of any of the LMP goals or tasks. Therefore, implementing the proposed LMP would result in no impact.

3.7 Greenhouse Gas Emissions

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VII. Greenhouse Gas Emissions. Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion

a), b) Less-than-significant impact. Implementing the proposed LMP would involve limited use of a barge and crane to remove abandoned structures within the project site, producing localized, temporary emissions. These emissions would be minimal and short term, however, and they would not cause a considerable increase in greenhouse gas emissions or impact on the environment. Further, implementing the proposed LMP would not require the construction of new permanent buildings or structures, nor would it generate significant numbers of automobile or boat trips. Prescribed burns may be performed as part of the LMP and would generate greenhouse gas emissions, but the duration and extent of the burns would be limited and localized, and burns would be implemented in compliance with conditions enforced by the Yolo Solano Air Quality Management District. Therefore, implementing the proposed LMP would not generate greenhouse gas emissions that would have a significant impact on the environment or conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

3.8 Hazards and Hazardous Materials

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VIII. Hazards and Hazardous Materials. Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials into the environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
h) Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

- a), b) **Less-than-significant impact.** Implementing some of the management tasks described in the proposed LMP would involve the short-term use of construction equipment to remove abandoned structures. However, equipment would be limited to a barge and crane, and no equipment or fuel would be stored on-site. Therefore, implementing the proposed LMP would not create a significant hazard to the public or the environment related to transport, use, or disposal of hazardous materials, or to their release into the environment.
- c) **No impact.** The nearest school is located approximately 6 miles northeast of the project site. Thus, implementing the proposed LMP would not result in hazardous emissions or handling of hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school.

- d) No impact.** LIER does not contain any hazardous contamination sites pursuant to Government Code Section 65962.5. Therefore, implementing the proposed LMP would not create a significant hazard to the public or the environment (DTSC 2014; SWRCB 2014).
- e) No impact.** LIER is located more than 2 miles from a public airport. Implementing the proposed LMP would not result in a safety hazard for people residing or working in the vicinity of the project site.
- f) No impact.** LIER is located more than 2 miles from any private airstrips. Implementing the proposed LMP would not result in a safety hazard for people residing or working in the vicinity of the project site.
- g) No impact.** No emergency response plans would be affected by implementation of the proposed LMP during or upon completion of management tasks.
- h) No impact.** LIER is not located in a hazardous fire zone. Implementing the proposed LMP would not expose people or structures to any wildland fires (CAL FIRE 2007).

3.9 Hydrology and Water Quality

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
IX. Hydrology and Water Quality. Would the project:				
a) Violate any water quality standards or waste discharge requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial on- or off-site erosion or siltation?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in on- or off-site flooding?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) Otherwise substantially degrade water quality?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
h) Place within a 100-year flood hazard area structures that would impede or redirect flood flows?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
i) Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
j) Inundation by seiche, tsunami, or mudflow?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

a), c), d), f) Less-than-significant impact. Implementing some of the management tasks described in the proposed LMP (e.g., restoration or habitat enhancement activities, removal of abandoned structures or other remnants of human activities, levee maintenance, placement of signage) would have the potential to result in the discharge of sediments or pollutants and alteration of drainage patterns. However, these tasks would be conducted in conformance with regulatory requirements regarding erosion and sediment control, flooding, and water quality protection, with a goal of a net improvement in water quality.

Permits, consultations, and/or approval actions may also be required to approve specific future projects. For example, CDFW would be required to coordinate with several agencies regarding the design and operation of restoration and habitat enhancement projects that could conflict with

flood flow conveyance requirements. Specifically, coordination would be required with the California Department of Water Resources (Central Valley Flood Protection Board), Central Valley Regional Water Quality Control Board, U.S. Army Corps of Engineers; and where appropriate, with local flood control agencies, reclamation districts, and Sacramento Area Flood Control Agency. All projects would be designed and operated to continue to have no impact on existing flood conveyance requirements of the Yolo Bypass. Project planning may include hydraulic modeling to guide design and confirm that performance criteria have been achieved (i.e., that potential adverse effects on necessary flow conveyance have been avoided). All hydraulic modeling would be conducted in coordination with appropriate flood control and management agencies. Therefore, implementing the proposed LMP would not violate water quality standards or waste discharge requirements, substantially alter drainage patterns, or otherwise substantially degrade water quality.

b), e), g), h), i), j) No impact. Implementation of the proposed LMP would not utilize additional surface or groundwater resources, create or contribute stormwater runoff, or construct new buildings or impervious surfaces. Further, the project site is relatively flat and no structures would be built as a result of the proposed LMP; thus, the proposed LMP would not alter existing risks of seiche, tsunami, or mudflow.

