

Memo



To: George Booth, Sacramento County Department of Water Resources; Charles Bergson, Isleton City Manager

From: Lynn Hermansen and Jeffrey Twitchell

Date: March 17, 2022

Re: Ecosystem Multi-benefit Opportunities for the Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies

GEI Consultants, Inc. (GEI) is assisting the Sacramento County Department of Water Resources in conducting feasibility studies to evaluate structural and non-structural actions to reduce the risk of flooding to six small communities in the Sacramento River Corridor of the North Delta study area. The six communities, all located along the banks of the lower Sacramento River, include the five unincorporated towns of Hood, Courtland, Locke, East Walnut Grove, West Walnut Grove/Ryde, and the small, incorporated City of Isleton (**Figure D-1**). The feasibility studies are being funded under the California Department of Water Resources (DWR) Small Communities Flood Risk Reduction Program.

Structural flood risk reduction measures that may be implemented include: improving existing perimeter levees with fix-in-place solutions, primarily on the landside of the levee (e.g., constructing seepage cut-off walls, seepage berms, or stability berms; geometry improvements; and/or remediation of deficient encroachments etc.); constructing new cross levees in strategic locations to protect existing infrastructure; constructing new ring levees in strategic locations; and/or establishing relief cuts in critical areas with associated protective measures (e.g., weir construction and armoring areas adjacent to the weir and the banks opposite of the weir). Non-structural measures could include elevating existing structures, Federal Emergency Management Agency (FEMA) reforms, community and flood-risk-based flood insurance programs, improved flood preparedness, and response and recovery actions.

As part of the feasibility study, GEI compiled potential multi-benefit opportunities for ecosystem restoration and enhancing wildlife-friendly agriculture within the small communities' study vicinity located in the North Delta.

This Technical Memorandum (TM) summarizes the current status of regional conservation and multi-benefit planning efforts and identifies existing and potential ecosystem restoration opportunities within the larger North Delta region of the six communities. Additionally, this memo provides an overview of the how ecosystem benefits could be incorporated into community specific flood risk reduction measures that have been identified for the six individual communities, and qualitatively how these benefits could contribute to the Central Valley Flood Protection Plan (CVFPP) Conservation Strategy (DWR 2016a) goals and objectives (**Attachment D-1a**) and other Delta-centric conservation plan goals and objectives (**Attachment D-2**), that are further described below.

Sacramento-San Joaquin Delta Conservation and Multi-benefit Planning Efforts

There have been multiple large-scale conservation and multi-benefit planning efforts ongoing in the Sacramento-San Joaquin Delta (Delta) Region since the early 1990's (CDFW 2017). The Delta Reform Act of 2009 (California Water Code §85054) was particularly pivotal because it identified co-equal goals for the Delta of providing a more reliable water supply to California and restoring and enhancing the Delta ecosystem. The reform act established the Delta Stewardship Council (DSC), the Delta Conservancy, and the Delta Protection Commission. These three entities all contribute to land management planning in the region.

The DSC is responsible for oversight of Delta Plan development. The Delta Plan, (DSC 2013) is a “legally enforceable, long-term management plan for the Delta that uses best available science and is built upon the principles of adaptive management”. The DSC is responsible for reviewing and updating the Delta Plan every five years, with the latest Plan Amendment dated January 2019. The DSC can revise some or all the plan, based on current science and ongoing adaptive management actions. Performance measures identified in the Delta Plan are organized into five categories: 1) Water Supply: increasing and improving the reliability; 2) Ecosystem: protecting, restoring, and enhancing the Delta ecosystem; 3) Delta as an Evolving Place: protecting and enhancing the unique cultural, recreational, natural resources, and agricultural values; 4) Water Quality: improving water quality to protect human health and the environment; and 5) Risk Reduction: reducing risk to people, property, and State interests in the Delta. Performance measures that are relevant to developing ecosystem restoration actions and incorporating ecosystem restoration into multi-benefit projects are outlined in **Attachment D-2**.

The DSC is responsible for reviewing most ground disturbing actions subject to CEQA that may be considered a “Covered Action” under the Delta Plan to ensure consistency with the Delta Plan and compliance with the regulatory provisions in the plan. Specifically, covered actions under the Delta Plan are those actions that meet the following criteria (1) are defined as a “project” under CEQA; (2) will occur in whole, or in part, within the boundaries of the Delta or Suisun Marsh, (3) will be carried out, approved, or funded by the State or a local public agency; (4) will have a significant impact on the achievement of one or both of the coequal goals, or implementation of a government-sponsored flood control program; and (5) is covered by one or more provisions of the Delta Plan. Excluded categories include ministerial projects exempt from CEQA, emergency projects, and temporary water transfers (less than one year). Additionally, the DSC has been responsible for developing the Delta Levee Investment Strategy (DLIS) which attempts to prioritize levee repairs and improvements throughout the Delta.

The Delta Conservancy is the primary state agency responsible for ecosystem restoration in the Delta with a mission to “protect, enhance, and restore the Delta’s economy, agriculture, working landscapes, and environment.” (Delta Conservancy 2019).

The Delta Protection Commission (DPC) is the primary venue for residents to provide recommendations and take actions. The DPC has produced several guiding documents including a Land Use and Resource Management Plan (DPC 2010) that establishes the goals and policies of the DPC for the Primary and Secondary Zones of the Delta. The DPC’s Vision 2030 Strategic Plan (DPC 2015) also identifies specific programs, funding, and leadership strategies to be implemented through 2030. The five unincorporated communities identified for flood risk reduction studies in the North Delta are located within the Primary Zone of the Delta, whereas the City of Isleton and surrounding areas beyond the City limits are located within the Secondary Zone of the Delta. The DPC has developed several documents for consideration while identifying potential multi-objectives, including, but not limited to the Delta Economic Sustainability Plan (DPC 2012).

The Delta Conservation Framework 2018-2050 (DCF) was developed by California Department of Fish and Wildlife (CDFW 2018) in coordination with these three Delta agencies, other Delta stakeholders, the Department of Water Resources, and the Natural Resources Agency. The DCF is an “overarching, landscape-

scale planning framework intended to guide conservation in the Sacramento-San Joaquin River Delta, Suisun Marsh and Yolo Bypass through 2050” (CDFW 2018). The DCF acknowledges and integrates the numerous individual planning efforts in the Delta with the intent of accelerating the pace of current projects, identifying new conservation opportunities and advocating a connected landscape-scale conservation approach. The DCF serves as a long-term extension of the California EcoRestore initiative. The DCF does not specifically identify acreage targets or maps showing where conservation should occur, but instead provides guiding principles. The state agency coordinated EcoRestore initiative seeks to advance over 30,000 acres of habitat restoration and enhancement including: 3,500 acres of managed wetlands, 9,000 acres of tidal and sub-tidal habitat, 17,500 acres of floodplain, and 1,000 acres of riparian and upland habitat.

