ADAPTIVE MANAGEMENT AND MONITORING PLAN
YOLO FLYWAY FARMS RESTORATION PROJECT

PREPARED FOR:

Reynier Fund, LLC
34284 Corcoran Hill Lane
Davis, CA 95616
Contact: Charles Tyson
916.716.3900

PREPARED BY:

ICF
630 K Street, Suite 400
Sacramento, CA 95814
Contact: Carl Jensen
916.737.3000

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I. INTRODUCTION

The Yolo Flyway Farms Restoration Project (Project) is situated in the northwestern Sacramento–San Joaquin River Delta, in southern Yolo County, at the southern end of the Yolo Bypass floodway, and near the north end of the Cache Slough complex. The Yolo Bypass is a levee-protected 59,000-acre floodplain west of the lower Sacramento River; the 41-mile-long Bypass routes Sacramento River floodwaters away from heavily developed urban and suburban areas and onto minimally developed farmland. Land uses within the Yolo Bypass are managed to facilitate flood flow conveyance. Land uses within the Bypass consist of the state-owned Yolo Wildlife Area (16,700 acres) and, mainly privately owned, agricultural lands, all of which are subject to flood flow conveyance easements that restrict development. The Bypass is predominantly used for annual agricultural crops and some grazing. The Yolo Wildlife Area is managed as a mix of emergent, seasonal, and permanent wetland, agriculture, and grasslands. Bounding the Yolo Bypass on the east is the Sacramento Deep Water Ship Channel. The Yolo Wildlife Area provides seasonal or permanent habitat for 44 species of fish, 8 of which are special-status species that suffer from habitat loss needed to support spawning (i.e. Delta Smelt) or rearing (i.e. anadromous salmonids). Wetlands that evolved as dynamic systems, changing in response to floods, droughts and fire have been converted into an engineered floodway, enclosed by levees and berms, and flooded with water from irrigation that results in loss of dynamic habitat that used to provide abundant food resources to species that evolved to take advantage of historically rich food availability associated with seasonally inundated floodplains.

A. Purpose of Project

The goal of this proposed restoration effort is to partially fulfill the 8,000-acre tidal restoration obligations of the California Department of Water Resources contained within the Reasonable and Prudent Alternative (RPA) of the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (BiOp) (USFWS 2008) and referenced in the National Marine Fisheries Service (NMFS) Salmonid BiOp (NMFS 2009), for coordination of the State Water Project (SWP) and the federal Central Valley Project (CVP). These BiOps establish the problem statement, and identify tidal and associated subtidal restoration as a component of the larger strategy for protection and potential recovery of the covered species.

The BiOps identify fundamental impairments to delta smelt and juvenile salmonids within the tidal reaches of the Sacramento-San Joaquin delta, for which tidal and subtidal marsh restoration is an intended remedy:

Delta smelt

- Food limited (USFWS 2008, p.189–190)
- Water quality inhibited (USFWS 2008, p.189–190)

Juvenile salmon

- Floodplain rearing habitat limited (NMFS 2009, p.49)
- Water quality inhibited (NMFS 2009, p.49)

The premise for tidal and subtidal restoration, thus, is that it can reduce these limitations through restoration of aquatic food webs, water quality, and rearing habitat, or through indirect effects that contribute to such improvements external to a restoration site.

Because of its location at the Sacramento-San Joaquin Delta margin, the Project site provides an opportunity to restore a small amount of wetland-upland transitional habitats. The Project seeks to supplement the credits generated by the Lower Yolo Restoration Project and, if possible, integrate its design with that project in order to provide a larger project that maximizes utilization of the unique landscape setting that both sites occupy.

B. Purpose of this Adaptive Management and Monitoring Plan

The purpose of this adaptive management and monitoring plan (AMMP) is to ensure that the restored habitats are protected, managed, monitored and maintained for the species listed below (Table 1). This AMMP establishes objectives, priorities, and tasks to manage, monitor, maintain, and report on the habitats and species at the Project site. The monitoring component of this AMMP identifies the metrics of functional outcomes from Project construction and operation that will be measured to evaluate progress toward desired or hypothesized outcomes, and to inform corrective measures if criteria are not met. Monitoring categories include physical processes, vegetation, food web (nutrients, primary and secondary productivity), fish, and water quality (DWR et al., 2012, IEP in development).

Specifically, this AMMP provides:

1. A descriptive inventory of plant, wildlife, and fish habitats that occur on the site prior to construction
2. An overview of the Project site operation and maintenance, and personnel requirements to implement management activities
3. Monitoring metrics and methods for the restored habitats during the interim management period
4. A process for initiating adaptive management actions in consultation with cooperating and regulatory agencies

Table 1. Fish Species Occurring on the Yolo Bypass Floodplain and Northwest Delta and Potentially Occurring on the Project Site

Common Name	Scientific Name	Native/Introduced	Federal/State Status *
Acipenseridae – Sturgeons			
Green sturgeon	*Acipenser medirostris*	Native	T/SSC
White sturgeon	*Acipenser transmontanus*	Native	--/--
Atherinopsidae – Silversides			
Inland silverside	*Menidia beryllina*	Introduced	--/--
Catostomidae – Suckers			
Sacramento sucker	*Catostomus occidentalis*	Native	--/--
Centrachidae – Sunfish and Basses			

Table 1. Fish Species Occurring on the Yolo Bypass Floodplain and Northwest Delta and Potentially Occurring on the Project Site

Common Name	Scientific Name	Native/Introduced	Federal/State Status *
Black crappie	*Pomoxis nigromaculatus*	Introduced	--/--
Bluegill	*Lepomis macrochirus*	Introduced	--/--
Green sunfish	*Lepomis cyanellus*	Introduced	--/--
Largemouth bass	*Micropterus salmoides*	Introduced	--/--
Redear sunfish	*Lepomis microlophus*	Introduced	--/--
Smallmouth bass	*Micropterus dolomieu*	Introduced	--/--
Spotted bass	*Micropterus punctatus*	Introduced	--/--
Warmouth	*Lepomis gullosus*	Introduced	--/--
White crappie	*Pomoxis annularis*	Introduced	--/--
Clupeidae – Herrings			
Threadfin shad	*Dorosoma petenense*	Introduced	--/--
American shad	*Alosa sapidissima*	Introduced	--/--
Cottidae – Sculpins			
Pacific staghorn sculpin	*Leptocuttus armatus*	Native	--/--
Prickly sculpin	*Cottus asper*	Native	--/--
Cyprinidae – Minnows			
Common carp	*Cyrpinus carpio*	Introduced	--/--
Fathead minnow	*Pimephales promelas*	Introduced	--/--
Golden shiner	*Notemigonus crysoleucas*	Introduced	--/--
Goldfish	*Carassius auratus*	Introduced	--/--
Hitch (Central Valley)	*Lavinia exilicauda*	Native	--/--
Red shiner	*Cyprinella lutrensis*	Introduced	--/--
Sacramento blackfish	*Orthodon microlepidotus*	Native	--/--
Sacramento pikeminnow	*Ptychocheilus grandis*	Native	--/--
Sacramento splittail	*Pogonichthys macrolepidotus*	Native	--/SSC
Embiotocidae – Surfperches			
Tule perch	*Hysterocarpus traskii*	Native	--/--
Gasterosteidae – Sticklebacks			
Threespine stickleback	*Gasterosteus aculeatus*	Native	--/--
Gobiidae – Gobies			
Yellowfin goby	*Acanthogobius flavimanus*	Introduced	--/--
Shimofuri goby	*Tridentiger bifasciatus*	Introduced	--/--
Ictaluridae – Bullhead Catfish			
Black bullhead	*Ameiurus melas*	Introduced	--/--
Brown bullhead	*Ameiurus nebulosus*	Introduced	--/--
Channel catfish	*Ictalurus punctatus*	Introduced	--/--
White catfish	*Ameiurus catus*	Introduced	--/--

Table 1. Fish Species Occurring on the Yolo Bypass Floodplain and Northwest Delta and Potentially Occurring on the Project Site

Common Name	Scientific Name	Native/Introduced	Federal/State Status *
Moronidae – Striped Basses			
Striped bass	*Morone saxatilis*	Introduced	--/--
Osmeridae – Smelts			
Delta smelt	*Hypomesus transpacificus*	Native	T/--
Longfin smelt	*Spirinchus thaleichthys*	Native	--/T
Wakasagi	*Hypomesus nipponensis*	Introduced	--/--
Percidae – Perches			
Bigscale logperch	*Percina macrolepida*	Introduced	--/--
Petromyzontidae – Lampreys			
Pacific lamprey	*Lampetra tridentate*	Native	SC/--
River lamprey	*Lampetra ayresii*	Native	--/SSC
Poeciliidae – Livebearers			
Western mosquitofish	*Gambusia affinis*	Introduced	--/--
Salmonidae – Salmon and Trout			
Chinook salmon	*Oncorhynchus tshawytscha* (spring-run)	Native	T/T
	O. tshawytscha (fall-run)	Native	SC/SSC
	O. tshawytscha (late fall–run)	Native	SC/SSC
	O. tshawytscha (winter-run)	Native	E/E
Steelhead (Central Valley)	*O. mykiss*	Native	T/--

Source: Sommer et al. 2003.

* Status abbreviations: E = Endangered; T = Threatened; SC = Species of Concern; SSC = Species of Special Concern.

The Project is anticipated to generate habitat “credits” to apply against various regional restoration obligations. It is anticipated that Reynier Fund, LLC will sell or transfer credits to DWR through an RFP or other delivery process and the understanding that DWR would provide management funds for the Project in perpetuity. Funding arrangements will be detailed in a Credit Purchase Agreement with DWR. Until such time as a Credit Purchase Agreement is executed, Reynier Fund, LLC will be responsible for funding and executing all of the management and maintenance activities as described in this AMMP until the Yolo Flyway Farms property is turned over to DWR or its designee. Reynier Fund, LLC may also be responsible for funding and executing some, but not all, of the monitoring activities as described in this AMMP.

The Fishery Agency Strategy Team (FAST) approving the Project consists of representatives from the USFWS, NMFS, CDFW, and the U.S. Bureau of Reclamation (Reclamation). Substantive changes in this AMMP are subject to review and written approval by the FAST as

well as the Delta Science Council (DSC). This AMMP is a binding and enforceable instrument for the Project site upon completion of construction.

This AMMP is intended to be consistent with federal, state, and local permits and, to the extent any discrepancies arise between this AMMP and the permits, the permits shall govern absent written approval from the agency of jurisdiction allowing a permit deviation.

C. Management Objectives

The management objectives of this AMMP are to:

1. guide management of the restored landscape to promote the objectives of the Project and
2. assure preservation of restoration benefits that are consistent with an evolving landscape

D. Project Goals and Objectives

The goals and objectives of this tidal marsh restoration Project are to:

1) **Food Web Contribution:** Enhance regional food web productivity and export to Cache Slough Complex in support of delta smelt recovery and for direct use by delta smelt

2) **Rearing Habitat for Native Fishes and Wetland-Dependent Species:** Provide rearing habitat for out-migrating salmonids and other native fish, as well as rearing, breeding, and refuge habitat for other aquatic and terrestrial wetland-dependent species that utilize or depend upon the combination of Delta freshwater aquatic-tidal marsh-floodplain-seasonal wetland-lowland grassland interfaces that existed historically

3) **Enhance Ecosystem Function:** Provide suitable habitat for establishment of diverse native plant communities including rare plants

4) **Manage Invasive Vegetation:** Minimize potential for colonization by invasive aquatic vegetation

5) **Habitat Succession:** Preserve existing topographic variability to allow for habitat succession and resilience against future climate change

E. AMMP Implementation Strategy

The AMMP implementation Strategy relies on funding availability to implement, monitor, and manage the proposed project in perpetuity for three discrete periods:

1. Performance and completion of Project construction
2. Achieve objectives of construction with verification monitoring, property maintenance and management, and any remedial measures
3. Manage the project in perpetuity following specifications in the Site Specific Agreement and Long Term Management Plan, using monitoring and enforcement of the perpetual conservation mechanism described below

The amount of the funding assurance required will be based on realistic cost estimates for all of the actions described above. Tools are available to calculate funding needs for the post-construction activities, such as the Center for Natural Lands Management's Property Analysis

Record (PAR)[1] software, designed and utilized for developing cost estimates for long-term funding assurance mechanisms, or an equivalent analysis using other proprietary methods.

F. Assurance Mechanisms

Assurance mechanisms can take several forms. These mechanisms may include those used by private entities such as mitigation banks (including endowments, letters of credit, performance bonds, escrow agreements, and casualty insurance).

Key aspects of the assurance mechanism are that it provides for the following:

- Costs and expenses reasonably incurred through the monitoring, maintenance, or long-term management, including, without limitation, property taxes, contracts, equipment or materials, and signage related to the management of the Project area and consistent with the Conservation Easement
- Staffing costs for the Land Manager, Conservation Easement Monitor, and other necessary personnel
- Capital improvements in the event that substantive corrective measures become necessary
- Continue in perpetuity as a covenant running with the land

G. Responsible Parties

1. Land Owner and Responsibilities

The Project site was purchased by Reynier Fund, LLC in 2008 for the purposes of providing seasonal waterfowl habitat and grazing land for cattle with the ultimate goal of restoring native habitats. Sub-surface mineral rights and surface water rights for the property were acquired by Reynier Fund, LLC at the same time as fee title.