3.10 Land Use and Planning

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
X. Land Use and Planning. Would the project:				
a) Physically divide an established community?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, a general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

a), b), c) No impact. The proposed LMP would not require any physical changes to an established community, nor would implementing any activity after adoption of the LMP physically divide an established community. The proposed LMP would comply with California State Lands Commission requirements, and the LMP has been developed in conformance with land management plans (e.g., general plans) for adjacent areas. The goals of the proposed LMP provide for protection and preservation of natural resources and any projects implemented after LMP adoption are not expected to conflict with any HCPs and natural community conservation plans that may be applicable at that time.

3.11 Mineral Resources

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XI. Mineral Resources. Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

a), b) **No impact.** Implementing the proposed LMP would not result in resource extraction. Further, as described in Section II.H.4, “Minerals,” of the LMP, the project site is not located in an area that has been classified for aggregate mineral resources as part of the mineral land classification project established by the California Surface Mining and Reclamation Act. The proposed LMP would not result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state. The LMP also would not conflict with mineral resources protection plans or result in the loss of a known mineral resource.

3.12 Noise

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XII. Noise. Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or in other applicable local, state, or federal standards?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

a), c), d) Less-than-significant impact. Implementing the proposed LMP would require the use of a barge and crane to remove abandoned structures within the project site. This activity would temporarily increase noise levels in the project vicinity, but impacts would be short term and would not result in a substantial increase in ambient noise levels. The Solano County Code, Article III – Land Use Regulations, Section 28.70.10(B)(1)(b), contains a general noise standard stating that no land use should produce noise in excess of 65 A-weighted decibels (dBA) at any property line, based on a 24-hour sample. Nighttime noise levels (usually those occurring between 10 p.m. and 7 a.m.) are penalized by 10 dBA. This noise metric is commonly known as the day-night average noise level, or L_{dn} . Because the nearest residences to the project area are located on the west-northwest side and are approximately 600 feet away at the closest point, there would be sufficient distance between any project activities and the properties for noise levels to remain below the 65 dBA threshold.

A portion of the project area would be located within Yolo County, which does not have general noise standards. However, thresholds expressed for channel maintenance in the Cache Creek Plan Area and for mining activities in Yolo County are 80 dBA at the project site boundary and 60 dBA at residential property lines between 6 a.m. and 6 p.m. (Yolo County Code, Title 10, Chapter 3, Section 411, or 10-3.411, and Title 10, Chapter 8, section 416, or 10-8.416). Allowable noise levels are reduced to 65 dBA at the project site boundary between 6 p.m. and 6 a.m. Because the Yolo County portion of the project site is farther from personal properties than the Solano County portion, no noise impacts would be expected from activities in the Yolo County portion of the project area.

In addition, temporary construction-related noise from project activities would be similar to existing noise from ongoing agricultural activities in the adjacent areas, would not occur at night, and would not be continuous throughout any one day. Further, no permanent operational changes or construction of new buildings or structures that would increase ambient noise levels would occur. Because the project site is isolated, these types of short-term noise impacts would not be anticipated to affect a substantial number of people.

- b) **No Impact.** Management tasks described in the proposed LMP are not expected to generate groundborne vibration.

- e), f) **No impact.** The project site is located approximately 3.2 miles north of the nearest airport, Rio Vista Muni Airport, and is not located within an airport land use plan. In addition, the proposed LMP would not expose residents or people working within the project area to excessive noise.

3.13 Population and Housing

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XIII. Population and Housing. Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Displace substantial numbers of existing homes, necessitating the construction of replacement housing elsewhere?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

a), b), c) No impact. Implementing the proposed LMP would not involve new housing, nor would it induce growth by providing new infrastructure or removing barriers to growth. Implementing some of the management goals and tasks may require additional CDFW staff hours, but this would not be anticipated to induce population growth that would require additional housing.