In addition to Delta specific planning efforts, there are a number of Habitat Conservation Plan (HCP) planning areas located near the six communities including: the Solano Multispecies HCP, San Joaquin County Multispecies Habitat Conservation and Open Space Plan, East Contra Costa HCP/Natural Community Conservation Plan and the South Sacramento HCP. Only the South Sacramento HCP intersects with the small community study areas of Hood, Courtland, Locke, and a portion of East Walnut Grove (**Figure D-1**). However, none of these small communities are listed as Plan Permittees. Sacramento County does have the ability to extend take coverage to Third-Party Project Proponents that are under the jurisdiction of the County. However, identified flood management measures are not considered covered activities, thus, without plan modification, these activities would not be eligible to achieve federal take coverage under the Endangered Species Act through the HCP.

Finally, the CVFPP Conservation Strategy identifies goals and objectives for ecosystem benefits within the entire CVFPP Statewide Planning Area. The six communities covered by this planning effort are all located within the Lower Sacramento River Conservation Planning Area (CPA), which coincides with the Lower Sacramento – Delta North Regional Flood Management Plan (RFMP) Region. Specific quantitative objectives were identified for the Lower Sacramento River CPA and are provided in **Attachment D-1b**.

These documents, the supporting materials used to prepare them, and planning documents generated from them, were reviewed to generate a list of existing and potential multi-benefit opportunities for the north region of the Delta where the subject Delta Legacy Communities of Sacramento County are located, and to assess how they could contribute to regional conservation goals and objectives.

Wildlife Friendly Agriculture and Flood Easements

With nearly two-thirds of land in the Delta dedicated to farming, agriculture is not only the dominant land use, but also the largest contributor to the local economy, particularly within the Primary Zone of the Delta. Total agricultural revenue in the Delta was estimated to be \$795 million in 2008 (DPC 2012). Because agriculture is such a driving force in the Delta economy, proposals to convert active farmland to habitat for mitigation, conservation, or restoration generates community concern. While retaining farming in the Delta is of critical importance, consideration for changes to management practices is necessary due to several outstanding issues.

As subsidence continues, particularly in the Central and Southern portions of the Delta, and concerns around climate change related impacts to Delta water quality and temperature grow, there is a growing urgency to improve water supply operations and agricultural practices. Modifying current agricultural practices in the Delta to better support wildlife habitat, may also help facilitate resolution to other ongoing issues. Wildlife-friendly agriculture can include: modifying crop types and/or incorporating crop rotation to reverse subsidence; employing integrated pest management techniques to reduce the need for pesticides; cultivating cover crops to enrich the soil; the strategic use of permanent crops, such as pasture, to reduce soil disturbance and oxidation; and conservation of tillage for field and row crops to support a greater diversity of wildlife species (Trott 2007).

Some native species have adapted to using agricultural lands as habitat in place of natural ecosystems such as seasonal wetlands, emergent marsh, and grasslands. Rice and other flood-irrigated crops support a range of

wildlife, especially waterfowl and giant garter snakes. Many raptor species, including the state-listed as Threatened Swainson's hawk (*Buteo swainsonii*), feed on small mammals and other pest species that inhabit alfalfa fields and irrigated pastures. Other species, such as ring-necked pheasant and greater sandhill crane also feed on grain.

In the Delta, Staten Island represents a good example of wildlife-friendly agriculture. The island is currently managed by The Nature Conservancy and represents one of the most important sites for greater sandhill cranes (*Grus canadensis tabida*), a state-listed-as-Threatened species, in California (Golet 2011). Wintering cranes and migratory waterfowl are supported while growing crops like corn, alfalfa, potatoes, and supporting permanent pastures (DPC 2012). Management measures include carefully planned water management, alternative approaches to tillage, and precise herbicide/pesticide application. Potential non-structural flood risk reduction measures would be compatible with current land use on Staten Island. This could be accomplished through developing voluntary flood easements to reduce flood stages in the nearby Mokelumne River system, thereby reducing flood risks to adjoining communities of East Walnut Grove and Locke. Benefits would also extend to lands upstream of Staten Island, by reducing flood stages in the Morrison Creek and Franklin Pond drainage areas thereby reducing flood risks to the adjoining communities of Hood, Courtland, Point Pleasant, and Elk Grove.

Enhancing habitat management practices, such as managing wetlands for waterfowl and shorebirds, installing fish screens to reduce entrainment at water pumping facilities, or removing barriers that block migration of fish to upstream spawning habitat, may also minimize ecosystem stressors and better support natural processes (DSC 2013).

There are a number of opportunities to offset costs associated with incorporating wildlife-friendly agricultural practices, including preserving and enhancing areas of habitat such as wetland and riparian areas. Some U.S. Department of Agriculture (USDA) programs provide financial incentive for landowners to manage natural areas on their properties, including the Wildlife Habitat Incentive Program, the Environmental Quality Incentives Program, and the Conservation Reserve Program (CDFW 2014). The California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS) and Delta Conservancy also can assist landowners who want to enhance wildlife habitat. These programs include the California Waterfowl Habitat Program to assist private landowners with planning, funding, and managing breeding and wintering habitat for waterfowl; the Permanent Wetland Easement Program that pays landowners 50-70 percent of fair market value to develop and implement habitat management plan for wetlands; the Landowner Incentive Program to assist with enhancing wetlands, native grasslands, and riparian habitat for special-status species.

Previous studies have shown that wildlife-friendly agriculture can increase crop yield, minimize the need for pest management, and improve overall ecosystem function (DPC 2013). Coupled with available financial incentives, incorporating wildlife-friendly agricultural practices can reap benefits for both farms and wildlife.

Ecosystem Restoration

In general, it is important to point out that stakeholder and citizen input to the conservation planning process has overwhelmingly underscored the importance of identifying restoration opportunities on public lands first (CDFW 2017). The importance of retaining agriculture to sustain the economy in the Delta is described in "Wildlife-friendly Agriculture," above and is reflected in multiple planning documents for the Delta region (DPC 2010 and DPC 2012). Therefore, our approach has been to primarily focus on public lands.