The Land Owner's responsibilities shall include but not be limited to the following:

- Implementing or causing to be implemented all habitat restoration, creation and management activities
- Executing the long-term management, monitoring, maintenance, and reporting responsibilities as described in this AMMP
- Performing general inspections to ensure restored habitat values are protected and maintained
- Performing or causing to be performed some of the monitoring actions and surveys as described in the monitoring component of this AMMP
- Analyzing portions of the monitoring data resulting from the monitoring activities and implementing any remedial or adaptive management actions as agreed to by the FAST
- Filing annual reports with the FAST describing the status and evolution of the restored habitats, general plant and tidal area health, presence and abundance of invasive flora and fauna, hydrologic conditions, wildlife utilization, trespass and trash problems, and other management, maintenance, monitoring and reporting activities
- Maintaining a file on the Project detailing management, maintenance, monitoring, and reporting activities, correspondence, and determinations. The file will be available for review and approval by the FAST

[1] See www.cnlm.org

- Coordinating and approving any research activities proposed on the site
- Other similar duties not specifically described above

2. Qualified Personnel/Monitoring Biologists

The Land Owner shall retain professional biologists, botanists, restoration ecologists, and other Qualified Personnel, including Monitoring Biologists to conduct specialized tasks and monitoring as described in this AMMP. The Monitoring Biologists shall be familiar with wetland biology and have knowledge relative to monitoring protocols, management techniques, endangered species needs, and fisheries ecology. Monitoring Biologists must have current USFWS, NMFS and/or CDFW authorizations and permits to conduct monitoring surveys for listed species. Duties of the Qualified Personnel may include, but are not limited to:

- Pre-construction monitoring
- Monitoring and maintaining habitat function
- Monitoring and maintaining erosion control
- Identifying and evaluating the presence of invasive species and developing management recommendations
- Conducting surveys that are required by this AMMP
- Evaluating site conditions and recommending remedial actions and or adaptive management actions to the Land Owner
- Assisting in the review or planning of any additional restoration actions following initial construction
- Water quality monitoring
- Carrying out or monitoring special studies at the site
- Preparing annual reports

3. Changes in Personnel

Significant personnel changes will be reported in annual reports to the FAST. If needed or desired by the FAST, any related transfer of management responsibilities will be coordinated with a site visit with the FAST and as identified in the conservation easement.

II. PROPERTY AND RESTORATION PROJECT DESCRIPTION

A. Regional Setting

The Project site is in the northwestern Sacramento–San Joaquin River Delta, in southern Yolo County (Figure 1), at the southern end of the Yolo Bypass floodway, and near the north end of the Cache Slough complex (Figure 2). The Yolo Bypass is a levee-protected 59,000-acre

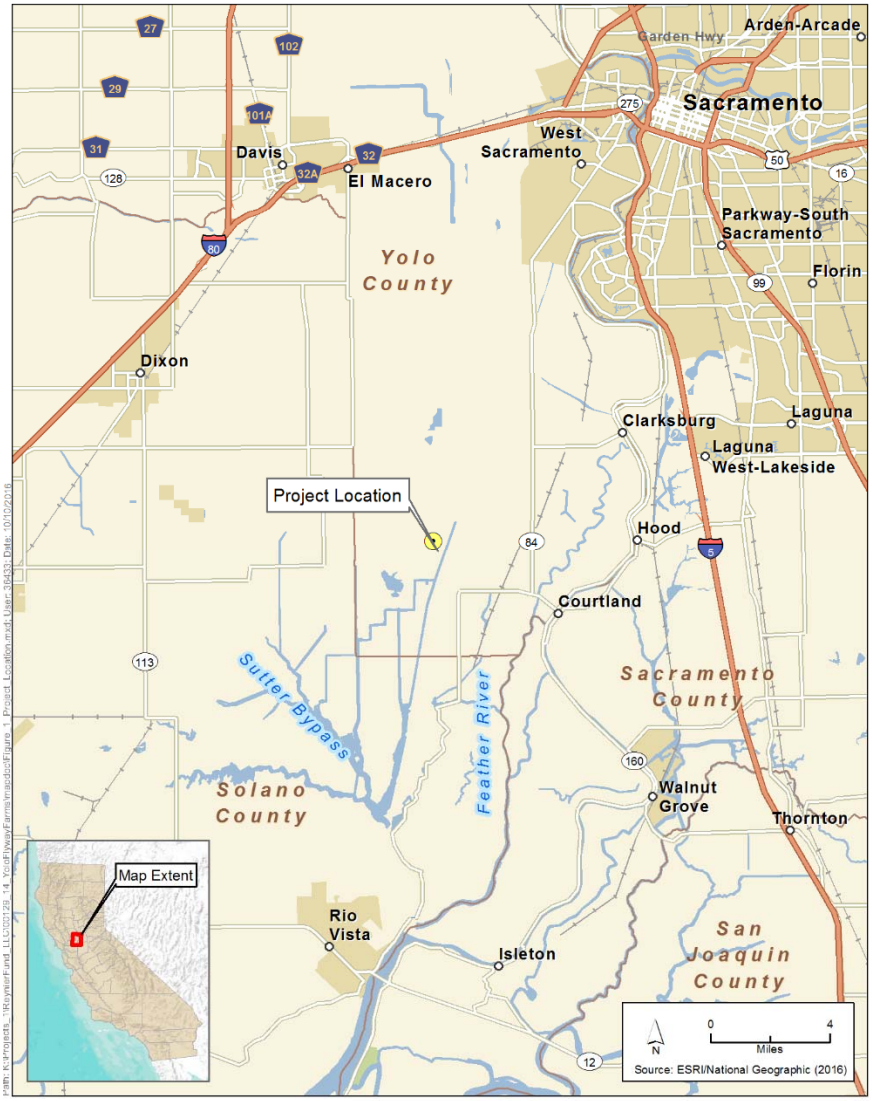

Figure 1. Project location

floodplain west of the lower Sacramento River; the 41-mile-long Bypass routes Sacramento River floodwaters away from heavily developed urban and suburban areas and onto minimally developed farmland. Land uses within the Yolo Bypass are managed to facilitate flood flow conveyance. Land uses within the Bypass consist of the state-owned Yolo Wildlife Area (16,700 acres) and, mainly privately owned, agricultural lands, all of which are subject to flood flow conveyance easements that restrict development. The Bypass is predominantly used for annual agricultural crops and some grazing. The Yolo Wildlife Area is managed as a mix of emergent, seasonal, and permanent wetland, agriculture, and grasslands. Bounding the Yolo Bypass on the east is the Sacramento Deep Water Ship Channel.

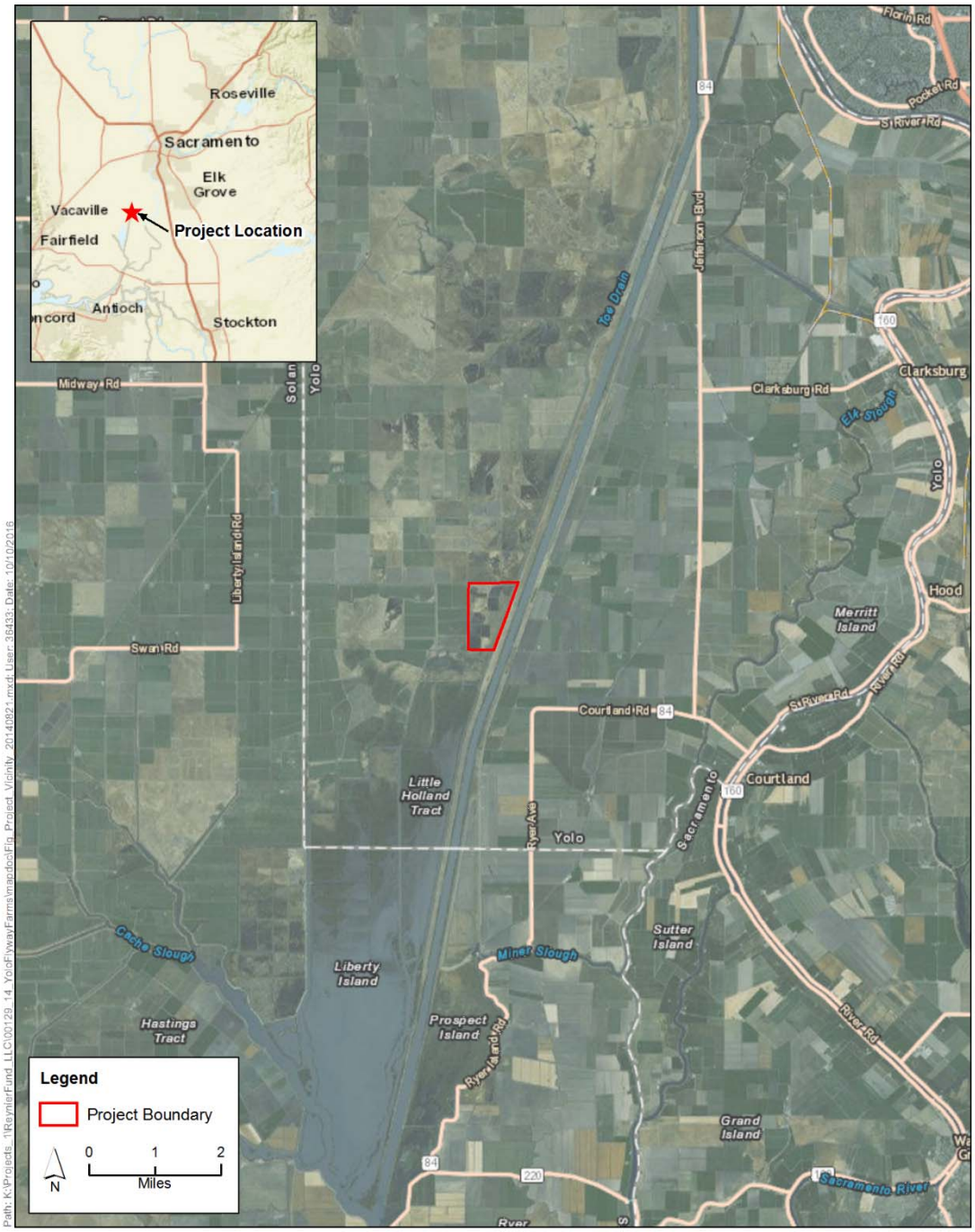

Figure 2. Project Vicinity

B. Site Setting and Surrounding Land Uses

Agricultural lands surround the Project site in all directions except to the immediate south and east (Figure 3). To the north, agricultural lands within the Yolo Bypass are used for a mixture of cattle grazing and crop production. West of the Yolo Bypass are extensive agricultural lands (pasture and crops) of Solano County. East of the Yolo Bypass and across the Sacramento Deep Water Ship Channel are additional agricultural lands. Bordering the Project site to the south is the Lower Yolo project site, and south of that are the flooded islands of Liberty Island and Little Holland Tract. Farther south are more agricultural lands in Solano and Sacramento counties.

Figure 3. Land use around Yolo Flyway Farms

C. Historical Site Conditions

According to the San Francisco Estuary Institute's (SFEI's) *Sacramento-San Joaquin Delta Historical Ecology Investigation* (SFEI 2012), the Project site historically held a uniquely rich location at the intersection of the Putah Creek alluvial fan, historic Sacramento River Yolo Basin floodway and North Delta tidal marshes. Before being diked and reclaimed for agricultural use in the early and mid-1900s, the site supported a combination of grasslands, seasonal wetlands, and tidal marsh. The proposed Project would restore areas that historically were wetlands prior to the twentieth century.

D. Topography

The topography of the Project site is primarily flat, with an almost imperceptible slope descending from the northwest to the southeast (Figure 3-8). Much of the site is at elevations above modern mean higher high tide (+6.5 ft. NAVD88[2]), with elevations ranging between +6.5 to +9 ft. NAVD88. Approximately three-quarters of the site topography is within elevation ranges of +2 to +6.5 ft. NAVD88. Many areas within the site are currently pastures that have been graded to drain to agricultural drainage ditches.

E. Yolo Bypass Floodplain Hydrology

1. Overview

The Yolo Bypass was designed to prevent flooding of the City of Sacramento and other nearby cities and farmland by diverting up to 455,000 cubic feet per second (cfs) of floodwaters through the Fremont and Sacramento weirs, along with capturing and sending south flows from tributaries along the west side of the Yolo Bypass (California Department of Fish and Game [DFG] 2008). The Bypass is 41 miles long and is bounded on the east and partially on the west by levees constructed by the U.S. Army Corps of Engineers (USACE) (Yolo Basin Foundation [YBF] 2001). The levees are designed to accommodate the calculated water-surface of the design flow plus an extra buffer for freeboard. The Yolo Bypass was originally constructed in 1924 and has undergone one major modification, in the 1950s, with construction of the Sacramento Deep Water Ship Channel (DFG 2008).

The extent and depth of flooding within the Bypass are influenced by the total amount of water flowing into the Bypass from the Fremont and Sacramento weirs and the west side tributaries such as Cache Creek, and by the local topography. Diversion of the majority of the Sacramento River, Sutter Bypass, and Feather River high flows to the Yolo Bypass via Fremont Weir controls Sacramento River flood stages at Verona, immediately downstream of Fremont Weir. In the current configuration, the Fremont Weir spills when Sacramento River flows exceed approximately 56,000 cfs at Verona, or a river stage of 33 feet NAVD88 (DFG 2008). During large flood events, 80 percent of the Sacramento River flows are diverted into the Yolo Bypass (DFG 2008). Once in the Bypass, smaller flows generally move to the eastern side of the Bypass into Tule Canal and south into the Toe Drain; as inflows continue to rise, the Tule Canal/Toe Drain banks are overtopped, flooding the Bypass and activating the floodplain. Within the northern extents of the Tule Canal, flows start to inundate the Bypass just in excess of 1,000 cfs. In the southern reach of the Toe Drain, in the vicinity of the Lisbon Weir, flows start to inundate the Yolo Bypass from between 3,000 and 4,000 cfs (DFG 2008).