3.14 Public Services

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XIV. Public Services. Would the project:				
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:				
Fire protection?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Police protection?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Schools?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Parks?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Other public facilities?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion

- a) **Less-than-significant impact.** Implementing the proposed LMP would not require substantial changes to existing levels of public services. Implementing habitat, public use, facilities, and fire management goals could require a minimal increase in staff hours per year by the Courtland Fire department, the Solano County Sheriff’s Department, Yolo County Sherriff’s Department and CDFW, but these potential minimal increases would not be anticipated to create the need for new or altered facilities.

3.15 Recreation

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XV. Recreation. Would the project:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

a), b) No impact. No existing neighborhood or regional parks or other recreational facilities are present at LIER. In addition, implementing the proposed LMP would not require the construction of recreational facilities. Therefore there will be no impact to recreation.

3.16 Transportation/Traffic

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVI. Transportation/Traffic. Would the project:				
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Result in inadequate emergency access?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion

a), b), c), d), e), f) No impact. Levels of use at the project site are anticipated to remain the same after adoption of the proposed LMP. Therefore, no changes in automobile, boat, or air traffic levels are anticipated. Liberty Island Road, a two-lane road that is maintained by Solano County, is the only road that provides access to the northern portion of Liberty Island. This road connects to King Road and ends at Liberty Island. The southern portion of the property is accessible only by boat, with most of the interior accessible only by air boat (because of submerged navigational hazards). No design changes are proposed for current road access, nor are any changes anticipated with traffic patterns; therefore, no traffic hazards are anticipated. Because no changes to current traffic levels or patterns are anticipated, emergency access is also not expected to change, and implementing the proposed LMP would not interfere with alternative transportation plans.

3.17 Utilities and Service Systems

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVII. Utilities and Service Systems. Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand, in addition to the provider's existing commitments?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
g) Comply with federal, state, and local statutes and regulations related to solid waste?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion

a), b), c), d), e), f), g) Less-than-significant impact. Levels of use at the project site are anticipated to remain the same after the adoption of the proposed LMP. The proposed LMP does not include a proposal for additional storm drain facilities, water supplies, wastewater treatment, or solid waste disposal. Adopting the proposed LMP and implementing the plan's goals and tasks would not require construction of new residences or service-related facilities. Therefore, implementing the proposed LMP would generate no new demand for or changes to storm drain facilities, or demand for additional water supplies, wastewater treatment, or solid waste disposal.

3.18 Mandatory Findings of Significance

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVIII. Mandatory Findings of Significance.				
a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare, or threatened species, or eliminate important examples of the major periods of California history or prehistory?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b) Does the project have impacts that are individually limited, but cumulatively considerable? (“Cumulatively considerable” means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Note: Authority cited: Sections 21083 and 21083.05, Public Resources Code. Reference: Section 65088.4, Gov. Code; Sections 21080(c), 21080.1, 21080.3, 21083, 21083.05, 21083.3, 21093, 21094, 21095, and 21151, Public Resources Code; *Sundstrom v. County of Mendocino*, (1988) 202 Cal.App.3d 296; *Leonoff v. Monterey Board of Supervisors*, (1990) 222 Cal.App.3d 1337; *Eureka Citizens for Responsible Govt. v. City of Eureka* (2007) 147 Cal.App.4th 357; *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th at 1109; *San Franciscans Upholding the Downtown Plan v. City and County of San Francisco* (2002) 102 Cal.App.4th 656.