As previously described above, there have been multiple conservation planning efforts ongoing in the Delta for many years. Ecosystem restoration opportunities identified herein rely partially on these existing planning documents that are comprehensive compilations, and build on potential opportunities that exist within, and adjacent to, the study areas. Restoration opportunities in and adjacent to these communities

can be summarized as enhancing, establishing, or expanding floodplain, tidal and nontidal marsh, seasonal wetland, riparian, and channel margin habitat; creating managed wetlands for subsidence reversal and carbon sequestration (primarily in the Central Delta and areas to the south); and integrating native vegetation and consideration of habitat value into management actions and operations and management implementation, timing, or methods.

There are three categories of potential ecosystem restoration opportunities that were compiled and presented in **Attachment D-3 in Figure D-2, Attachments D3a-3c and Figures D-3 through D-8**: (1) existing opportunities previously identified through other planning efforts, (2) opportunities to directly integrate ecosystem restoration into proposed flood risk reduction actions to achieve multi-benefit projects, and (3) new ecosystem restoration opportunities identified within, or adjacent to these study areas.

The Delta Conservation Framework, a key Delta planning document developed by CDFW summarizes conservation opportunities in the Delta and identifies seven Conservation Opportunity Regions (CORs): Suisun Marsh, Yolo Bypass, Cache Slough Complex, Central Delta Corridor Partnership, South Delta, North Delta, and Contra Costa. Each COR identifies projects in a Regional Conservation Strategy. Of the seven, only two CORs include portions of one or more study areas: the North Delta and the Central Delta Corridor Partnership (**Figure D-1**).

The North Delta is characterized by legacy communities, long-standing agriculture, and several high-value ecosystems supporting diverse wildlife with the potential for enhancing habitat and supporting recreational activities. These communities include Hood, Courtland, Walnut Grove (West/Ryde), and Isleton. Conservation opportunities are predominately aimed at the conversion of public lands to higher-value ecosystems in the Central Delta, so opportunities in the more developed areas such as the North Delta are somewhat limited and focus on implementing wildlife-friendly agricultural practices and enhancing existing habitat (**Attachment D-3b and Figure D-2**). Examples of feasible opportunities adjacent to the North Delta community of Courtland include the Zacharias Island/Snodgrass Slough Enhancement project and enhancing the combination of wildlife habitat and recreation opportunities within the Delta Meadows State Park adjacent to the communities of Locke and East Walnut Grove.

The Central Delta Corridor is characterized by lakes, floodplain, tidal wetland, and deeply subsided islands. The lands making up the corridor are predominately public, with the exception of a few scattered privately-owned properties. Ecosystem restoration opportunities in the corridor do not fall within the boundaries of the community study areas, but are adjacent to the Hood, Locke, East Walnut Grove, and Isleton. Restoration opportunity areas include: Stone Lakes National Wildlife Refuge (NWR), McCormack-Williamson Tract, Bouldin Island, Webb Tract, and Twitchell Island.

As part of the CVFPP planning efforts, Regional Flood Management Plans (RFMPs) were funded by DWR to obtain input from regional and local flood managers and provide an opportunity for these regions to identify priorities and challenges. As part of this effort, 15 Potential Conservation Sites (PCSs) were identified during the planning process conducted for the Lower Sacramento River/Delta North RFMP (FloodProtect 2014). Two PCSs are located within, or adjacent, to the study area boundaries for the six communities.

The first, identified in the RFMP as PCS-13, identifies enhancement of the right bank of the Sacramento River, between River Mile (RM) 35 and RM 46. This extends along the entire western boundary extent of Hood, and a portion of the Courtland boundary. The second, identified as PCS-15, is enhancement to Zacharias Island/Snodgrass Slough.

It is anticipated that many ecosystem restoration opportunities would be integrated directly into the design of prescribed flood risk reduction management actions to ultimately develop multi-benefit features. For example, flood management actions that require levee repairs could create a need for borrow sites and

restoring these sites to wetland habitat could be an optimal re-use, if deemed inappropriate for future agricultural cultivation. Repaired, or newly constructed levees could be planted with native perennial grass that provides both erosion protection and foraging habitat, and aquatic and riparian habitat channel margin habitat or riparian corridors could be established for wind and wave erosion protection. Ecosystem enhancement measures that can be incorporated into the design of anticipated flood risk reduction management actions are identified in **Attachment D-3c**; the anticipated benefits and contributions to the CVFPP Conservation Strategy goals and objectives and relevant performance measures identified in the Delta Plan are also provided. Habitat design would focus on benefitting special-status species identified as target species in the CVFPP Conservation Strategy as well as meeting the identified goals of Delta conservation planning efforts including the DSC Delta Plan (DSC 2013), the DPC Land Use and Resource Management Plan (DPC 2010), and the DPC Economic Sustainability Plan (DPC 2012).

Finally, several additional ecosystem improvement opportunities within, or adjacent to the study area boundaries were identified. Locations are identified in **Attachment D-3, Figure D-2** and these opportunities are further described in **Attachment D-3a and D-3b**. These opportunities include a parcel south of Hood that is currently in public ownership (potential to be surplus to the needs of the Delta Conveyance Authority), the East Walnut Grove Sewage Ponds, improvements to two existing borrow canals, and the southeast end of Grand Island. Anticipated opportunities and potential contribution to Conservation Strategy and relevant performance measures identified in the Delta Plan are identified in **Attachment D-3b and D-3c**.

The implementation of multi-benefit flood risk reduction actions and other ecosystem restoration opportunities provide many opportunities to contribute to the habitat-based goals and objectives identified in the CVFPP Conservation Strategy; however, other opportunities are more limited. Specifically, due to the physical land characteristics, it is anticipated that there would be few opportunities to contribute to the Ecosystem Processes Goals of “improving dynamic hydrologic flow and geomorphic processes in the State Plan of Flood Control” (DWR 2016a).

To support improving ecosystem processes, the Conservation Strategy Floodplain Restoration Opportunity Analysis (FROA; Appendix I of the Conservation Strategy, DWR 2016b) evaluated the entire CVFPP Systemwide Planning Area to prioritize areas best suited for establishing setback levees and modifying floodplains to expand/improve habitat (e.g., lowering the floodplain to achieve longer inundation periods and/or connect side channels during a greater range of flows). Generally, the lands along the Sacramento River between RM 0 and RM 50, including the study areas, are perched (i.e., the elevation of the floodplain is primarily below the baseflow of the river). Therefore, the FROA (DWR 2016b) considered these areas generally unsuitable for levee setback and floodplain modification opportunities. The primary reasons were due to the higher construction cost associated with building setback levees at lower ground elevations and the depth of inundation (DWR 2016b). While this characterization is generally true in the region, there are a few locations in the study area where a levee setback may be possible including the southwest corner of Grand Island (**O-7 on Figure D-2 and Attachment D3b**) and Staten Island (**O-10**). While larger setbacks may be infeasible, there are opportunities to contribute to shaded riverine aquatic habitat and limited zones of tidal marsh by establishing planting berms on the waterside of levees and/or increasing the levee prism with landside improvements to allow for establishment of waterside vegetation, including locations on Twitchell Island (**ER-2**) and Staten Island (**O-10**).