[2] North American Vertical Datum of 1988

2. Lower Bypass Inundation

The extent of flooding within the lower Yolo Bypass (including the Project site) has not been monitored in the past. However, by comparing elevation data at the Project site (from DWR LiDAR topographic data) with historic aerial photographs (1974 and 1982), high-water marks (1986 and 1997) and gage data (2010) of five known flooding events to their corresponding elevations at Lisbon Weir, the average depth of inundation at the site relative to the duration of inundation at the Lisbon Weir (based on DWR records) flooding can be estimated. The Lisbon Weir overtops into the Yolo Bypass when flows exceed 3,530 cfs in the Tule Canal or at approximately +12.9 ft NAVD88. A small flood pulse that inundated the site in January 2010, with a corresponding flood elevation of +12.9 ft NAVD88 at the Lisbon Weir, is the point at which the site will begin to experience backwater flooding through low points in field berms. More recently, the Project site flooded in late March and early April 2011, completely inundating the entire Project site when water levels at Lisbon Weir were at approximately +19 ft NAVD88. Accordingly, this would roughly correspond to a flood elevation of approximately +15 ft NAVD88 on the Project site. Figure 3-5 shows the period and depth of inundation at the Lisbon Weir from 1934 to 2002.

F. Habitat

1. Wetlands

Overall, wetland communities on the Project site are associated with seasonally flooded (naturally or artificially) fields and perennially inundated areas. In addition, much of the vegetation on the Project site includes nonnative or generalist species, indicative of ongoing disturbance and agricultural activities.

Extensive farmed wetland habitats on the Project site consist predominantly of degraded seasonal wetlands, with very small areas of perennial wetlands and tidal marsh. Wetland conditions on the Project site are complex due to the natural and artificial hydrologic inputs, which include ponding due to direct precipitation and limited subsurface saturation in areas near major waterways, influences attributable to the position of the Project site within the Yolo Bypass (periodic flood events), and artificial sources (flood irrigation). In spite of manipulations to support flood irrigation practices and artificial hydrologic inputs, the extent of historic wetlands on the Project site is still reflected in the underlying soils and residual natural topography. Soils across the Project site are characterized as hydric, and are generally composed of poorly drained clayey or clay loam substrates in the upper soil horizons.

Wetland ecologists identified three wetland habitat types on the Project site: perennial emergent marsh, muted and non-tidal; seasonal wetland; and riparian woodland. In addition to wetland habitats, the Project site supports jurisdictional other waters, which include drainage ditches, tidal waterways, and tidally-surcharges irrigation ditches.

2. Uplands

The Project site has little upland (non-wetland) habitats due to its position within the Yolo Bypass, which is subject to periods of inundation long and frequent enough to support seasonal wetlands. Areas of upland habitat are restricted to roads and berms in the interior of the Project site and a portion of the Project site in the northwest corner. Upland habitats on the Project site have limited ecological functions. When the adjacent areas of the Project site are inundated by Yolo Bypass floods, these lands may provide seasonal refuge for terrestrial wildlife.

G. Land Use

The Project site is comprised entirely of agricultural lands and is designated in the Yolo County General Plan as Agricultural Preserve.

The Project site serves as a flood bypass, with winter and spring floods occurring on average in 2 of every 3 years (DFG 2008).

H. Infrastructure

There is limited infrastructure on the property to support cattle ranching and water management operations and consists largely of unpaved roads, culverts and cattle fencing. Low internal berms for managing irrigation water are located throughout the site. Irrigation water is supplied to the site via a pump located in the northwest corner of the site. All irrigation water drains to the southeast corner of the site though a network of the aforementioned culverts.

The Toe Drain is a large, constructed tidal waterway that supplies irrigation water north to agricultural lands within the Yolo Bypass during the growing season, and conveys floodwaters south in the winter and spring. The Toe Drain is located directly east of the Project site.

One abandoned (plugged) gas well exists on the site.

I. Existing Easements

Just north of the Project site are some privately owned lands currently used for waterfowl hunting, some with federal wetlands easements supporting those land uses. The approximately 2100-acre Lower Yolo restoration project is currently on hold. Farther north in the Yolo Bypass (but not shown in Figure 3-6) is the 16,700-acre Yolo Wildlife Area, which is managed by CDFW.

J. Consistency with Local Planning Efforts

Several regional conservation plans (HCPs/NCCPs) have been approved in the vicinity of the Delta, and others are in the process of being developed. These plans are generally sponsored by local governments and special districts to address the mitigation and conservation needs of terrestrial and wetland wildlife and plant species. The regional conservation plans in the vicinity of the Delta are the following.

- San Joaquin County HCP (approved)
- East Contra Costa County HCP/NCCP (approved)
- Solano County HCP (in development)
- Yolo County HCP/NCCP (in development)
- Suisun Marsh Habitat Restoration and Management Plan (in development)
- South Sacramento County HCP (in development)
- East Alameda County Conservation Strategy (in development)

The Project site lies within the planning area for the Yolo County HCP/NCCP (called the Yolo Natural Heritage Program), and directly adjacent to the Solano County HCP, both of which are currently in development.

1. Yolo County Natural Heritage Program

The Yolo Natural Heritage Program (NHP) serves as a joint HCP/NCCP. The NHP, currently in development, is a comprehensive, county-wide plan that encompasses approximately 653,817

acres, and is designed to provide long-term conservation and management of natural communities, sensitive species, and the habitats upon which those species depend. The natural communities addressed by the NHP include grasslands, shrublands and scrub, woodlands and forest, riparian and wetlands, and agriculture.

Though the Yolo County NHP is still in development, working draft chapters of the NHP document are available on its web portal.[3] In March 2006, the Independent Science Advisors to the Yolo NHP published their recommendations for the plan, to help ensure that the NHP is developed using best available science (Spencer et al. 2006). The Independent Science Advisors' Report sets out the following recommendations for the Yolo Bypass under NHP:

1. Increase the amount of riparian forest habitats within the Yolo Bypass;
2. Reduce water temperatures via restoration (e.g., increase shading vegetation) and management (control of water flows) to favor cool-water native fishes;
3. Improve aquatic connectivity, including fish passage between the Bypass and the Sacramento River, Cache Creek, and Putah Creek;
4. Increase frequency of inundated floodplain habitat, including during low-flow conditions;
5. Investigate opportunities for restoration of natural floodplain functions and incorporate mechanisms to coordinate with other relevant entities to integrate aquatic, wetland, and riparian enhancement with flood control efforts in the Bypass; and
6. Evaluate improvements to management and monitoring for target species, such as recommended habitat improvements for native fishes.

The goals, objectives, and design elements of the Project are all consistent with, and serve to further, the above stated principles and measures for the Yolo County NHP. The Project has potential to contribute to the recovery of aquatic resources in coordination with these planning mechanisms:

- Provide a buffer between agricultural operations and restored/enhanced habitats
- Provide seasonal floodplain functions and values during flood events in the Yolo Bypass

K. Ecological History and Restoration Potential

According to the San Francisco Estuary Institute's (SFEI's) *Sacramento-San Joaquin Delta Historical Ecology Investigation* (SFEI 2012), the Project site historically held a uniquely rich location at the intersection of the Putah Creek alluvial fan, historic Sacramento River Yolo Basin floodway and North Delta marshes. Before being diked and reclaimed for agricultural use in the early and mid-1900s, the site supported a combination of grasslands, seasonal wetlands, and marsh. The proposed Project would restore areas that historically were wetlands prior to the twentieth century.

[3] http://www.yoloconservationplan.org/enviro-portal.html

L. Restoration Project Description

1. Design Process

The restoration design process for this Project was carried out with close attention paid to the Restoration Design Principles described below. The process began by determining the locations on the property with the greatest suitability for wetland construction. These locations were initially determined by examining the topography of the site in relation to the local datums. The 2005 Delta LiDAR digital elevation model (DEM), updated with more recent data in certain locations to improve accuracy, served as the topographic data source, while the local datums were calculated by cbec for this restoration effort (cbec 2010). All areas of the site within elevations (below mean higher high water [MHHW], above mean lower low water [MLLW]) were prioritized for restoration.

For the Lower Yolo project effort, a technical advisory committee of scientists with expertise in regional ecosystems and hydrology was formed in order to advise SFCWA on the design for the Project site. The design for the Yolo Flyway Farms builds on the conclusions reached by the committee and seeks to integrate the two projects together as much as possible.

According to Robin Grossinger with SFEI, both the Lower Yolo and Yolo Flyway Farms project sites hold a uniquely rich location at the intersection of the historic edges of the Putah Creek alluvial fan, the Yolo Basin floodplain and the north Delta marshes. Optimal function in the current highly altered regional landscape would preserve as much of the historic hydroperiod diversity as possible by creating habitats that will flood at different time of the year depending on the prevailing hydrology. The Project design will provide the maximum resiliency in the face of sea level rise and regional stressors such as changes in tides, floods, salinity mixing and invasive species.

The technical advisory committee has indicated that they would like to see designs that are mindful of the historical ecology of the site and region and does just enough to tip a site onto a new ecological trajectory. With this direction in mind, the Yolo Flyway Farms project seeks to accomplish the following objectives.

- Preserve as much of the historic hydroperiod diversity as possible in order to restore productivity associated with natural floodplain inundation and incorporate the ability to come back to the site to adjust Project features and change functionality depending on monitoring results
- Provide functions and values that meet the immediate needs of the special-status fish species targeted by the OCAP Biological Opinions, such as productive rearing habitat for seasonal species and suitable spawning habitat for resident species.
- Preserve a landscape that can accommodate some sea level rise. Marshes serve as key buffers to sea level rise

In order to accomplish these objectives, the Project design seeks to maximize residency time diversity, and associated foodweb production, by capturing and slowly draining water on the existing landscape. This water will come from daily exchange or from seasonal inundation during flood events in the Yolo Bypass. Water will be partially impounded behind existing berms that are part of the irrigated pasture landscape that now exists on the Project site. Notches would be excavated in certain spots to allow for water and biota to flow out into surrounding marsh plain and channels, and will help reduce the potential for fish stranding. In order to

facilitate outflow from the site, swales will be cut to drain the deepest portions of the site. Depth of the swales will vary in order to vary the hydrology within the associated network and test different residency time hypotheses. Details of these design elements are discussed in the following section.

The wetland restoration area will connect to the Toe Drain via two engineered breaches excavated along the eastern property boundary. The dimensions of these engineered breaches were sized according to the methods used to determine channel geometries, as described above. The breaches will be sited to minimize, if possible, any areas supporting existing vegetation. Opportunities to relocate/transplant existing vegetation elsewhere would be afforded to the appropriate resource agencies prior to construction.

Minimal earthwork will occur in areas of the Project site that are currently at intertidal elevations. Earthwork in these areas will be limited to channel creation, berm breaching, and bench creation.

The transitional uplands within the grazing buffer, marsh enhancement areas, and riparian enhancement areas generally encompass those areas directly adjacent to the restored marsh/channels. The wetland enhancement areas were selected from areas that would become isolated and inaccessible as a result of the restoration Project (and therefore could no longer be effectively managed with irrigation for agriculture). The transitional uplands areas would provide a suitable wetland transition zone and accommodate extreme high tides and future sea level rise and act as ecological buffers from the adjacent continued agricultural activities (primarily cattle grazing and associated irrigation practices).

The enhancement actions would involve the removal of current agricultural management activities. A temporary electric fence would be installed seasonally along the edge of the grazing buffer for livestock management. Agricultural irrigation practices would cease. The complete removal of irrigation practices within the enhancement areas would ensure that minimal agricultural contaminants in the form of irrigation runoff would enter the restored marsh habitat.

2. Enhancement Design

The design involves enhancing the immediately surrounding environments with improved hydrology. The restoration design in its entirety would include modifications of up to approximately 381 acres of the 439-acre site. Areas on the site that are outside of the Project footprint would remain in their current condition and would continue to support agricultural operations following Project implementation.

Components

1) **Marsh Restoration:** Restoring 278 acres of intertidal and associated subtidal marsh habitat, including approximately 11.5 acres of new channels and swales,
2) **Riparian Enhancement:** Enhancing approximately 3 acres of existing riparian habitat.
3) **Open Water Enhancement:** Enhancing approximately 18 acres of existing open water habitat in the Toe Drain
4) **Transitional Uplands:** Enhancing approximately 136 acres of farmed uplands, including an 80 acre soil stockpile located on agricultural land located northwest of the Project site

5) **Water quality enhancement and minimizing the introduction of agricultural contaminants:** Improving irrigation and drainage on the Project site by relocating, modifying, or completely removing several water control structures and irrigation and drainage ditches.

Actions to Construct the Proposed Project

1) **Restoration:** Marsh restoration would be accomplished by excavating three new channels and adjacent swales within the restoration area, notching or degrading minor interior and perimeter berms, removing some culverts, and connecting the restoration area to the Toe Drain with two engineered connections through the perimeter berms.
    - The northernmost connection would be approximately 225 feet wide with an inset channel approximately 25 feet wide by 150 feet long and up to 10 feet deep. The adjacent floodplain terrace would be approximately 200 feet wide and 6 feet deep.
    - The southernmost connection would be approximately 225 feet wide with two inset channels approximately 25 feet wide and between 800 feet and 2300 feet long and up to 10 feet deep. The adjacent floodplain terrace would be approximately 100 to 200 feet wide and 6 feet deep.
2) **Enhancement:** Enhancement of existing riparian and transitional upland habitat would be accomplished by controlling grazing, ceasing irrigation, and improving hydrologic connectivity to high tides and smaller flood flows through strategic notching of interior and perimeter berms. Following Project construction, temporary electric fencing would be installed seasonally as needed around the restored marsh, transitional uplands, and enhanced wetlands to exclude cattle from these areas.
3) **Soils stockpile:** Soils excavated from the restoration areas and the newly constructed irrigation and drainage ditch would be stockpiled on approximately 80 acres of existing agricultural land owned by Reynier Fund, LLC and located directly northwest of the Project and outside of the restoration area. Stockpiled materials would be located to avoid adverse effects on Yolo Bypass flood flow conveyance. The fields within this location are currently used for summer cattle grazing and hay production. Approximately 61,000 cubic yard (CY) of material would be placed over the 80 acres at a depth no greater than 6 inches and contoured for border irrigation to match existing conditions.