Discussion

- a) **Less-than-significant impact.** Adopting the proposed LMP and implementing the plan’s goals and tasks would help preserve and enhance natural resources. As described in Sections 3.4 and 3.5 of this IS/MND, some activities that could be implemented with adoption of the proposed LMP would have the potential to result in impacts on biological and cultural resources. However, implementation activities would comply with all applicable regulatory requirements and measures included in the LMP that would protect these resources from adverse effects would be implemented. In addition, many of the goals and tasks are designed to have a net benefit to these resources, and no large-scale projects are anticipated that could threaten entire populations or communities. Therefore, implementing the proposed LMP would not cause a significant impact on these biological or cultural resources.
- b) **Less-than-significant impact.** Adopting the proposed LMP and implementing the plan’s goals and tasks would not require any substantial infrastructure improvements or new construction, and any implementation activities would comply with all applicable regulatory requirements. In addition, most of the proposed goals and tasks are proposed to encourage a net benefit to environmental conditions. Therefore, although the potential exists for some temporary and less-than-significant impacts on the environment as described above, none of these impacts are anticipated to be cumulatively considerable.

- c) **Less-than-significant impact.** Implementing the proposed LMP would not result in construction or substantive physical changes. Implementation activities would comply with all applicable laws and regulations. As a result, adopting the proposed LMP and implementing the plan's goals and tasks is not anticipated to have any direct or indirect environmental effects that would cause substantial adverse effects on human beings.

2015072008

Notice of Completion & Environmental Document Transmittal

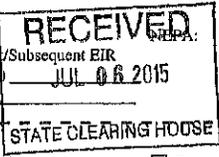
Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH #

Project Title: Liberty Island Ecological Reserve Land Management Plan
Lead Agency: California Department of Fish and Wildlife
Contact Person: Ryan Carrothers
Mailing Address: 7329 Silverado Trail
Phone: 630-767-1813
City: Napa Zip: 94558 County: Napa

Project Location: County: Solano City/Nearest Community: Rio Vista
Cross Streets: Liberty Island Road and Levee Road Zip Code: N/A
Longitude/Latitude (degrees, minutes and seconds): 38 ° 17 ' 12.91" N / 121 ° 40 ' 39.13" W Total Acres: 5,303
Assessor's Parcel No.: 033-170-04, 033-280-06, 033-280-01 Section: Twp.: Range: Base:
Within 2 Miles: State Hwy #: 84 Waterways: Cache Slough, Elkhorn Slough, Lindsey Slough, Prospec
Airports: None Railways: None Schools: None

Document Type:
CEQA: [] NOP [] Draft EIR [] NOI [] Joint Document
[] Early Cons [] Supplement/Subsequent EIR [] EA [] Final Document
[] Neg Dec (Prior SCH No. JUL 06 2015) [] Draft EIS [] Other:
[] Mit Neg Dec Other: [] FONSI



Local Action Type:
[] General Plan Update [] Specific Plan [] Rezone [] Annexation
[] General Plan Amendment [] Master Plan [] Prezone [] Redevelopment
[] General Plan Element [] Planned Unit Development [] Use Permit [] Coastal Permit
[] Community Plan [] Site Plan [] Land Division (Subdivision, etc.) [] Other: Ecological Reser

Development Type:
[] Residential: Units Acres Employees
[] Office: Sq.ft. Acres Employees
[] Commercial: Sq.ft. Acres Employees
[] Industrial: Sq.ft. Acres Employees
[] Educational:
[] Recreational:
[] Water Facilities: Type MGD
[] Transportation: Type
[] Mining: Mineral
[] Power: Type MW
[] Waste Treatment: Type MGD
[] Hazardous Waste: Type
[] Other: Resource Management; no development planned

Project Issues Discussed in Document:
[] Aesthetic/Visual [] Fiscal [] Recreation/Parks [] Vegetation
[] Agricultural Land [] Flood Plain/Flooding [] Schools/Universities [] Water Quality
[] Air Quality [] Forest Land/Fire Hazard [] Septic Systems [] Water Supply/Groundwater
[] Archeological/Historical [] Geologic/Seismic [] Sewer Capacity [] Wetland/Riparian
[] Biological Resources [] Minerals [] Soil Erosion/Compaction/Grading [] Growth Inducement
[] Coastal Zone [] Noise [] Solid Waste [] Land Use
[] Drainage/Absorption [] Population/Housing Balance [] Toxic/Hazardous [] Cumulative Effects
[] Economic/Jobs [] Public Services/Facilities [] Traffic/Circulation [] Other:

Present Land Use/Zoning/General Plan Designation:
Exclusive Agricultural, Agricultural General, Agricultural Preserve

Project Description: (please use a separate page if necessary)
The Liberty Island Ecological Reserve (LIER) Land Management Plan (LMP) will guide the adaptive management of habitats, species, and programs on the 5,303-acre partially inundated island and intends to protect and enhance fish and wildlife values; serve as a guide for appropriate public uses of LIER; serve as a descriptive inventory of fish, wildlife, and native and nonnative plants and vegetation communities that occur within LIER; and provide an overview of the property's planned operation and maintenance activities and of the personnel requirements to implement management goals.