As project alternatives within the communities are advanced further, restoration opportunities will also be refined and further developed with additional details and contributions to Conservation Strategy metrics and Delta Plan performance measures will be more accurately quantified.

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Attachments

- **Attachment D-1a.** CVFPP Conservation Strategy Goals, Objectives, and Metrics
- **Attachment D-1b.** Conservation Needs, Potential Opportunities, and Objectives in the Lower Sacramento River Conservation Planning Area
- **Attachment D-2.** Delta Plan Performance Measures Relevant to Ecosystem Restoration and Development of Multi-benefit that Incorporate Ecosystem Restoration
- **Attachment D-3. Restoration Opportunities**
 - **Figure D-2** Ecosystem Restoration Opportunities
 - **Attachment D-3a.** Restoration Opportunities Summary Table
 - **Attachment D-3b.** Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Existing and New Restoration Opportunities Contribution to CVFPP and Delta Plan Metrics
 - **Attachment D-3c.** Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Integrated Multi-benefit Opportunities Contribution to CVFPP and Delta Plan Metrics for Multi-benefit Opportunities
 - **Figure D-3** Hood Restoration Opportunities
 - **Figure D-4** Courtland Restoration Opportunities
 - **Figure D-5** West Walnut Grove/Ryde Restoration Opportunities
 - **Figure D-6** Locke Restoration Opportunities
 - **Figure D-7** East Walnut Grove Restoration Opportunities
 - **Figure D-8** Isleton Restoration Opportunities

Attachment D-1a.

CVFPP Conservation Strategy Goals, Objectives, and Metrics

Excerpted from CVFPP Conservation Strategy (DWR 2016a)

Goal	Targeted Ecosystem Process, Habitat, Species, or Stressor ¹	Metric
<p>Ecosystem Processes: Improve dynamic hydrologic and geomorphic processes</p>	<p>Floodplain Inundation</p>	<p>Inundated floodplain—total amount (acres) of 50 percent flows (i.e., a 2-year event) with 14-day or longer duration during December–May): The amount of inundated floodplain benefiting riverine ecosystems and, in particular, target fish species. These amounts are derived from hydraulic modeling using data developed for planning flood management projects.²</p>
	<p>Riverine Geomorphic Processes</p>	<p>Natural bank—total length (miles): A component of SRA cover and bank habitat necessary for migration of a river channel. Its length is related to the area of floodplain potentially reworked by channel migration (river meandering). The length of natural bank can be measured from imagery, topographic data, and DWR-maintained inventories of revetment.</p> <p>River meander potential—total amount (acres): Movement of a river channel across its floodplain regenerates channel and floodplain habitats. River meander potential is the area of floodplain with potential to be reworked by the meandering channel because it is within the river’s natural meander zone, not underlain by substrates resistant to erosion, and not isolated by revetted banks or levees. Areas with river meander potential can be cost-effectively mapped using aerial photography, inventories of revetment and levees, and existing geologic/soils data.</p>
<p>Habitats: Increase and improve quantity, diversity, quality, and connectivity of riverine aquatic and floodplain habitats.</p>	<p>SRA Cover</p>	<p>Natural bank—total length (miles): see natural bank description above.</p>
		<p>Riparian-lined bank—total length (miles): Natural or revetted banks bordered by trees and shrubs. These banks are an attribute of SRA cover, and because SRA cover exists only along channel margins, length is a direct measure of its quantity. Mapping of riparian-lined banks is related to the mapping of riparian vegetation, natural bank, and revetment, all of which DWR inventories for multiple purposes.</p>
	<p>Riparian</p>	<p>Habitat amount—total amount (acres) in floodways: The area of riparian vegetation (i.e., riparian forests, woodlands, and scrub) is a direct measure of its quantity. DWR has mapped this vegetation in the Sacramento and San Joaquin valleys.</p>
	<p>Marsh and Other Wetlands</p>	<p>Habitat Amount—total area (acres) in floodways: The area of marsh and other wetlands is a direct measure of their quantity. DWR has mapped this vegetation in the Sacramento and San Joaquin valleys.</p>
	<p>Floodplain Agriculture</p>	<p>Habitat amount—total amount (acres) of wildlife-friendly agriculture in floodways: The area of floodplain agricultural land with wildlife-friendly agricultural practices is a direct measure of its quantity. Wildlife-friendly practices increase</p>

Attachment D-1a.

CVFPP Conservation Strategy Goals, Objectives, and Metrics

Excerpted from CVFPP Conservation Strategy (DWR 2016a)

Goal	Targeted Ecosystem Process, Habitat, Species, or Stressor ¹	Metric
		habitat value for target wildlife species; fish habitat provided by inundated agricultural land is addressed under inundated floodplain. Areas implementing wildlife-friendly practices have not yet been mapped.
Stressors: Reduce stressors related to the development and operation of the flood risk management system that negatively affect at-risk species.	Fish Passage Barriers	Fish passage barriers—number of high-priority barriers remediated: This metric documents the number of high-priority barriers modified to improve passage. DWR has inventoried and prioritized barriers in the Sacramento Valley and inventoried barriers in the San Joaquin Valley (DWR, 2014a). (San Joaquin Valley barriers have not yet been prioritized.) This inventory will be updated to support multiple programs. (It is important to recognize that, even among high-priority barriers, there is a range of effects on fish migration.)
	Invasive Plants	Invasive plant-dominated vegetation—total area reduced (acres): Land identified as Channel Maintenance Areas in the SPFC Descriptive Document (DWR, 2010) include areas dominated by invasive plants. For species prioritized for treatment, this metric measures reduction in the extent of infested areas that impact both ecosystem targets as well as O&M of the SPFC. DWR has mapped this vegetation in the Sacramento and San Joaquin Valley.

Source: DWR, 2016a

Key:

O&M: operations and maintenance

SRA: shaded riverine aquatic

Notes:

1 Target species needs were a basis for process, habitat, and stressor objectives and thus are not represented by separate objectives. Amounts of levee and revetment modification would be determined during project and plan formulation as a means of providing needed improvements to processes, habitats, and other stressors; thus, objectives were not established for these two stressors.

2 Floodplain inundation duration requirements vary by salmonid species from 7 to 14 days

Attachment D-1b.