III. HABITATS AND SPECIES PRESENT

A. Wetland Delineation

Wetland delineation surveys for USACE jurisdiction under the Clean Water Act and Rivers and Harbors Act have been conducted for the Project (Vollmar Consulting and Wetlands and Water Resources 2011a, b and ICFI 2014). Field verification took place May 24, 2011 with subsequent field visits to update the delineation information for consistency with revised USACE requirements. The delineation identified nearly the entire Project site as Wetlands and Waters of the United States. This finding was based on Yolo Bypass hydrology, which has averaged a 1.5-year flood recurrence interval (flooding 2 of every 3 years) since its construction nearly 100 years ago (DFG 2008). Hydric soils are typical throughout much of the property, reflecting their

natural formation as seasonal floodplain and marsh deposits. Consequently, much of the delineation effort focused on mapping vegetation communities for application to natural resource impacts and benefits. A preliminary jurisdictional determination (Table summarizes total acreages identified during the wetland delineation surveys for the entire Project.

Table 2. Summary Jurisdictional Wetlands and Waters of the US on the Project Site

Feature Type	Total Acres
WETLANDS	
Seasonal Wetland	262.839
Perennial Non-Tidal and Muted Emergent Marsh	34.665
Farmed Wetland	0.436
Riparian Woodland (scrub and forest)	3.310
WATERS	
Other Waters (Drainage Ditches)	0.001
Navigable Waters: Waterways	17.979
Navigable Waters: Irrigation Ditches	7.403
TOTAL	326.633

B. Special Status Plant Species

1. Tidal Marsh

Prior to the beginning of any construction activities, rare plant surveys will be conducted to quantify and delineate the extents of existing populations of the aforementioned species. If needed, existing plants will be salvaged and transplanted to other areas on the Project site prior to any ground disturbance. All transplantation activities will be done in accordance with the appropriate State or Federal endangered species act consultation protocols.

Under current conditions, multiple occurrences of two rare plant species. Mason's lilaeopsis (*Lilaeopsis masonii*) and Suisun Marsh aster (*Symphyotrichum lentum*) have been identified within the Project site boundaries. Small populations of Mason's lilaeopsis and Suisun Marsh aster were observed along the Toe Drain. Tidal marsh restoration is expected to considerably expand the availability of suitable habitat for these species on the site. Currently, potential habitat is restricted to the regions were populations have already been documented. Irrigation channels and other sections of the bordering tidal sloughs do not provide the suitable habitat conditions required for these species to recruit and establish in the future. Restored tidal channels will provide both the hydrologic regime and habitat structure preferred by Suisun Marsh aster and Mason's lilaeopsis. Because both species currently occur on the site, the likelihood of new populations becoming established within the restored habitats in the future is high.

In addition to rare plant species, there are multiple California native plant communities that currently exist on the site, including tule or hardstem bulrush (*Schoenoplectus acutus*), which was historically the dominant plant community on the site prior to conversion for agricultural uses. Restoration of tidal marsh is expected to significantly expand perennial emergent plant community establishment. Additionally, native establishment is projected to occur naturally due to the proximity of onsite source populations of native species.

2. Transitional Uplands

Enhancement activities within the grazing buffer will improve native plant community composition and extent, due primarily to improvements in the hydrologic regime. Under current conditions, periodic irrigation activities (within irrigated pastures) influence plant community composition and recruitment and have resulted in less community complexity across the landscape. The proximity of enhancement areas to restored tidal marsh will create the availability of transitional habitats, driven by variations in hydrologic influences. Additionally, the site is currently dominated in many areas by species desirable for cattle forage, including several introduced species of nonnative clover (*Trifolium* spp.). Removal of cattle foraging and management activities directed to improve cattle foraging value, in addition to removal of direct grazing impacts, including soil disturbance and plant destruction, will provide opportunities for re-establishment of native plant species and communities and reduce favorable conditions for less-desirable species.

A reduction of cattle grazing activities, with a focus on invasive plant management, and the removal of irrigation inputs will improve conditions within the grazing buffer areas for re-establishment of a more natural vegetation community composition. Non-irrigated areas on the site have a more dynamic vegetation community structure, driven by the natural hydrologic influences and topography of the area, rather than by management to improve cattle forage values.

3. Riparian

Exclusion of cattle grazing and improvements to the hydrologic regime within and adjacent to riparian enhancement areas is expected to benefit these areas by fostering recolonization by native plant species and development/regeneration/maturation of riparian forbs, shrubs, and trees. The extent and quality of existing riparian habitats on the site are currently restricted by hydrologic controls and direct disturbances associated with cattle grazing practices. Improvement of hydrologic connectivity to adjacent aquatic habitats and establishment of a more natural hydrologic regime, in combination with removal of cattle trampling, forage, and manure inputs, will create opportunities for development of more species rich and structurally diverse riparian scrub and woodland plant communities in enhanced sites, with subsequent increases in habitat values.

C. Invasive Plants

1. Marsh

Egeria densa (Brazilian waterweed) is a species of submerged aquatic vegetation (SAV) nonnative to the region. It grows in permanent aquatic environments and can grow in water depths up to 6 meters depending on water clarity. Egeria is known to invade natural waterways and significantly impede water flow, reduce turbidity, harbor invasive predator fish species, and decrease the quality of habitat for native resident and anadromous fish (Durand et al. 2010; Grimaldo et al. 2012). This plant has colonized in several areas of the Delta, is the most abundant invasive SAV species in the Delta, and is considered to be one of the major threats to the Delta ecosystem. Currently, this species does not occur on the Project site and it is unknown if Egeria occurs within waterways adjacent to the site. It is reported to have been observed at Liberty Island in the shallow waters near the lower edge of the emergent tidal marsh. Delta SAV is believed to grow best at annual water velocities below 0.49 m/s (1.5 ft/s) (Hestir 2010). It also grows preferentially on soft substrate and its establishment is limited with harder substrates.

One design objective for the Project is to minimize (or avoid if possible) colonization by Egeria. The Project design includes two features intended to accomplish this objective. The colonization potential at the Project site is within deeper tidal channels at lower intertidal or subtidal elevations. The first design element is the promotion of higher channel water velocities. Tidal channels are sized to achieve peak spring ebb tide velocities of approximately 1.6 to 3 ft per second (fps) which is common in tidal marshes (Fagherazzi et al. 2008). Tidal velocities will be monitored to identify and assess whether higher velocities are effective at excluding Egeria.

The second design element is the hard channel bottom substrate. The soils of the Project site are predominantly mineral floodplain deposits formed naturally over thousands of years. Soil test pits at the Project site revealed the presence of predominantly silty clay and clay soils extending to depths of roughly 40 to 80 inches, below which are commonly iron-silica cemented hardpans (i.e., duripans) of varying degrees of cementation and weathering. Areas of Riz, Pescadero, and Clear Lake series soils and other areas underlain by a soil that is a heavy clay to the surface may be suitable for vernal pool, vernal swale, and other seasonal wetland creation (Kelley and Associates 2011).

2. Transitional Uplands

Studies conducted by Feijoo et al. (1996, 2002) have indicated that Brazilian waterweed invasions can be correlated with high nutrient concentrations in water, including soluble phosphorus and ammonium, and nitrogen deposits in sediments. The removal of nutrient rich water run-off in the form of irrigation water (drainage) from enhancement areas and preventing such waters from entering the restored aquatic areas (tidal marsh and channels) will further reduce the favorable conditions for this species to recruit and thrive. Brazilian waterweed is adapted to submerged aquatic habitat, and therefore will not colonize wetlands within the grazing buffer.

3. Riparian

Brazilian waterweed is adapted to submerged aquatic habitat, and therefore will not colonize riparian habitats.

D. Fish

The Yolo Bypass and Cache Slough Complex provide aquatic habitat for at least 44 fish species, all of which have the potential to occur in the Project vicinity (Sommer et al. 2003; Nobriga et al. 2005). The fish assemblage is composed of an ecologically diverse array of native and introduced fish species that may occur year-round in the perennial waters adjacent to the Yolo Bypass, and seasonally on the wetted floodplain; or seasonally during the spawning, egg incubation, and early rearing periods of their life cycles. Introduced fish species comprise nearly two-thirds (61%) of the species composition, outnumbering the native fish species (39% of the species) occurring on the Yolo Bypass (Table 1).

Of the 17 native fish species potentially occurring on the Yolo Bypass, eight have been designated as special-status species under the ESA and the California Endangered Species Act (CESA). These species include green sturgeon (*Acipenser medirostris*; federally threatened, state species of special concern), delta smelt (*Hypomesus transpacificus*; state and federally threatened), longfin smelt (*Spirinchus thaleichthys*; state threatened), Sacramento splittail (*Pogonichthys macrolepidotus*, state species of special concern), Pacific lamprey (*Lampetra tridentate*; federal species of concern), river lamprey (*Lampetra ayresii*; state species of special concern), steelhead (*Oncorhynchus mykiss*; federally threatened), and all four runs of Chinook

salmon (*Oncorhynchus tshawytscha*) occurring in the Central Valley. These four runs are spring-run (state and federally threatened), fall-run (state and federal species of concern), late fall-run (state and federal species of concern), and winter run (state and federally endangered).

IV. MONITORING

The Project includes monitoring elements to serve multiple purposes:

- Effectiveness Monitoring: High priority monitoring elements to track progress towards Project objectives
- Special Studies: Desirable discretionary (supplementary) monitoring elements. These are noted in the event that additional funding or research partners become available

In addition, all monitoring will be used to identify the need for management actions necessary for the development and maintenance of the site (i.e., "adaptive management") and to learn whether or not the stated objectives of the Project are being met.

Effectiveness Monitoring

The Project's goal is to partially fulfill the 8,000-acre tidal restoration obligations of the FRPA in satisfaction of the BiOps (USFWS 2008, NMFS 2009) and ITP, as credited by the FAST through the Prospectus. The Project will verify implementation by post-construction monitoring of constructed outputs (acres restored, as-built topography and elevations, and hydrology).

Effectiveness monitoring will track progress towards objectives by measuring indicators of ecological status and function ("metrics") and comparing the measurements to expected or hypothesized outcomes. The sampling approach will include annual terrestrial surveys, continuous hydrologic and water quality monitoring via instrumentation, and seasonal sampling of aquatic food web components to support fish production, and analysis of fish CDFW Survey in the Cache Slough area. Measurements of physical and biological components will be used to evaluate the evolution of habitat on the site including tidal channel and marsh morphology, vegetation response (including non-native invasive plants) to the reconnected tidal influence, habitat component contributions to the food web and identification of occupied fish habitat.

The objectives of the Project are to:

1) **Food Web Contribution**: Enhance regional food web productivity and export to Cache Slough Complex in support of delta smelt recovery
2) **Rearing Habitat for native fishes**: Provide rearing, breeding, and refuge habitats for a broad range of other aquatic and wetland-dependent species that utilize or depend upon the combination of Delta freshwater aquatic-tidal marsh-floodplain-seasonal wetland-lowland grassland interfaces.
3) **Enhance Ecosystem Function**: Provide suitable habitat for establishment of diverse native plant communities including rare plants
4) **Manage Invasive Vegetation**: Minimize potential for colonization by invasive SAV
5) **Habitat Succession**: Preserve existing topographic variability to allow for habitat succession and resilience against future climate change

Special Studies

Special studies will be implemented to address uncertainties that require more in-depth investigation than basic monitoring can provide. Design and implementation of special studies will depend upon available funding. Special studies would be developed to address questions and hypotheses with input from FAST.

Examples of special studies may include:

- Predation – measurements of native fish predation on and off restoration site
- Food web flux – transport and exchange of dissolved and particulate organic carbon, from the project site to adjacent waters to evaluate the magnitude and dynamics of food web subsidies from restored tidal marsh
- Outmigration survival – track the movement, growth, and survival of salmon smolts on and off the Project site
- Larval fish sampling – determine whether diversity and abundance of resident and seasonal fishes changes over time in response to restoration efforts.
- Water quality monitoring

Hypotheses

The following hypotheses have been developed for the Project.

- **Physical and hydrodynamic functions**: The Project will create channel geometries that will result in peak ebb tidal flow velocities that will discourage colonization and establishment of non-native SAV. The channel inlets at the two breach locations will self-adjust over time.
- **Food Web support**: The Project will provide food resources to support Delta Smelt and other native fishes. In addition, the Project will function as a net source of primary production for pelagic food webs to surrounding habitats in the North Delta.
- **Fish utilization:** The restored habitats at the Project site (tidal channel, marsh ponds, pannes) will support a fish community (including juvenile salmonids) similar in composition and relative abundance to that documented in comparable habitats in the Yolo Bypass and the Cache Slough Complex. This hypothesis will not be tested directly in this AMMP. This will be examined indirectly by existing CDFW surveys (i.e, 700 stations) that are within the tidal footprint of the Project.
- **Vegetation establishment**: Soil organic matter and planting methods will influence vegetation establishment on the habitat berm. This hypothesis will test the difference between the use of organic matter from stockpiled topsoil and hydroseeding/drill seeding and mulch in establishing desired vegetation on the habitat berm.

Monitoring and Adaptive Management Approach

This AMMP follows an *objective-driven* monitoring framework with indicators of functional outcomes for metrics developed for Project construction and operation. Metrics will be used to evaluate progress toward expected outcomes and to inform corrective measures if thresholds for action are not met. Monitoring categories include physical processes and hydrology, water quality, food web, fish, and wetlands and vegetation (DWR et al., 2012). Metrics have been

selected to be ecologically meaningful, efficient, cost-effective, feasible to measure, and informative for management decisions.

Monitoring for the Project will follow an adaptive management approach. Adaptive management is a framework allowing for a flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation, leading to continuous improvements in management and implementation of a project to achieve specified objectives (Delta Reform Act, Water Code Section 85052).