State Clearinghouse Contact: (916) 445-0613
State Review Began: 7-6-2015
SCH COMPLIANCE 8-4-2015

- Project Sent to the following State Agencies
[X] Resources
[X] Boating & Waterways
[X] Coastal Comm
Colorado Rvr Bd
Conservation
CDFW #
[X] Delta Protection Comm
[X] Cal Fire
[X] Historic Preservation
[X] Parks & Rec
[X] Central Valley Flood Prot.
[X] Bay Cons & Dev Comm.
[X] DWR
OES
Resources, Recycling and Recovery
CalSTA
Aeronautics
[X] CHP
[X] Caltrans # 4
Trans Planning
Other
HCD
Food & Agriculture
State/Consumer Svcs
General Services
Cal EPA
[X] ARB: ALL Other Projects
ARB: Transportation Projects
ARB: Major Industrial/Energy
SWRCB: Div. of Drinking Water
SWRCB: Div. Financial Assist.
SWRCB: Wtr Quality
SWRCB: Wtr Rights
[X] Reg. WQCB # 55
Toxic Sub Ctrl-CTC
Yth/Adlt Corrections
Corrections
Independent Comm
Energy Commission
[X] NAHC
Public Utilities Comm
State Lands Comm
Tahoe Rgl Plan Agency
Conservancy
Other: Delta Stewardship Council

Please note State Clearinghouse Number (SCH#) on all Comments
SCH#: 2015072008
Please forward late comments directly to the Lead Agency

AQMD/APCD 2/40
(Resources: 7/11)

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "X".
If you have already sent your document to the agency please denote that with an "S".

<input checked="" type="checkbox"/> Air Resources Board	<input checked="" type="checkbox"/> Office of Historic Preservation
<input checked="" type="checkbox"/> Boating & Waterways, Department of	<input type="checkbox"/> Office of Public School Construction
<input type="checkbox"/> California Emergency Management Agency	<input checked="" type="checkbox"/> Parks & Recreation, Department of
<input type="checkbox"/> California Highway Patrol	<input type="checkbox"/> Pesticide Regulation, Department of
<input type="checkbox"/> Caltrans District # _____	<input type="checkbox"/> Public Utilities Commission
<input type="checkbox"/> Caltrans Division of Aeronautics	<input checked="" type="checkbox"/> Regional WQCB # <u>5S</u>
<input type="checkbox"/> Caltrans Planning	<input checked="" type="checkbox"/> Resources Agency
<input checked="" type="checkbox"/> Central Valley Flood Protection Board	<input type="checkbox"/> Resources Recycling and Recovery, Department of
<input type="checkbox"/> Coachella Valley Mtns. Conservancy	<input checked="" type="checkbox"/> S.F. Bay Conservation & Development Comm.
<input type="checkbox"/> Coastal Commission	<input type="checkbox"/> San Gabriel & Lower L.A. Rivers & Mtns. Conservancy
<input type="checkbox"/> Colorado River Board	<input type="checkbox"/> San Joaquin River Conservancy
<input checked="" type="checkbox"/> Conservation, Department of	<input type="checkbox"/> Santa Monica Mtns. Conservancy
<input type="checkbox"/> Corrections, Department of	<input checked="" type="checkbox"/> State Lands Commission
<input checked="" type="checkbox"/> Delta Protection Commission	<input type="checkbox"/> SWRCB: Clean Water Grants
<input type="checkbox"/> Education, Department of	<input type="checkbox"/> SWRCB: Water Quality
<input type="checkbox"/> Energy Commission	<input type="checkbox"/> SWRCB: Water Rights
<input type="checkbox"/> Fish & Game Region # _____	<input type="checkbox"/> Tahoe Regional Planning Agency
<input checked="" type="checkbox"/> Food & Agriculture, Department of	<input type="checkbox"/> Toxic Substances Control, Department of
<input checked="" type="checkbox"/> Forestry and Fire Protection, Department of	<input checked="" type="checkbox"/> Water Resources, Department of
<input type="checkbox"/> General Services, Department of	<input type="checkbox"/> Other: <u>USGS, USACE</u>
<input type="checkbox"/> Health Services, Department of	<input type="checkbox"/> Other: _____
<input type="checkbox"/> Housing & Community Development	
<input checked="" type="checkbox"/> Native American Heritage Commission	