Conservation Needs, Potential Opportunities, and Objectives in the Lower Sacramento River Conservation Planning Area

Excerpted from CVFPP Conservation Strategy (DWR 2016a)

Goal Objective: Metric	Additional Need ¹	Potential Opportunity ¹	Objective Amount ¹	Notes
Ecosystem processes				
Floodplain inundation: inundated floodplain – major river reaches Area inundated by 2-year, 14-day or longer flows, December–May (acres)	50,500	4,100–11,200	7,650	Opportunity includes all reconnected land, not just portion with frequent, sustained inundation.
Floodplain inundation: inundated floodplain – bypasses/transient storage areas (acres)	Included in rivers above	1,100–13,900	7,500	Only portions inundated during 50% of years or more frequently for 14 days or longer
Riverine geomorphic processes: natural bank ² (miles)	4	9–12	4	Fish needs may be larger but have greater uncertainty.
Riverine geomorphic processes: river meander potential (acres)	1,300	3,800–10,400	1,300	Fish needs may be larger but have greater uncertainty.
Habitats				
SRA cover: natural bank ² (miles)	4	9–12	4	Fish needs may be larger but have greater uncertainty.
SRA cover: riparian-lined bank (miles)	0–114	2–3	3	Need has a high level of uncertainty.
Riparian habitat (acres)	1,500	2,100–5,600	1,900	With grassland inclusions
Marsh/other wetland habitat (acres)	6,600	300–3,500	3,500	With inclusions off upland vegetation
Stressors				
Fish passage barriers: channel-wide structures	6	4	4	Need consists of channel-wide barriers; opportunity includes all Priority 1 and 2 barriers
Invasive plants: prioritized species (infested acres) ³	682	363	363	Opportunity is in Channel Maintenance Areas

Sources: Appendix E, “Invasive Plant Management Plan”; Appendix F, “Existing Conditions”; Appendix H, “Central Valley Chinook Salmon Rearing Habitat Required to Satisfy the Anadromous Fish Restoration Program Doubling Goal”, Appendix K, “Synthesis of Fish Migration Improvement Opportunities in the Central Valley Flood System”; and Appendix L, “Measurable Objectives Development: Summary of Conservation Needs and Scale of Restoration Opportunities”.

Key: SRA = shaded riverine aquatic.

Notes:

¹ Values have been rounded to the nearest 100 acres and 1 mile, excluding invasive plant acreages, which are provided to the nearest acre.

² This condition is provided under both riverine geomorphic processes and SRA cover.

³ Acreages are underestimates because of data limitations described in Appendix E, “Invasive Plant Management Plan.”

Attachment D-1b.

Summary of Specificity Added to Lower Sacramento River Conservation Planning Area Objectives to Maximize Contribution to Targeted Species Recovery

Excerpted from CVFPP Conservation Strategy (DWR 2016a)

Objective Topic	Specificity Added to Maximize Contribution to Targeted Species Recovery
Inundated Floodplain	<ul style="list-style-type: none"> • Sustain inundation for 14 days or longer between late November and late April to benefit anadromous fish • Modify floodplain topography to minimize stranding potential • Eliminate or modify ditches potentially trapping fish
Riverine Geomorphic Processes	[No additional specificity identified.] ¹
SRA Cover	<ul style="list-style-type: none"> • Avoid degradation of bank swallow habitat when restoring SRA or near-channel vegetation
Riparian	<ul style="list-style-type: none"> • Incorporate elderberry shrubs into habitat restored in riparian areas, especially within 12 miles of habitat occupied by valley elderberry longhorn beetle • Establish large trees in close proximity to field and row crops to provide Swainson's hawk nesting habitat
Marsh (and Other Wetlands)	<ul style="list-style-type: none"> • Restore marsh to be inundated throughout the active season for giant garter snake (mid-March—October) and, where feasible, in 539-acre or larger blocks within 5 miles of and connected to comparable or larger areas of marsh by habitat corridors at least 0.5 miles wide • Restore patches of marsh greater than 20 acres in size to provide habitat for California black rail, where potential for occupancy is high • Minimize potential for submerged aquatic vegetation in restored marsh because it reduces habitat value for target species • Include refugia and basking sites for giant garter snake in restored marsh • Provide refugia from floodwaters for giant garter snake and California black rail • Restore marsh and seasonal wetland that is shallowly flooded (less than 6 inches in depth) to provide habitat for greater sandhill crane
Fish Passage Barriers	<ul style="list-style-type: none"> • Remediate the following priority structures to improve fish passage: <ul style="list-style-type: none"> – Sacramento Weir in the Sacramento Bypass – Fremont Weir in the Yolo Bypass – Lisbon Weir in the Yolo Bypass – Tule Canal crossings (5) in the Yolo Bypass
Invasive Plants	[No additional specificity identified.] ¹

Sources: Appendix G, "Identification of Target Species and Focused Conservation Plans," and Appendix K, "Synthesis of Fish Migration Improvement Opportunities in the Central Valley Flood System."

Key: SRA = shaded riverine aquatic.

Note:

¹ Focused conservation plans for targeted species do not identify additional specificity as necessary to maximize contribution of objective to recovery of species. Lack of additional specificity does not imply lesser importance for species recovery. Objectives making a major contribution to species recovery (e.g., riverine geomorphic processes) simply may not require additional design criteria to be effective.

Attachment D-2.

Delta Plan Performance Measures Relevant to Ecosystem Restoration and Development of Multi-benefit that Incorporate Ecosystem Restoration