Monitoring will be consistent with the FRPA Implementation Strategy (DWR et al., 2012), the Delta Science Plan (Delta Stewardship Council, 2013), and guidance being developed by the IEP Tidal Wetlands Monitoring Project Work Team. The monitoring approach draws from examples such as the CDFW Ecosystem Restoration Program's Performance Measures (Spautz et al., 2012), the Dutch Slough Adaptive Management Plan (Cain, 2008), the Lower Yolo Project Long Term Management and Monitoring Plan (SFCWA, 2013), and evolving plans for Prospect Island and Dutch Slough. Comparability with regional monitoring standards and efforts will allow for a summary of findings that can improve understanding and management of habitat at the Delta-wide scale. However, certain parameters and sampling methods may not be readily applicable or transferable across the spatial and ecosystem scales of site-specific projects, or between the Suisun marsh, the Cache Slough Complex region, and Delta-wide scales.

Conceptual Models

The Project's restoration design and crediting has been based on an understanding of target fish species, Delta habitats, food webs, and tidal marsh evolution. This includes life history and habitat requirements of delta smelt, Chinook salmon, and longfin smelt, as well as ecological functions of tidal emergent wetlands and managed wetlands. Information from the Sacramento-San Joaquin Delta Regional Restoration Implementation Plan, Ecosystem Conceptual Model (Durand 2008) was used to capture current understanding of how the ecosystem works and how species may respond to restoration (Kneib et al, 2008; Opperman 2008). This understanding informed the design of sustainable habitat features that would increase rearing habitat for salmonids and food web productivity for delta smelt and longfin smelt, while minimizing potential negative effects on other species.

a) Delta Food Web

Since the introduction of the overbite clam (*Potamocorbula amurensis*) in 1987, food web and fishery production in the low salinity has declined to record low levels (Orsi and Mecum 1996; Kimmerer 2002; Baxter et al. 2008; MAST 2015). In the Delta, other factors have likely contributed to food web alterations, including loss of tidal wetland habitat and invasion of large primary producers (i.e., SAV) that support epiphytic-based carbon pathways (Grimaldo et al. 2009). It has been hypothesized that tidal wetland restoration will boost zooplankton production through detrital-based energy pathways (Howe and Simenstad 2007). Primary production of diatoms, green algae and chrysophyte phytoplankton in wetlands provides food resources for calanoid copepods that are, in turn, important food for juvenile fish, especially delta smelt (especially *Eurytemora affinis*, a major delta smelt prey species) (IEP MAST, 2015). Delta smelt also consume cladocerans, mysids, amphipods, and larval fish (IEP MAST, 2015).

In a drastically changing Delta landscape, restored flooded islands can also function as important sources of phytoplankton and zooplankton production (Mueller et al. 2002; Grimaldo

et al. 2004, Lopez et al. 2006; Lehman et al. 2015). For example, among several habitats examined, Grimaldo et al. 2004 found that a restored flooded island (Mildred) with little SAV supported high densities of zooplankton and larval fish. Work by Mueller et al. 2002 found that *Daphnia* growth rates were almost twice at Mildred Island compared to other Delta habitats. Flooded islands, not likely a common feature of the historic Delta, can have high residence time which promotes primary production (Lucas et al. 2006) if clam grazing is minimal (Lucas and Thompson 2013). This findings are interesting because, overall, primary production within the channels of the Delta are inherently low because of high turbidity and low light levels (Jassby et al., 2002; Lopez et al., 2006). Work by Sobczak et al. (2002) suggests that the Delta food web is dominantly fueled by phytoplankton because much of the upstream detrital carbon is not bioavailable to consumers.

High productivity originating from tidal wetlands can be exported to surrounding areas, but the magnitude, extent and direction of net transport is variable (Howe and Simenstad, 2007; Lehman et al., 2010; Lehman, 2013; Lehman et al., 2015). For example, small vegetated ponds at the north end of Liberty Island (Upper and Lower Beaver Ponds) had greater concentrations of organic and inorganic material, and were important sources to the adjacent open water pond, the barren open waters of south Liberty Island (Lehman et al. 2015). Exchange between ponds was important to wetland flux. Lehman and others identified small vegetated ponds as an important source of inorganic and organic material to the wetland, and noted the importance of small scale physical processes within ponds to material flux of the wetland.

The Project will implement restoration actions designed to affect key physical process of the restoration site, such as maximizing residency time, diversity, and associated food web production by capturing and slowly draining water on the existing landscape. This water will come from daily tidal exchange or from seasonal inundation during flood events in the Yolo Bypass. Water will be partially impounded behind existing berms that are part of the irrigated pasture landscape that now exists on the Project site. Notches would be excavated in certain spots to allow for water and biota to flow out into surrounding tidal marsh plain and channels, and will help reduce the potential for fish stranding. In order to facilitate outflow from the site, swales will be cut to drain the deepest portions of the site. Depth of the swales will vary in order to vary the hydrology within the associated network and test different residency time hypotheses.

The tidal wetland restoration area will connect to the Toe Drain via two engineered breaches excavated along the eastern property boundary. The dimensions of these engineered breaches were sized according to the methods used to determine the tidal channel geometries, as described above. The breaches will be sited to minimize, if possible, any areas supporting existing vegetation. Opportunities to relocate/transplant existing vegetation elsewhere would be afforded to the appropriate resource agencies prior to construction.

b) Marsh Evolution

The transitional uplands within the grazing buffer, tidal marsh enhancement areas, and riparian enhancement areas generally encompass those areas directly adjacent to the restored tidal marsh/tidal channels. The wetland enhancement areas were selected from areas that would become isolated and inaccessible as a result of the restoration Project (and therefore could no longer be effectively managed with irrigation for agriculture). The transitional uplands areas would provide a suitable wetland transition zone and accommodate extreme high tides and

future sea level rise and act as ecological buffers from the adjacent continued agricultural activities (primarily cattle grazing and associated irrigation practices).

c) Fish Use of Marshes

A number recent studies illustrate that native fishes are likely to inhabit tidal marshes where they are available (Grimaldo et al. 2012; Feyrer et al. 2015). In the north Delta, tidal marsh habitat overall is limiting but native fish occupation is relatively high (Nobriga et al. 2005; Harrell and Sommer 2003). Delta smelt and Chinook salmon are particularly abundant in the north Delta (McLain and Castillo 2009; Mejia and Sommer 2013). To date, little research has been done to verify if Delta Smelt are using tidal marsh habitats in the north Delta. In contrast, Chinook salmon use of shallow and edge habitats of the north Delta is well documented (McLain and Castillo 2009), especially during floodplain inundation (Sommer et al. 2001).

In the long term, there is uncertainty about how climate change and associated sea level rise could affect habitat outcomes. The resiliency of restored tidal marsh habitat to keep pace with sea level rise depends upon realized rates of accretion of inorganic sediment or organic material. If sea level rise exceeds expectations and accretion fails to keep pace, currently designed intertidal habitats could become subtidal. Tides in the Project vicinity reach up to MHHW during about 4–5 percent of the high tides, or roughly 30–35 tides per year. High tides above MHHW reach elevations of just over 1 foot above MHHW, with a diminishing frequency of occurrence. Daily tides at different times of year will inundate the restored marsh plain, and especially show how the king tides of the summer and winter solstices produce numerous large spring tides that will inundate areas above local MHHW within areas the Project designates as transitional uplands. King tides give some indication of how future sea level rise will affect the Project area. This supratidal zone represents the transition from tidal marsh to uplands. Since the Project site is within the Yolo Bypass, the term *uplands* refers to jurisdictional seasonal and farmed wetlands. When the Yolo Bypass is in flood stage, all these areas would be submerged. Northern Delta tide stages are also more influenced by river flows and thus higher stages could be reached even when the Yolo Bypass is not in flood stage. Such high-stage events would inundate more lands than indicated by the MHHW contour.

Predicting the actual area of tidal marsh that will be restored in this effort depends upon having an accurate understanding of tidal datum and land surface elevations. Errors in either of these data sources will cause the true extent of tidal marsh restoration to differ from what is predicted in the restoration design. Uncertainty in land surface or tidal datum elevations could come from a variety of sources, as described below:

Potential sources of uncertainty in land surface elevations

- Vegetation interference with LiDAR signal returns
- Errors in benchmark corrections for LiDAR and ground-based topographic data
- Digital elevation model interpolation errors

Potential sources of uncertainty in tidal datum elevations

- Errors in tide gage benchmark elevation (for converting water depth to water surface
- elevation)
- Errors in tide gage calibration
- Use of data record shorter than the 18.6-year tidal epoch – because few data records used for tidal datum reckoning are this long, this uncertainty always occurs

and the National Ocean Survey methodology for tidal datum calculations (National Ocean Service [NOS] 2003) includes approaches to estimate this uncertainty

- Distance from NOS tidal reference station – the closest NOS reference station is Port Chicago in Suisun Bay. Hydrodynamic processes that affect water level between the Project site and Port Chicago are significant, especially with the major influence of Sacramento River outflow. Tidal datum reckoning filtered out all data during flood stages to help ameliorate this uncertainty. Also complicating Delta tidal datums is the overall intensive management of stage associated with reservoir, exports, and Delta barriers (Delta Cross Channel, South Delta Barriers) operations

Although the potential for significant uncertainty in the datasets used for this Project is small, it is important to understand how a moderate amount of error in one or both of the datasets could affect tidal restoration outcomes. To analyze these potential errors, it was assumed that the combined uncertainty in both land surface elevation and tidal datums could vary up to ± 0.5 ft from the predicted values. The effect of this uncertainty on the extent of restored tidal marsh was determined by mapping tidal marsh extent over the existing ground topography at potential MHHW elevations varying from 6 to 7 ft NAVD88 at 0.25-foot increments. The Project's adaptive management and monitoring program is designed to address remaining uncertainties. For the purpose of adaptive learning, a certain number of questions have been developed from the objectives and questions, and framed as hypotheses for evaluation to reduce areas of uncertainty and improve understanding of system functions.

Baseline, Pre-Construction, and Reference Data

Baseline information includes:

- Description of existing infrastructure for managing wetland
- Topographic surveys
- Vegetation surveys
- Wetland delineation
- Tidal level monitoring
- Wildlife observations

Monitoring from regions where restoration is occurring can provide reference data, although comparability will depend on the parameter, sampling methodology, and site-specific conditions. Selection of reference sites will be guided by similarity of desired habitat, target species, proximity to the Project site, and/or ecological function.

Monitoring Program Design

Monitoring Categories

The monitoring program is organized by the following categories of compliance and effectiveness monitoring tasks:

- Physical processes and hydrology
- Water quality
- Food web productivity
- Wetlands and vegetation

For each of these categories, progress toward meeting the objectives of the Project will be measured. Metrics for each category are identified along with methods for collecting data,

expected outcomes, and thresholds for corrective action. Vegetation, hydrology and food web metrics will be the responsibility of DWR.

Table 3. Metrics, Methods, and Duration of Sampling for Interim Management Period

Monitor Category	Metric	Method	Time of Year, Frequency	Sampling Intervals								Sites and Samples
				Pre-Construction	Post-Construction	Years after Construction						
						1	2	3	4	5	Every 5 y	
Monitor Category: Physical Processes and Hydrology												
Topography and bathymetry (e.g., channel morphology)		Ground-based GPS survey, or LiDAR if available, aerial photos	Annual during summer		X	X		X		X	X	Project area, up to 9 cross-sections including channels and adjacent terraces
Tidal Regime		Gauges or water level loggers	All year, automatic measurements (may focus on spring-fall or tidal extremes)		X	X		X		X		2 sites in main channels
Residence time		Calculated with data from loggers	Annual during summer		X	X		X		X	X	Project area
Monitor Category: Water Quality												
Water quality (temperature, EC, turbidity, pH, DO)		Continuous data sonde	All year, automatic measurements (may focus on spring-fall period)		X	X	X	X	X	X	D	2 sites (1 in each channel)
		Discrete seasonal samples	Up to 9 monthly events (Feb-Oct) with food web and fish sampling		X	X	X	X	X	X	D	2 sites (1 in each channel)
Methyl mercury in water		Special Study (e.g., participate in regional study if available)	To be determined	D (GB2)		D		D				Special study, to be determined
Nutrients (NH_4-PO_4)		Special Study	To be determined	D (GB2)		D		D				Special study, to be determined

Monitor Category	Metric	Method	Time of Year, Frequency	Sampling Intervals: Pre-Construction	Post-Construction	Years after Construction: 1	2	3	4	5	Every 5 y	Sites and Samples
Monitor Category: Food Web												
Chlorophyll a		Optical sensor (if available); Grab samples	Up to 9 monthly events (Feb-Oct) Typical: 3 events (spring, summer, fall).	GB		X	D	X	D	D	X	Up to 3 sites in the Toe Drain
Phytoplankton		Plankton tows, lab sorting										
Zooplankton		Zooplankton tows, lab sorting										
Benthic macroinvertebrates		Benthic grab samples or sediment cores	2 events (spring and fall)	GB		X	D	X	D	D	X	Up to 3 sites in the Toe Drain
Epibenthic and epiphytic macroinvertebrates		Sweep net; leaf packs optional										
Monitor Category: Wetlands and Vegetation												
General habitat conditions		Photo points	Annual during growing season	X		X	X	X	X	X	X	Up to 10 points across the site
Aquatic habitat mapping		Aerial imagery and ground-truthing survey	Annual during growing season		X	X		X		X	X	Entire site
Vegetation composition and cover		Percent cover in plots along transects	Annual during growing season	X		X		X		X	X	4 transects through site
Invasive plants		Visual survey	Annual during growing season	X	X	X		X		X	X	Entire site

Notes:

D = Discretionary sampling contingent on available resources, partners, and project needs

Sampling Program

The sampling program will attempt to address the hypotheses at appropriate time scales relevant to study goal and objectives. For example, effectiveness monitoring will be conducted annually for the first the 3 years post-restoration and once every 5 years after the third year of the effectiveness monitoring. Pre-construction monitoring will be conducted the year prior to construction. Special studies will be needed at periodic intervals to determine if the effectiveness monitoring results are providing expected benefits to native fishes.