Local Public Review Period (to be filled in by lead agency)

Starting Date July 6, 2015 Ending Date August 5, 2015

Lead Agency (Complete if applicable):

Consulting Firm: <u>AECOM</u>	Applicant: <u>California Department of Fish and Wildlife</u>
Address: <u>2020 L Street, Suite 400</u>	Address: <u>7329 Silverado Trail</u>
City/State/Zip: <u>Sacramento/CA/95811</u>	City/State/Zip: <u>Napa, CA 94558</u>
Contact: <u>Charles Battaglia</u>	Phone: <u>707-944-5500</u>
Phone: <u>916-414-5826</u>	

Signature of Lead Agency Representative: *Scott Wilson* Date: July 3, 2015

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

Notice of Determination

Appendix D

To:
[] Office of Planning and Research
U.S. Mail: P.O. Box 3044
Sacramento, CA 95812-3044
Street Address: 1400 Tenth St., Rm 113
Sacramento, CA 95814

[] County Clerk
County of: Solano
Address: 675 Texas Street, Suite 1900
Fairfield, CA 94533

From:
Public Agency: California Dept. of Fish and Wildlife
Address: 7329 Silverado Trail
Napa, CA 94558
Contact: Ryan Carrothers
Phone: (530) 757-1813

Lead Agency (if different from above):
Address:
Contact:
Phone:

SUBJECT: Filing of Notice of Determination in compliance with Section 21108 or 21152 of the Public Resources Code.

State Clearinghouse Number (if submitted to State Clearinghouse): 2015072008

Project Title: Liberty Island Ecological Reserve, Land Management Plan

Project Applicant: California Department of Fish and Wildlife

Project Location (include county): Located in the eastern portion of Solano County, 10 miles north of Rio Vista.

Project Description:

The Liberty Island Ecological Reserve (LIER) Land Management Plan (LMP) will guide the adaptive management of habitats, species, and programs on the 5,303-acre partially inundated island and intends to protect and enhance fish and wildlife values; serve as a guide for appropriate public uses of LIER; serve as a descriptive inventory of fish, wildlife, and native and nonnative plants and vegetation communities that occur within LIER; and provide an overview of the property's planned operation and maintenance activities and of the personnel requirements to implement management goals.

This is to advise that the California Department of Fish and Wildlife has approved the above ([] Lead Agency or [] Responsible Agency)

described project on 03/02/16 and has made the following determinations regarding the above (date) described project.

- 1. The project [] will [] will not have a significant effect on the environment.
2. [] An Environmental Impact Report was prepared for this project pursuant to the provisions of CEQA.
[] A Negative Declaration was prepared for this project pursuant to the provisions of CEQA.
3. Mitigation measures [] were [] were not made a condition of the approval of the project.
4. A mitigation reporting or monitoring plan [] was [] was not adopted for this project.
5. A statement of Overriding Considerations [] was [] was not adopted for this project.
6. Findings [] were [] were not made pursuant to the provisions of CEQA.

This is to certify that the final EIR with comments and responses and record of project approval, or the negative Declaration, is available to the General Public at:

7329 Silverado Trail, Napa, CA 94558

Signature (Public Agency): Scott Wilson Title: Regional Manager Governor's Office of Planning & Research

Date: August 26, 2016 Date Received for filing at OPR: SEP 27 2016

STATE CLEARINGHOUSE

4.0 References

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CNPS. *See* California Native Plant Society.DOC. *See* California Department of Conservation.

DTSC. *See* California Department of Toxic Substances Control.

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