Outcome Performance Measures

- Progress toward the documented occurrence in and use of protected and restored habitats and migratory corridors by native resident and migratory Delta fish and bird species. Trends in the number of native species in protected and restored habitats and corridors will be derived from monitoring surveys that are conducted as part of adaptive management strategies for the protection and restoration of these areas. (Strategy 4.2)
 - Specific targets are:
 - Increasing the relative abundance of native fish in and near restoration project sites, and
 - Increasing the native birds, including waterfowl, in the Delta.
- Progress toward; 1) increased habitat, connectivity, and functionality; and 2) more favorable spatial distribution of habitat types. (Strategy 4.2)
 - Specific targets are:
 - Increasing extent of flooding by different inundation types and tidal inundation,
 - Increasing proportion of marsh to open water ratio,
 - Marsh patch size, distribution, and fragmentation
 - Increasing extent and proportion of marsh to open water habitat
 - Increasing proportion and extent of marsh-open water edge that occurs along large marsh patches (>100 ha) and decreasing proportion of marsh-open water edge that occurs along small marsh patches.
 - Increasing proportion of marsh habitat in large size classes and decreasing the proportion of marsh habitat in small size classes
 - Increasing the proportion of marsh habitat that occurs in core habitat (at least 50 m outside edge of marsh)
 - Increased extent of different types of inundation for types wintering waterfowl.
 - Increasing proportion and extent of riparian habitat that occur in larger patches.
 - Decreasing proportion of riparian habitat that occurs in smaller patches.
 - Increasing proportion and extent of riparian habitat length that occurs in wider width size classes. Decreasing proportion of riparian habitat length that occurs in narrow width size classes.
 - Increasing length of marsh-terrestrial transition zone
- Prevention and reduction of key nonnative terrestrial and aquatic invasive species in the Delta and Suisun Marsh. (Strategy 4.4)
 - Acreage targets for treatment of invasive plants as defined by individual plans and projects: ○ 680 acres within lower Sacramento
 - A 50 percent reduction in peak nonnative invasive plant species coverage (acres), including, but not limited to: *Eichhornia crassipes*, *Ludwigia spp.*, *Egeria densa*, *Arundo donax*, *Rubus armeniacus*, *Lepidium latifolium*, and *Phragmites australis*
- Increase acres with subsidence reversal or carbon sequestration practices. (Strategy 5.2)
 - Metrics assess the acres of subsidence reversal and carbon sequestration projects annually.

Output Performance Measures

- Progress toward higher acreage of the following types: floodplain, tidal and subtidal, emergent wetland, shaded riverine aquatic and upland and riparian forest habitats. Tidal wetland and floodplain restoration projects should occur in the priority habitat restoration areas described in ER R2. (Strategy 4.2)
 - 8,000 acres of tidal wetlands and 17,000-20,000 acres of floodplain habitat projects constructed in the Priority Restoration Habitat Areas as described in the 2008 and 2009 Biological Opinions for the state and federal water projects.

Administrative Performance Measures

Strategy 4.2: Restore Habitat

- 100% of proposed actions that include habitat restoration in the Delta meet one of the following standards: 1) are consistent with the text of Appendix H, based on the Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011); or 2) are not consistent with the elevation map (Figure 4-6), but the deviation is supported by a rationale based on best available science
- 100% of all proposed actions other than habitat restoration have clearly demonstrated that significant adverse impacts to the opportunity for habitat restoration as described in ER P2 were avoided or mitigated.
- 100% of proposed actions to construct new levees or substantially rehabilitate or reconstruct existing levees in the opportunity areas defined in Appendix 8, demonstrate that they have evaluated alternatives (including use of setback levees), and where feasible, have incorporated such alternatives into levee projects to increase the extent of floodplain and riparian habitat.
- 100% of proponents of habitat restoration projects consult the California Department of Public Health's Best Management Practices for Mosquito Control in California.

Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts

- 100% of all proposed actions that have the reasonable probability of introducing, or improving the habitat conditions for, nonnative invasive species have demonstrated that the potential for new E-16 introductions of and/or improved habitat conditions for nonnative invasive species have been fully considered and avoided or mitigated in a way that appropriately protects the ecosystem

Strategy 5.2: Plan to Protect the Delta's Lands and Communities

- Water management facilities, ecosystem restoration, and flood management infrastructure are sited to avoid or reduce conflicts with existing or planned uses when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration consider sites on existing public lands, when feasible and consistent with a project's purpose, before privately owned sites are purchased.
- Agencies acquiring land for water management facilities, ecosystem restoration, and flood management infrastructure purchase from willing sellers, when feasible, including consideration of whether lands suitable for proposed projects are available at fair prices.

Strategy 5.3 Maintain Delta Agriculture

- The Department of Fish and Wildlife, the Delta Conservancy, and ecosystem restoration agencies take steps to encourage habitat enhancement and wildlife friendly farming systems on agricultural lands to benefit both the environment and agriculture.

Strategy 7.6: Integrate Delta Levees and Ecosystem Function

- DWR develops criteria to define locations for future setback levees in the Delta and Delta watershed.

Attachment D-3: Restoration Opportunities

- **Figure D-2** Ecosystem Restoration Opportunities
- **Attachment D-3a.** Restoration Opportunities Summary Table
- **Attachment D-3b.** Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Existing and New Restoration Opportunities Contribution to CVFPP and Delta Plan Metrics
- **Attachment D-3c.** Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Integrated Multi-benefit Opportunities Contribution to CVFPP and Delta Plan Metrics for Multi-benefit Opportunities
- **Figure D-3** Hood Restoration Opportunities
- **Figure D-4** Courtland Restoration Opportunities
- **Figure D-5** West Walnut Grove/Ryde Restoration Opportunities
- **Figure D-6** Locke Restoration Opportunities
- **Figure D-7** East Walnut Grove Restoration Opportunities
- **Figure D-8** Isleton Restoration Opportunities