Because Delta Smelt have continued to decline since the 2008 USFWS Biological Opinion has been released, their presence may be difficult to detect in the restoration site as they become increasingly rare, which may have little to do with habitat function of the Project. It is already well documented that Delta Smelt inhabit the Cache Slough Complex (Sommer and Mejia 2013) so it is likely the Project will provide some form of direct or indirect rearing habitat for Delta Smelt. Second, if Delta Smelt numbers remain low, incidental take may be more difficult obtain which is why this AMMP focuses on how physical and biological functions support Delta Smelt habitat.

Regulatory permits obtained for constructing the Project have associated conservation and mitigation measures that require specific monitoring actions to satisfy compliance. These monitoring elements focus on permitting requirements and mitigation measures under the Suisun Marsh Plan, USACE, RWQCB, Section 7 consultations, and BCDC permits. These will be incorporated once the final permits have been issued.

Monitoring Metrics and Methods

This section details the proposed monitoring metrics and potential monitoring methods.

1. Physical Processes and Hydrology

Purpose: Elevations within marsh plain, spatial distribution of created features, and topography of features such as channels and terraces form the physical template upon which the driving forces of hydrology and hydrodynamics act to move the towards a natural floodplain complex. Subsequent changes in topography and geomorphology that result from restored hydrology will influence whether or not the Project is meeting the following objectives:

- Food Web Contribution
- Rearing Habitat for native fishes
- Habitat for Other Species
- Ecosystem Functions
- Habitat Succession

Metrics: Monitor topography and channel planform to document development of the site, in particular the size and geometry of the channels. Measure the flow regime on the restoration site and compare it to the unrestricted flow at a reference site (i.e., the “boundary condition”) such as the river gauge on the Sacramento River. Use the measurements from the daily flow fluctuations to estimate residence times in various locations throughout the Project site.

Methods: Several cross sections will be established and will run across the tidal channels and adjacent marsh terraces. Surface elevations will be mapped using standard surveying techniques. Site elevation information will be collected prior to and immediately after construction. Site elevations and channel geometries will be measured again during years 1, 3,

and 5 after construction. Aerial photographs will be obtained prior to restoration and immediately following construction, and during years 3, and 5. Where possible, photo acquisition could be coordinated with other surveys in the Cache Slough Complex. Photos should be ortho-rectified for use in GIS applications. Google Earth photos can also be used to provide a visual record in other years and seasons. Tidal regime will be measured continuously using Solinst pressure transducer level-loggers or similar, placed in several channel locations around the Project site. Tidal regime will be measured continuously during years 1, 3, and 5 after construction, and will be compared with the boundary condition reference location of the Liberty Island monitoring gage.

2. Water Quality

Purpose: Water quality within a tidal wetland can affect the vegetation response to the restored hydrology as well as potentially affecting fish and wildlife survival and reproduction within the restored site. Water quality can have a strong influence on whether or not the Project is meeting the following objectives:

1. **Food Web contribution**
2. **Native fish rearing habitat**
3. **Habitat for other native species**

A variety of water quality characteristics can influence the productivity, habitat suitability, or toxicity to fish or vegetation within a restored site. A basic set of water quality parameters will be recorded over several intervals after the completion of construction to characterize water quality during habitat development to determine suitability of the habitats in supporting the objectives above.

Metrics: Measurements will be taken for temperature, dissolved oxygen, pH, turbidity, and conductivity (EC). Methyl mercury (MeHg) will also be sampled in spring, summer and fall.

Methods: 2 water quality measurement data sondes (e.g., YSI 6600 V2-4 Sondes) will be deployed in the constructed channels near the outlets on the Toe Drain in years 1, 3, and 5. One grab sample for MeHg will be collected seasonally during an outgoing tide to assist in characterization of MeHg production in years 1, 3, and 5. Methyl mercury will be sampled following SWAMP and CALFED methods.

3. Food Web Productivity

Purpose: Restoration of wetlands such as the Project site is thought to support native fish species by increasing the production of nutritionally valuable phytoplankton, zooplankton and other invertebrates. In addition, recent studies have shown that shallow autotrophic habitats can export algal biomass and fuel secondary production in adjacent deep heterotrophic habitats, but only if these habitats are properly connected (Lopez et al., 2006; Lehman et al., 2010). Standing stock of primary productivity will be monitored along with the different phytoplankton species produced in the restoration site. Secondary productivity (zooplankton, benthic invertebrates) produced and exported from the restoration site will also be monitored.

Evaluating the quantity and quality of the food supply available at the Project site for larval and juvenile native fish in the Toe Drain will address the following objectives:

1. **Food Web contribution**

2. Native fish rearing habitat

Metrics: Food web contributions will be measured by primary production (chlorophyll a and phytoplankton), zooplankton, and benthic and epibenthic invertebrates.

Methods: This sampling program is initially proposed to be conducted seasonally for at least three years and every five years post-construction. The scale and intensity of monitoring efforts, as summarized in Tables 5 and 6, will be re-evaluated following Year 3.

Food webs will be examined via two primary monitoring efforts. The first effort will be to measure relative monthly abundance of macroinvertebrates and zooplankton at the site during winter and spring (~January – June) when native fishes would be most likely to use the site. Along with measurements of primary production and water quality, the purpose of this monitoring is to provide a baseline for in-site foodweb production at seasonal and annual intervals. The second monitoring effort will be examine foodweb flux between the Project site and outside channels via more focused short term studies (i.e., see Lopez et al 2006 and Lucas et al. 2006).

Methods are outlined below:

a. Zooplankton

Zooplankton sampling will be conducted at the same relative time and frequency as primary production sampling. Tow nets have been used extensively for measuring zooplankton community composition and biomass throughout the Delta, in order for data to be comparable to similar regional monitoring programs.

Field crews will sample zooplankton during daylight using a 1m long x 0.127m mouth diameter (153µm mesh) Clarke-Bumpus net to measure mesozoplankton and 1.48m x 30cm mouth diameter (0.505mm mesh size) mysid net to capture macrozooplankton. Nets will be attached to a flowmeter to measure sample volume and a float to keep the net off the bottom in shallow water.

At sites that boats can access (water depth greater than 0.7m (2.3 ft)), the crew will deploy the gear alongside the boat via a davit and, if possible, sample obliquely through the water column. In shallow water (0.2-0.7m (0.7-2.3 ft), the net and flowmeter will be attached to a 5m long rope. The investigator will throw the net to the full extent of the rope and retrieve five times.

After retrieval, the crew will rinse the net from the outside to wash down sample into the cod end. All content collected in a cod end will be preserved in 10% buffered formalin (IEP methodology in Hennessy 2009). Crew will remove any fish that are visible in the sample before preserving. Laboratory personnel will identify a minimum of 6% of the sample to the lowest possible taxon in the lab either using a microscope or by photographing samples and using automated image recognition software (i.e., ZooImage, http://cran.r-project.org/web/packages/zooimage/index.html, as cited in Gislason and Silva, 2009).

b) Benthic and Epibenthic Invertebrates

Benthic and epibenthic invertebrates will be sampled at least twice seasonally (spring and fall), and up to quarterly based on seasonal occurrence of target fish species. The potential methods described below are from the IEP Tidal Wetlands Monitoring group's pilot study proposal (Contreras et al., 2015), based on regional surveys and studies by CDFW, USFWS Liberty Island, DWR and others.

Benthic cores/Ponar grabs have been used extensively to quantify chironomid and amphipod populations, as well as bivalves and other infauna in tidal wetlands (Wells, 2015; Howe et al., 2014; CDFW, unpublished data). Three samples will be taken at each site to account for high variability in the benthic community. In shallow water (<1.5m), a 4in (20cm) diameter benthic core will be hand-deployed to a depth of 20 cm. In deep water(>1.5m), a 9x9 in ponar grab modified for use in hard substrates (as per USFWS Liberty Island Monitoring) will be used to collect three samples at each site. This may be in conjunction with substrate analysis during fish sampling to minimize disturbance and maximize efficiency. The core will be washed and sieved on board the boat to remove the sand/mud and preserve any organic detritus and invertebrates. Two crew members will estimate % silt, sand, and gravel in the field, and average the values. Effort as catch per surface area of substrate sampled will be calculated. The number of 4 in. cores may be increased to create aggregate samples of areas equal to the ponar grab if catch of single cores is too low for analysis.

Sweep nets are another approach for sampling in shallow water (Katz et al., 2013; Contreras et al., 2015). In areas 1m mean lower-low water or less, a 500-micron d-frame net will be swept through the water approximately 3cm above the bottom 5 times (10 seconds of effort) with each sweep being approximately 1 m in length. In emergent vegetation, we will disturb the vegetation as much as possible to knock invertebrates off the stems. In submerged vegetation, we will collect any vegetation within the border of the net after the sweep is completed. The net will be rinsed into a pan to and remove all invertebrates. The sample will be preserved for later ID. Crew will remove and release any fish that are visible in the sample before preservation. Any vegetation captured in the sweep net will be dried to a constant weight to standardize the sample.

4. Vegetation re-establishment

Purpose: Once the Project is restored to tidal inundation, it is hypothesized that it will become re-colonized by marsh vegetation reminiscent of the natural landscape. To this end, the Project has been designed to promote colonization of marsh plants through placement and seeding of habitat berm. In addition, the Project has been designed to minimize colonization of non-native SAV. As the marsh re-colonizes, it is expected to provide habitat and food resources for aquatic organisms. Vegetation re-establishment will promote the following ecosystem services:

- **Habitat for fish and invertebrates and terrestrial animals**
- **Provide source of carbon for primary consumers**

Metrics

It is anticipate that it may take several years for the Project to become fully colonized by marsh vegetation. Colonization rates will be measured over time to compare progress of the project in the first three years of the project and every fifth year afterwards. Non-native invasive species can threaten the diversity and abundance of native species. A control program for non-native invasive plants may be implemented if the site becomes overrun and limits habitat quality for target organisms.

Methods

Habitat Berm

Vegetation establishment on the habitat berm will be conducted using plots along transects. Fixed, permanent transects, located along the elevation gradient of the marsh transition zone and oriented perpendicular to the main channel should be established at cross-sections across topographic locations. Transect locations will be strategically placed to capture the diversity of the topographic gradient of the marsh transition zone throughout Yolo Flyway Farms. Transect length may vary depending on the size and shape of the transition zone at the transect location though a good target is 100 feet or more (30 meters or more). Based on the total length of the transect 3-5 plot locations should be identified for each transect. Each plot should be one square meter in size ($1m^2$), and the location of plots along transects should be randomized, with a minimum distance of 2 meters between plots. The same plots should be monitored using visual estimations of plant cover, according to the CNPS relevè protocol (CNPS, 2015). All plant taxa observed should be recorded, along with their total cover value. Alternatively, cover can be recorded in cover classes, as determined appropriate by the vegetation ecologist performing the monitoring. The maximum canopy height of each species within the plot will also be recorded. Vegetation composition and cover monitoring should be conducted in years 1, 3, and 5.

Photo documentation with fixed, permanent digital photograph locations repeated over time is an economical method to provide a qualitative way to visually assess changes in the landscape. Photo documentation is also a useful tool in communicating these changes to the public. Photographs taken from fixed locations can be coordinated with aerial photos and used to calibrate aerial photographs as well as track the development of vegetation communities, channel structure, and other metrics such as invasive plants. Photo-points for ground level documentation will be established and correlated with aerial photographs. Several factors should be considered when establishing the location and number of photo point locations such as: site access for repeatability, number and stratification of photo points to represent areas of interest (i.e., different habitat types, channel development), elevation of photo point to clear expected height of mature vegetation, coordination with other surveys such as vegetation surveys and aerial photographs, coordination with tide (extent of inundation during high tide or tidal evacuation during low tide), or to capture extreme phenomena (i.e., extent of inundation during king tide events).

A number of invasive plant species have been found at the Project site and monitoring and mapping is included in this plan. Invasive plants found at the site will be evaluated to determine whether they should be a management priority. Particular attention should be given to species rated with a high negative ecological impact in California. High-impact invasive plant species known to occur in the Suisun Marsh include common reed (*Phragmites australis*) and perennial pepperweed (*Lepidium latifolium*).

Mapping shall be accomplished through the use of available technologies, such as GIS, aerial photography, and field surveys. Target invasive plant mapping will be conducted during years 1, 3, and 5 after construction to establish a baseline. Target invasive plant mapping will be conducted every five years after the habitat is established.

5. Fish Utilization

Purpose: Tidal wetland restoration is hypothesized to provide direct and indirect habitat benefits to native fish. As mentioned previously, fish will not be sampled as a direct measure of this project due to concerns with having impacts to CESA and ESA species. However, special studies are proposed to evaluate food web benefits (described above) to native fish. In addition, the tagging and tracking studies will be conducted to examine growth and survival of native fish

with the Project. Finally, the Project will examine nearby monitoring data trends to gain a better understanding of how the Project may be contributing to overall fishery production in the region.

- **Food Web contribution**
- **Native fish rearing habitat**

Metrics: Fish communities will not likely be measured within the Project site given concerns over incidental take of Delta Smelt and other listed species. Data from the nearby monitoring sites will be used to assess the status of native fish in the area. Special studies will be conducted to determine rearing and survival of Chinook salmon and potential other species (e.g., Splittail) in the Project. This information can be compared over time to evaluate the habitat quality of the Project.

Methods: Special studies will be conducted during the first 3 years of the Project and every five years post-construction. Fish survival will be examined using radio-tagged fish released at the site over short intervals (~1-2 weeks) to determine movements and overall residence time (Sommer et al. 2001).

Incident take permits: Take permits for direct take of listed species will not be required for the monitoring because the Project is not proposing to do targeted fish collections within the study site. Incidental take permits will be sought for the larval life stages of listed species likely to be collected during lower trophic sampling (Table 3):

Table 4. Anticipated Take by Life Stage

Method	Species	Life stage	Anticipate Take	Permitting agency
Zooplankton net	Delta Smelt	Larvae Juvenile Adult	10 0 0	USFWS
Zooplankton net	Longfin Smelt	Larvae Juvenile Adult	10 0 0	CDFW
Zooplankton net	Chinook salmon	All	0	NMFS/CDFW
Zooplankton net	Steelhead	All	0	NMFS/CDFW
Zooplankton net	Green Sturgeon	All	0	CDFW

Any permits required for the survival studies (i.e, transport and handling) will be obtained prior to the study implementation.

V. Data Management, Analysis, and Assessment

Effective data management will be integral to the success of this monitoring plan. The integration of protocols, standards, and practices will help ensure that data will be scientifically valid and usable for the widest possible variety of assessments.

Detailed monitoring protocols will be developed prior to initiating monitoring activities, based on logistical constraints and precise locations of sampling locations. The protocols will be established for both field survey and laboratory tests, and will include a description of the measures that will ensure the quality of the data collected and how to implement those measures. These quality assurance techniques may include, but are not limited to, procedures

for calibrating devices, procedures for recording and transferring data, and methods for ensuring proper operation of field equipment.

The data management activities for the Project monitoring will be the responsibility of the Land Owner during the Interim Management Period (first 5 years after construction) and partnering agencies (e.g., CDFW, IEP, USGS) and can include database design and implementation. Data collection and information storage protocols will be standardized for such stages as data entry sheet design, data collection protocols, data entry, quality assurance/quality control, data processing, chart and graph generation, and metadata.

Data collected for the Project monitoring will be housed in a centralized location. Field measurements conducted by partnering agencies (e.g., USGS, IEP) will be conducted in a manner consistent with existing methodologies for regional monitoring. Data collected for the Project will be stored in commonly used and acceptable digital formats (e.g. databases in Access or Excel, documents in Microsoft Word or PDF) so that the collected information may contribute to existing datasets. The Access file will undergo QA/QC to ensure field data are accurately transcribed from the data sheets or electronic medium. Flat files will be created from the Access database for statistical analyses or public dissemination. Data will be made publically available upon request within a year of data collection. Biological data will also be uploaded to public databases for wider distribution, including the California Environmental Data Exchange Network, California Wetlands Information System database, and USFWS National Wetland Inventory. Data on collection of listed species will be reported to regulatory agencies per permit terms. In addition, any data on listed species will be made available to the regulatory agencies immediately upon request. Any reports using data collected during the monitoring will be made publically available via a FTP link. Statistical analyses will be performed in R, SAS, or Primer computing statistical environments. Statistical code will be made available as electronic supplementary material in all final monitoring reports.

Data Analysis

The monitoring plan outlined above will yield an array of physical and biological data necessary to evaluate performance objectives over key timeframes of the YFF AMP. For the most part, objectives to improve riparian, marsh, and floodplain vegetation cover targets can be evaluated using summary statistics (i.e., percent cover) from the field and photo measurements. Additional analyses to determine what covariates (i.e., distance from channel/levee, soil composition, etc) affect performance targets for vegetation recolonization will be analyzed using General Liner Model (GLM), General Additive Model (GAM), or logistic regression depending the distribution of the measurement of the response variable (e.g., normal distributed vs Poisson) to covariates. The ultimate purpose of the statistical analysis should be to parameterize the response to the environment to make predictions on the trajectory of change to help guide YFF AMP objectives. Changes in the native versus invasive vegetation communities in time and space will be examined using non-metric multidimensional scaling (nMDS) methods (e.g., SIMPER and ANOSIM procedures). Hydrodynamic data associated inundation events will be examined using graphical summaries and compared with each inundation event.

Fish survival studies will examine residence time and habitat use of tagged individuals using GLM's. Similarly, food web flux studies will be examined using GLM's and any other appropriate multivariate statistical models to determine if secondary production is exported to surrounding channels. Finally, abundance of secondary consumers measured within the site will be

examined using GLM or GAM depending the distribution of the data (i.e., Gaussian vs Poisson distributed).

Annual Monitoring Report

Annual reports will be prepared for submittal to the FAST. The annual reports will include a summary of work completed to date, milestones, current status, constraints, and relative accrued benefits of the Project. The report will specify remedial actions or management responses. Further details are provided in the following section.

VI. Adaptive Management

The goal of maintenance and management of the site is to promote the long-term functions and services associated with tidal wetlands. The approach to adaptive management of the site is to conduct regular site visits and monitor selected characteristics to determine the stability of the site and ongoing trends in physical and biological processes. Unexpected trends in the biological or morphological characteristics of the site will require examination to determine if they are compromising goals and objectives that were established for the site.

A. Restoration Objectives: Intervention Thresholds and Responses

While it is not anticipated that major modification to the site will be needed, an objective of this Plan is to guide monitoring, identify any thresholds that may compromise the Project objectives, and propose potential management responses or further focused monitoring efforts. This section summarizes the five Project objectives, the expected outcomes related to those objectives, the metrics by which progress towards meeting the objectives is measured, as well as thresholds for undertaking a management response if goals are not being met or problems occur which require intervention. The section below is summarized in Table 5.

1. Food Web Contribution

Objective: Enhance regional food web productivity and export to Delta in support of delta smelt and other native fish

Expected Outcome: The levee breach and new channels will increase tidal exchange and excursion on the site. This tidal exchange will increase the export of primary and secondary productivity from the site.

Monitoring Category: Physical Process and Hydrology

Metric: Elevation and topography, including channel cross sections. Hydrology measured with level-loggers in various locations throughout the Project site.

Goal: Breach channel erodes until reaching equilibrium and little or no tidal muting occurs within the site.

Intervention Threshold (trigger level): Breach channel declines in cross-section area for 2 or more years in a row from excessive sedimentation, resulting in tidal muting within the site. An obstruction such as a large tree or derelict boat or barge lodged in the breach could occur, resulting in tidal muting within the site.

Potential Management Response: The Land Owner will coordinate with the FAST on appropriate action(s) to take including, but not limited to, dredging or removal of obstruction. Any dredging will be limited to the period between September1 and November 30. Any dredging

will be reported in the annual report. Equipment may include long-reach excavator, barge-mounted dragline, suction dredge, or backhoe.

Table 5. Adaptive Management Responses

Objectives	Expected Outcome or Hypothesis	Monitoring Category	Metrics	Goal	Trigger level	Potential Management Response
1. Enhance regional food web productivity and export to Delta in support of delta smelt and longfin smelt recovery.	Constructed breaches and new channels will increase tidal exchange and excursion on the site. The tidal exchange will increase the export of primary and secondary productivity from the site	Physical and Hydrology	• Elevation and topography including channel morphology and pond depths • Tidal regime • Residence time in ponds and other habitats	No tidal muting occurs within the site.	Channel cross-section declines in area for 2 or more years in a row resulting in tidal muting within the site. An obstruction (tree, derelict vessel) lodged in the breach, resulting in tidal muting within the site.	The Land Owner will coordinate with the FAST on appropriate action(s) to take including, but not limited to, dredging to appropriate dimensions to maintain tidal exchange. Remove obstruction from channel.
		Food Web	• Chlorophyll a • Phytoplankton • Zooplankton	Food web contributions from the Project site are higher than from boundary conditions (Toe Drain). Food web contributions from the various habitat components within the site are maximized to the extent possible	Food web exports are lower in concentration than those found in the Toe Drain channel.	Modify elevations within the site to adjust residence time.
2. Provide rearing habitats for native fishes and wetland-dependent species and enhance ecosystem function	The Project site will create suitable terrestrial and aquatic habitat for and be occupied by target native species such as delta smelt, juvenile Chinook salmon, and giant garter snake	Fish	• Chinook salmon presence	Find Chinook salmon juveniles within the site	No threshold for intervention	Release captive-reared juvenile salmonids with coded wire tag or ratio tags to determine habitat use and growth within the site.
		Terrestrial vertebrates	• Giant garter snake	Create a complex of foraging, refugia and aestivation habitat within the site	No threshold for intervention	None

Objectives	Expected Outcome or Hypothesis	Monitoring Category	Metrics	Goal	Trigger level	Potential Management Response
		Wetlands and Vegetation	• Aquatic habitat mapping • Vegetation composition and cover • Invasive plants • General habitat conditions	Rate of colonization by native plant species is higher than that of non-native invasive plant species	Growth rate of percent cover of non-native invasive species is higher than that of native species for two years in a row	Chemical or physical control of non-native invasive species Replanting with native species
3. Water quality		Water Quality	• Water quality (temperature, EC, turbidity, pH, DO)	Maintain suitable water quality conditions for native fish	DO levels in excavated channels are below threshold for aquatic life; evidence of fish die-offs	Modify elevations within the site to adjust residence time.
4. Habitat succession: Provide topographic variability to allow for habitat succession and resilience against future climate change and sea level rise.	Topographic variability including transition corridor from intertidal to upland elevations will be maintained	Physical Processes and Hydrology	• Topography and planform of transition areas. • Tidal regime	Maintain wildlife values and to protect adjacent properties and maintain access to allow for monitoring activities, control of non-native invasive plants, and for adaptive management activities, if	Accretion or erosion that creates undesirable habitat conditions on the site	Removal or placement of material

1. Enhanced Regional Food Web

Objective: Enhance regional food web productivity and export to Delta in support of delta smelt and longfin smelt recovery.

Expected Outcome: Constructed breaches and new channels will increase tidal exchange and excursion on the site. The tidal exchange will increase the export of primary and secondary productivity from the site

Monitoring Category: Physical and Hydrology

Metric: Elevation and topography including channel morphology and pond depths, tidal regime, and residence time in marsh areas

Goal: No tidal muting occurs within the site

Intervention Threshold: Channel cross- section declines in area for 2 or more years in a row resulting in tidal muting within the site. An obstruction (tree, derelict vessel) lodged in the breach, resulting in tidal muting within the site.

Potential Management Response: The Land Owner will coordinate with the FAST on appropriate action(s) to take including, but not limited to, dredging to appropriate dimensions to maintain tidal exchange. Removing flood debris or other obstructions from channel will no required prior coordination with the FAST.

Monitoring Category: Food web

Metric: Chlorophyll a, Phytoplankton, zooplankton, benthic macroinvertebrates, particulate and dissolved organic matter.

Goal: Food web contributions from the Project site are higher than from boundary conditions (Lower Yolo Bypass). Food web contributions from the various habitat components within the site are maximized to the extent possible.

Intervention Threshold (trigger level): Food web components in restored marsh is lower in concentration than those found in the adjacent channels.

Potential Management Response: Increase intensity of water quality monitoring to determine conditions that may be leading to lower productivity. Modify the channel or marsh terrace elevations to adjust residence time. Methods may include excavation by amphibious long-reach excavator, or other small mechanized aquatic equipment (e.g. “marsh master”). Prior to any modification to the features, the following information will be provided to FAST and the Corps:

- A description of the proposed work
- The elevation of the existing landforms
- The daily and monthly tidal range of the features to be modified
- Water quality measurements for the features
- The results of an on-site field inspection for protected plants located within the proposed area of disturbance

2. Provide Rearing Habitat for Native Fishes and Wetland Dependent Species

Objective: Enhance regional food web productivity and export to Delta in support of delta smelt and longfin smelt recovery.

Expected Outcome: The Project site will create suitable terrestrial and aquatic habitat for and be occupied by delta smelt, juvenile Chinook salmon, and giant garter snake and other target native speices.

Monitoring Category: Native Fish

Monitoring Category: Fish

Metric: delta smelt and Chinook salmon presence

Goal: Find Chinook salmon juveniles within the site

Intervention Threshold (trigger level): No threshold for intervention is appropriate if delta smelt or Chinook salmon juveniles are not found within the site.

Potential Management Response: Release captive-reared juvenile salmonids with coded wire tag or ratio tags to determine habitat use and growth within the site.

Monitoring Category: Terrestrial vertebrates

Metric: Giant garter snake and other terrestrial vertebrates

Goal: Find giant garter snake within the site

Intervention Threshold (trigger level): No threshold for intervention is appropriate if giant garter snake is not found within the site.

Potential Management Response: none

Monitoring Category: Wetlands and Vegetation

Metrics: Vegetation composition and cover within the complex of uplands and wetlands, aquatic habitat mapping, percent cover of invasive plants, and general habitat conditions.

Goal: Increasing trend of native vegetation cover and species diversity within the Project site that is higher than that of non-native invasive plant species. Hydrology and vegetation characteristics mirror those found in regional fresh water marsh.

Intervention Threshold (trigger level): Little or no wetland vegetation establishes in restored marsh, growth rate of percent cover of non-native invasive species is higher than that of native species for two years in a row, dominance of non-native plans species in wetlands (> 25%),

Potential Management Response: Chemical or physical control of non-native invasive species and/or replanting with native species.

If non-native invasive plant species are inhibiting the value of the restored habitats and the qualified biologist recommends treatment, and the Land Owner and FAST agree that such treatment will benefit the site, control of targeted species may be proposed. Control techniques include hand or mechanical removal, biological control, or chemical treatment. Ground-based and aerial application of chemical treatments will be conducted as allowed under current State and Federal pesticide and water quality regulations. Only chemicals approved for such purposes in California may be used in any control action. Because funding and time to get to an infestation site may be limiting factors, monitoring may be done simultaneously with treatment to save time. Follow-up monitoring will occur at the time of year and frequency sufficient to detect change in the populations of invasive plants and the effects of any treatment.

If non-native invasive plant species are not inhibiting the values of the restored habitat, the Land Owner will work with the FAST to determine if there is any reason to propose control of these species. Any control of non-native invasive plant species would be reported in the Annual Report.

3. Water Quality

Metric: Dissolved oxygen, temperature, pH,

Goal: Maintain suitable water quality conditions for out-migrating juvenile Chinook salmon

Intervention Threshold (trigger level): Dissolved oxygen (DO) falls below the temperature dependent threshold for aquatic life for 24 hours or there is an observation of a fish kill within the site

Potential Management Response: Modify elevations within the site to adjust residence time. Methods for re-establishing full tidal exchange are covered under Objective #1, above.