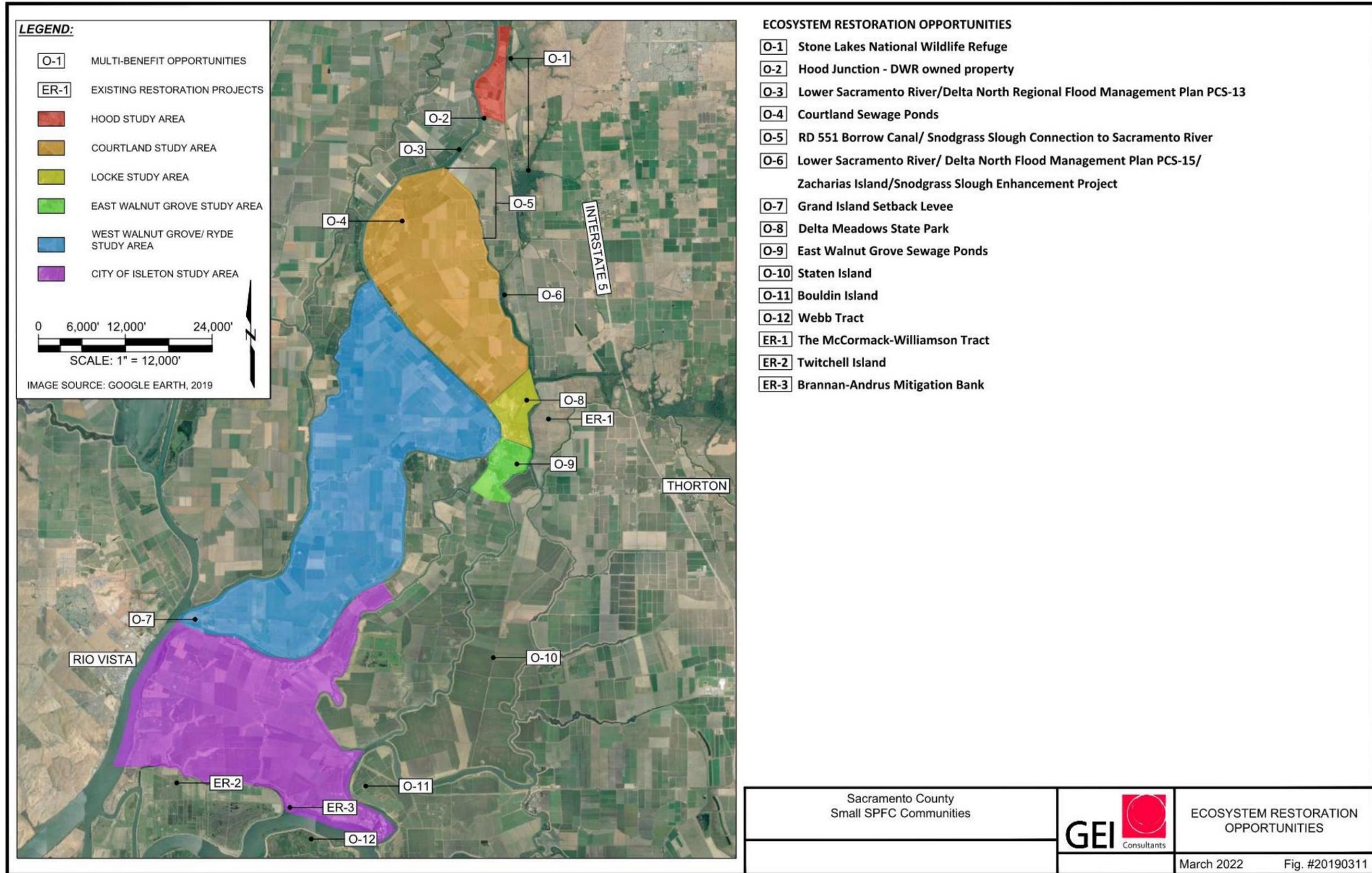


Figure D-2. Ecosystem Restoration Opportunities

D-3a. Restoration Opportunities																
O-x		Existing Preserved Lands and/or Restoration Opportunities Identified by Others														
O-x		Other Potential Restoration Opportunities														
ER-x		Existing Restoration Projects														
Name of Feature, Property, or Project	Location on Exhibit D-2	Ownership (public or private)	Project Proponent (if applicable)	Area (acres)	Levee Miles	Adjacent Communities					Current Land Use	Restoration Opportunity and Habitat Type	Other Benefit Opportunities	Project Status (0= opportunity; 1=concept, 2=design, 3=permitting, 4= in construction, 5=complete)	Notes/Considerations	
						Hood	Courtland	W. Walnut Grove /Ryde	Locke	E. Walnut Grove						Isleton
Stone Lakes NWR	O-1	Public	USFWS and Private	Total: 17,640; 6,550 USFWS owned; 428 acre potential borrow site	N/A		●	●				Preserve; National Wildlife Refuge	Expand and enhance existing freshwater marsh, riparian scrub, and riparian woodland. Potential to use County-owned parcel as a borrow site. Post-construction habitat, establish managed marsh, or other habitat types depending on location.	Recreation (ecotourism) and Wildlife-friendly Agriculture	1	Northernmost extension of Central Delta Corridor COR; Provides continuous habitat linkage to Cosumnes River Preserve
Hood Junction – DWR owned Property	O-2	Public	DWR	160	0.5	●	●				Agriculture	Managed freshwater marsh, riparian, or potentially tidal marsh.	Recreation	0		
Lower Sacramento River /Delta North Regional Flood Management Plan (RFMP) PCS-13	O-3	Various public and private owners	DWR, Yolo County, Sacramento County, SAFCA, WSAFCA	Up to 100-200 acres	11 miles	●	●					RM 35 to 46; Enhancements to left and right bank of the Sacramento River; Expand and create shaded riverine aquatic habitat (riparian scrub and riparian woodland) along the waterside of the river	Recreation	1	Additional evaluation would be needed to assess feasibility based on ownership.	
Courtland Sewage Ponds	O-4	Public	Community of Courtland	15	0		●				Ruderal (defunct sewage treatment ponds)	Seasonal wetland, managed freshwater marsh, and riparian.	Recreation	0	Contamination; confirm use of surrounding lands.	
RD 551 Borrow Canal/Snodgrass Slough Connection to Sacramento River	O-5	Private		35	0	●	●				Agriculture	Potentially connect to Snodgrass Slough and expand to establish backwater connected habitat		0		
Lower Sacramento River /Delta North RFMP PCS-15 Zacharias Island/ Snodgrass Slough Enhancements	O-6	Private/ Public	DWR	3,500	N/A		●				Agriculture	Would include a breach of the western levee to connect lands to Snodgrass slough SRA, riparian forest, and frequently inundated floodplain habitat. Additionally, could create off-channel habitat as rearing habitat for salmonids.	Wildlife-friendly Agriculture	1		

D-3a. Restoration Opportunities																
O-x		Existing Preserved Lands and/or Restoration Opportunities Identified by Others														
O-x		Other Potential Restoration Opportunities														
ER-x		Existing Restoration Projects														
Name of Feature, Property, or Project	Location on Exhibit D-2	Ownership (public or private)	Project Proponent (if applicable)	Area (acres)	Levee Miles	Adjacent Communities					Current Land Use	Restoration Opportunity and Habitat Type	Other Benefit Opportunities	Project Status (0= opportunity; 1=concept, 2=design, 3=permitting, 4= in construction, 5=complete)	Notes/Considerations	
						Hood	Courtland	W. Walnut Grove /Ryde	Locke	E. Walnut Grove						Isleton
<i>Grand Island Setback Levee</i>	O-7	Unknown	n/a	250					●	●		Ruderal	A setback levee could re-connect the river to potentially create subtidal, shallow subtidal, tidal marsh, riparian scrub, and riparian woodland habitats.	Recreation	1	
<i>Delta Meadows State Park</i>	O-8	Public	California State Parks	472	N/A				●			Preserved natural habitat including Snodgrass Slough and The Meadows Slough (both are tidal),	Enhance existing riparian, seasonal wetland (wet meadows) provide connectivity to McCormack-Williamson Tract and Consumes River Preserve;	Recreation	0	Boundaries encompass some of the last remaining remnant habitat exhibiting pre-European settlement conditions. Provides habitat for Delta mudwort and Delta smelt.
<i>East Walnut Grove Sewage Ponds</i>	O-9	Public	Community of East Walnut Grove	20	0					●		Ruderal (defunct sewage treatment ponds)	Seasonal wetland, managed freshwater marsh, and riparian.	Recreation	0	Contamination; confirm use of surrounding lands.
<i>Staten Island</i>	O-10	Public						●	●	●		Agriculture, wildlife habitat		Flood Easements and Flood Risk Reduction	1	
<i>Bouldin Island</i>	O-11	Public	Metropolitan Water District of Southern California (MWD)	5,300	17.9						●	Agriculture	Tidal marsh restoration; channel margin enhancement	Wildlife-friendly Agriculture	1	
<i>Webb Tract</i>	O-12	Public	MWD	4,300						●		Agriculture	Wetland restoration	Wildlife-friendly Agriculture	1	