4. Habitat Succession

Objective: Provide topographic variability to allow for habitat succession and resilience against future climate change and sea level rise.

Expected Outcome: Topographic variability including transition from intertidal to upland elevations will be maintained over time.

Monitoring Category: Physical processes

Metric: Topography, elevations, and plan-form arrangements of habitat components

Goal: Maintain seasonally inundated floodplain and transitional upland areas for their wildlife values and to protect adjacent properties and maintain access to allow for monitoring activities, control of non-native invasive plants, and for adaptive management activities, if necessary.

Intervention Threshold (trigger level): Accretion or erosion that causes undesirable habitat conditions on the site.

Potential Management Response: Removal or placement of material to correct undesirable conditions.

B. General Site Inspections

The Land Owner will conduct regularly scheduled site visits to monitor the conditions of the site. During these inspections, notes will be taken on general topographic conditions, hydrology, general vegetation cover and composition, invasive species, and erosion. Notes will include observations of plant and wildlife species observed, water quality, general extent of wetlands, and any occurrences of erosion and weed invasion. In addition, evidence of trash and trespass will be documented. Access for scientific and educational uses will be granted on a case-by-case basis after evaluation of the purpose, impacts, and need for the access. Table 6 summarizes the frequency and details of the general inspections to be conducted on the site.

Table 6. Inspection and Maintenance Activities

Activity	Pre-Construction	Construction	Post Construction		Seasonality
			Year 1	Years 2-5	
Site visits	Monthly	Monthly	Monthly	Quarterly	
Examine tidal channels	N/A	N/A	Every 2 months	Quarterly	
Examine tidal connections	N/A	N/A	Every 2 months	Quarterly	
Remove trash	N/A	N/A	Annually	Annually	After flood season
Map non-native invasive plant species	Annually	Annually	Annually	Annually	During growing season
Control non-native invasive species if impacting wetland habitat quality	Annually	Annually	Annually	Annually	During growing season prior to flowering
Maintain and replace signs and gates as needed	Annually	Annually	Annually	Annually	After flood season

1. Trash

Due to its isolated and remote location, trash is most likely to float in from the Yolo Bypass. During the regularly scheduled site visits, record occurrences of trash and floating debris.

Goal: The Restoration Site should remain free of trash and other debris that harms the aesthetic and ecological values of the site.

Intervention Threshold (trigger level): If trash or floating debris are observed and result in impairment of tidal exchange on the Restoration Site, corrective actions will be identified.

Potential Management Response: Debris may be removed by hand, backhoe, or by using a long-reach excavator, if necessary. Debris removal shall be done annually or on an as-needed basis, normally after the winter flood season.

2. Trespass

Signage will be installed along the perimeter of the site to inform the neighbors of the restoration activities on the site. Three signs will be installed every mile along the perimeter of the site. Signs will not be installed in the tidal habitat. The Land Owner will be responsible for maintenance and replacement of the signage.
Access to the site via gravel roads off of County Road 155 and located on existing easements will be maintained and controlled with temporary gates and fencing where needed and on a seasonal basis.
The Land Owner will be responsible for maintenance and replacement of the gates, fencing and signage as needed and removing any temporary fencing prior to the winter flood season.

Goal: Control access through maintenance of gates and discourage trespass with signage.

Intervention Threshold: Trespass levels threaten the biological stability of the Project site. Damage from unauthorized vehicle traffic is documented.

Potential Management Response During the regularly scheduled site visits, record conditions of the gates and signs as well as the access roads and habitats. Replace gates and signs on an as-needed basis. Increase frequency of site visits to determine source of trespass.

3. Scientific and Educational Use

Research and/or other educational programs or efforts shall be encouraged as deemed appropriate by the Land Owner and the FAST; however, these programs are not specifically authorized or funded by this AMMP or the conservation easement deed.

Goal: Provide limited access to the Project site for educational and research purposes to expand awareness of restoration, ecological values, and to reduce uncertainties associated with tidal restoration projects. Studies that are conducted will present findings at regional conferences like the Bay-Delta Science Conference and with other relevant science groups, such as the Tidal Wetlands IEP project work team.

Intervention Threshold: Not applicable.

Potential Management Response: Individuals, groups, educational facilities, or researchers proposing to use the Project site for educational purposes will coordinate their use with the Land Owner and FAST. If the educational activities will passive in nature, such as a hike to discuss plants and animals, then the written consent of the Land Owner is sufficient. If active use (any earthmoving or ground disturbance) of the Restoration Site is proposed, or regular ongoing use of the Restoration Site is proposed, review and written approval by the Land Owner and the FAST is required. Potential studies that could benefit the restoration effort could include:

- Time series of changes in diversity and abundance of insects in response to natural flooding regimes
- Changes in abundance of seasonal migrants using the floodplain as stopover habitat (birds) or rearing habitat (salmonids)
- Plant succession dynamics and associated changes in water temperature and flow

C. Giant Garter Snake Avoidance and Minimization

All ground disturbing maintenance and monitoring work occurring in or around the tidal marsh habitat at the site will follow the following avoidance and minimization measures for giant garter snake:

1. Avoid construction activities within 200 feet from the bank of giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance.
2. Construction activity within habitat should be conducted between May 1 and October 1. This is the active period for giant garter snakes and direct mortality will be lessened because snakes are expected to actively move and avoid danger. Between October 2 and April 30 contact the USFWS's Sacrament Fish and Wildlife Office to determine if additional measures are necessary to minimize and avoid take.
3. Confine clearing to the minimal area necessary to facilitate construction activities. Flag and designate avoided giant garter snake habitat within or adjacent to the work area as Environmentally Sensitive Areas. This areas should be avoided by all construction personnel.
4. Construction personnel should receive USFWS-approved worker environmental awareness training. This training instructs workers to recognize giant garter snakes and their habitat(s).
5. 24-hours prior to construction activities, the project area should be surveyed for giant garter snakes. Survey of the project area should be repeated if a lapse in construction

activity of two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. Report any sightings and any incidental take to the USFWS immediately by telephone at (916) 414-6600.

6. Any dewatered habitat should remain dry for a least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.
7. After completion of construction activities, remove any temporary fill and construction debris and, wherever feasible, restored disturbed areas to pre-project conditions. Restoration work may include such activities as replanting species removed from banks or replanting emergent vegetation in the active channel.

D. Annual Monitoring and Management Report

Annual reports will be prepared for submittal to the FAST. The annual reports will include a summary of work completed to date, milestones, current status, constraints, and relative accrued benefits of the Project. The report will specify remedial actions or management responses.

The Land Owner will be responsible for preparing an annual report on all monitoring and management tasks. The annual report will be completed and submitted to the FAST no later than December 31st of each year following the initiation of physical restoration actions. The Land Owner and/or restoration ecologists and biologists shall make recommendations in the annual report regarding:

- Actions to resolve or reduce management problems (weed control, security, etc.), and
- Warranted changes in monitoring or management programs based on experience to date.

Elements of the report will include:

- General Project information including:
  - Project name;
  - Land Owner's name, address, email and phone number;
  - Consultant name(s), address(es), email(s), and phone number(s):
  - Acres of impact and types of habitat impacted;
  - Date construction commenced and was completed for Phase 1 and Phase 2; and
  - Indication of monitoring year.
- Goals and objectives of the Project
- Monitoring and maintenance dates with information about activities completed, personnel, and time required to complete tasks
- Analysis of all quantitative and qualitative monitoring data
- Color photographs from each of the designated photo monitoring points
- Maps identifying monitoring areas, planting zones, etc., as appropriate
- Planned remedial action for the upcoming monitoring period
- A description of funds received and expended for management of the Restoration Site during the previous year
- Status of biological resources on the Restoration Site

- Results of biological monitoring or studies conducted on the Restoration Site including biological field data sheets and/or maps illustrating species observation locations
- Description of all management actions taken on the Restoration Site including any new practices, structures, or vehicle usage associated with the management actions
- Descriptions of any problems encountered in managing the Restoration Site

A final report to cover the entire restoration Project will be prepared at the end of the Interim Management Period (Year 5 after construction). This final report will include data from all years, including copies of all previous reports and a delineation of the Restoration Site.

E. Special or Emergency Notifications

The Land Owner will provide notice to the FAST and U.S. Army Corps of Engineers (Corps) on any activities or emergency situations requiring action with the potential to adversely affect waters of the United States, including wetlands or other habitats.

Intervention Threshold: An "emergency situation" is present where there is a clear, sudden, unexpected, and imminent threat to life or property demanding immediate action to prevent or mitigate loss of, or damage to, life, health, property or essential public services (i.e., a situation that could potentially result in an unacceptable hazard to life or a significant loss of property if corrective action requiring a permit is not undertaken immediately).

Potential Management Response: The Land Owner will provide notification to the FAST and Corps for any actions contemplated that (1) are deemed urgent and/or emergency in nature, and (2) are not part of activities recommended in this Plan or the annual report. Notification will be written and may be mailed or electronically transmitted. The notification will include a written description of the proposed action(s) and map(s) of the area affected. Methodology of the action shall be described in the letter. The FAST will have 30 days in which to discuss or object to the activity. The action(s) will be deemed approved if a written response is not received by the Land Owner within 30 days of transmittal. Any permits necessary for such action(s) are the responsibility of the Land Owner. Provide notice of actions not initiated by the Land Owner that have affected resource values at the Restoration Site.

Where an action natural or otherwise initiated or occurring outside of the Land Owner's control that affects resource values at the Restoration Site, and which are of a nature that timely reporting of these action(s) to the FAST is advisable, versus being reported in the annual report, the Land Owner shall report such action(s) to the FAST within 30 days of recognition of the action(s). The report will be written and may be mailed or electronically submitted. Any remedial actions recommended by the FAST shall be submitted to the Land Owner within 30 days of receipt and shall be included in the annual report for consideration.

The Land Owner shall be responsible for identifying emergency situations that require immediate action. Should an emergency situation arise that would otherwise require prior notification of the FAST prior to execution of remedial action(s), the Land Owner shall report the nature of the emergency and remedial action to the FAST by electronic mail or telephone within 48 hours with written confirmation within 5 days of initiation of the remedial action. An emergency situation for the purpose of this section is where there is an unacceptable risk to life, significant loss of property, or an immediate, unforeseen and significant economic hardship able to be addressed by the Land Owner consistent with restoration objectives.

Should an emergency situation arise that requires immediate action in a wetland or waters of the U.S., and would normally require that a permit be obtained from the Corps, the Land Owner shall be responsible for notifying the Corps and complying with the Corps requirements. As of 2015, the appropriate Corps permit is Regional General Permit Number 5 (Corps File No. 28218S) that authorizes discharges of dredged or fill material into Waters of the United States, including wetlands, and/or work or structures in Navigable Waters of the United States for necessary repair and protection measures associated with an emergency situation. California Fish and Game Code Section 1600 also has emergency procedure stipulations that may apply.

VII. Transfer, Replacement, Amendment, and Notices

A. Transfer

Any subsequent transfer of responsibilities under this AMMP to a different Land Owner shall be requested by the appropriate agency in writing to the FAST, shall require written approval of the FAST, and shall be incorporated into this AMMP by amendment.

Any subsequent Land Owners assume all Land Owner responsibilities described in this AMMP.

B. Replacement

If this Land Owner fails to implement the tasks described in this AMMP and is notified in writing by the FAST, the Land Owner shall have 90 days to cure such failure. If failure is not cured within 90 days, the Land Owner may request a meeting with the FAST to resolve the failure. Such meeting shall occur within 30 days or a longer period if mutually agreed to by the FAST and the Land Owner.

If the Land Owner fails to cure the failure, and fails to communicate with the FAST about the situation, the FAST may designate a Land Manager to implement the tasks described in this AMMP. A Land Manager designated by the FAST should be a public or private land or resource management organization acceptable to and as directed by the FAST. A Land Manager designated by the FAST may enter onto the Restoration Site at any time in order to fulfill the purposes of this AMMP.

C. Amendment

The Land Owner and FAST may meet and confer from time to time, upon the request of any one of them, to revise this AMMP to better meet management objectives and preserve the habitat and conservation values of the Restoration Site. Any proposed changes to this AMMP shall be discussed with the Land Owner and the FAST. Any proposed changes will be designed with input from all parties. Amendments to this AMMP shall be approved by the Land Owner and the FAST in writing, shall be required management components, and shall be implemented by the Land Owner.

If the FAST determines, in writing, that continued implementation of this AMMP would jeopardize the continued existence of a state or federally listed species, any written amendment to this AMMP, determined by the FAST as necessary to avoid jeopardy, shall be a required management component and shall be implemented by the Land Owner. Any permits, authorizations, and/or consultations shall be obtained prior to implementing the management component.

D. Notices

Any notices regarding this AMMP shall be directed as follows.

1. Land Owner

Reynier Fund, LLC
34284 Corcoran Hill Lane
Davis, CA 95616
Attn: Charles Tyson

2. Applicant

Reynier Fund, LLC
34284 Corcoran Hill Lane
Davis, CA 95616
Attn: Charles Tyson

3. FAST Agency Members

U.S. Fish and Wildlife Service
San Francisco Bay-Delta Fish and Wildlife Office
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814
Attn: Field Supervisor

National Marine Fisheries Service
Sacramento Area Office
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814
Attn: Regional Manager

California Department of Fish and Wildlife
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
Attn: Regional Manager

U.S. Bureau of Reclamation
Reclamation Mid-Pacific Region
Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536
Attn: Regional Manager

VIII. List of Contributors

Wetland Water Resources

- Stuart Siegel
- Eve Pier Kieli
- Dan Gillenwater
- Esa Crumb

ICF

- Carl Jensen
- Jason Hassrick
- Lenny Grimaldo

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