D-3a. Restoration Opportunities																
O-x	Existing Preserved Lands and/or Restoration Opportunities Identified by Others															
O-x	Other Potential Restoration Opportunities															
ER-x	Existing Restoration Projects															
Name of Feature, Property, or Project	Location on Exhibit D-2	Ownership (public or private)	Project Proponent (if applicable)	Area (acres)	Levee Miles	Adjacent Communities					Current Land Use	Restoration Opportunity and Habitat Type	Other Benefit Opportunities	Project Status (0= opportunity; 1=concept, 2=design, 3=permitting, 4= in construction, 5=complete)	Notes/Considerations	
						Hood	Courtland	W. Walnut Grove /Ryde	Locke	E. Walnut Grove						Isleton
McCormack-Williamson Tract	ER-1	Private	The Nature Conservancy and DWR	1,489	9							Agriculture	Create tidal emergent marsh, seasonal wetland, riparian scrub, riparian forest, and frequently inundated floodplain restoration; Levee adjustment to improve local flood capacity. Seasonal connection to lakes, channels and marshes to Delta Meadows, Grizzly Slough, Stone Lakes, Staten Island, and the Cosumnes River Preserve.	Recreation Enhancement; Flood Risk Reduction;	4	
Twitchell Island	ER-2	Public	DWR	2,050	12							Agriculture: previously flood irrigated ag (corn and alfalfa)	Wetland restoration, carbon storage, and subsidence reversal.	Water Quality – reduce salt water intrusion.	West end = 5 (complete) East end = 3	
Brannan-Andrus	ER-3	BALMD	BALMD									Planned for mitigation bank	Seasonal wetland, emergent marsh, riparian scrub, riparian woodland	Wildlife-friendly Agriculture	2	

Abbreviations: DWR (California Department of Water Resources); MWD (Metropolitan Water District of Southern California); NWR (National Wildlife Refuge); USFWS (United States Fish and Wildlife Service).

Attachment D-3b. Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Existing and New Restoration Opportunities
Contribution to CVFPP and Delta Plan Metrics

Figure D-2 Number	Site Name	Hood	Courtland	W. Walnut Grove/Ryde	Locke	E. Walnut Grove	Isleton	Ecosystem Benefits				Contribution to Delta Plan Output and Outcome Performance Measures								
								Inundated Floodplain	Habitats and Approximate Acreages	Shaded Riverine Aquatic Habitat	Threatened & Endangered Species ¹	Reduce Invasive Species ²				Strategy 4.2. Restore Habitat			Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts	Strategy 5.2: Plan to Protect the Delta's Lands and Communities
												Arrudo donax	Tamarisk sp.	Sesbania punicea	Rubus discolor	Increase special-status species fish and wildlife abundance	Increased habitat, connectivity, functionality and more favorable spatial distribution of habitat types.	Increase in floodplain, tidal and subtidal, emergent wetland, shaded riverine aquatic and upland or riparian forest habitats.	Prevention and reduction of key nonnative terrestrial and aquatic invasive species.	Increase acres with subsidence reversal or carbon sequestration practices.
O-1	Stone Lakes	•	•					TBD - one consideration would be improvements across from a Relief Cut at the north end of Hood.	Native perennial grassland - up to approximately 100-140 acres Seasonal Wetland - up to approximately 40-60 acres Freshwater Marsh - up to approximately 60-80 acres Riparian Scrub - up to 20 to 40 acres Riparian Woodland - up to 10-20 acres	N/A		•	•	•	Yes, moderate to high additional wildlife species that would benefit include western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), raptors, tricolored blackbird, other songbird species	Yes, high	Yes, moderate to high	Yes	Yes	
O-2	Hood Junction - DWR owned property	•	•					No	Freshwater Marsh - approximately 60-100 acres Riparian Scrub - approximately 30 acres Riparian Woodland - approximately 30 acres	N/A		•	•	•	Yes, moderate; additional wildlife species that would benefit include western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), tricolored blackbird, other songbird species	Moderate; potential for connection to Stone Lakes and improved patch size of riparian habitat.	Yes, moderate.	Yes	No	
O-3	Lower Sacramento River /Delta North Regional Flood Management Plan (RFMP) Potential Conservation Site (PCS)-13	•	•					No	Riparian - establish valuable waterside riparian scrub and woodland to provide Swainson's hawk nesting habitat; potential for benefit to Yellow-billed cuckoo, and/or Least-bells vireo depending on corridor width, species planted and proximity to Sacramento River.	Yes; up to approximately 17 miles of bank depending upon removal of hardened bank.				•	Yes; moderate to high depending on extent of restoration effort. Additional fish species that would benefit are Sacramento splittail and Delta smelt. Additional wildlife species that would benefit include western pond turtle, and other songbird species.	Yes, high; provides important connectivity and SRA along the Sacramento River and represents an important opportunity.	Yes; important SRA habitat improvements.	Yes	No	
O-4	Courtland Sewage Ponds					•		No	Freshwater marsh - up to 15 acres of managed marsh could be created for giant garter snake; Wildlife-friendly Agriculture - consider potential to return these ponds to agriculture and leverage conversion of other agriculture to habitat where habitat value and potential for connectivity is higher.	N/A	 TBD				Low to moderate	Low to moderate; would provide patch of habitat in center of agricultural lands where it is generally absent.	Moderate	Yes; low.	Yes	
O-5	RD 551 Borrow Canal/Snodgrass Slough Connection to Sacramento River	•	•					Yes; up to 35 acres	Tidal Marsh - approximately 20 acres Riparian Scrub - approximately 15 acres Riparian Woodland - approximately 15 acres	Yes, up to approximately 3 miles along Snodgrass Slough depending upon need for bank protection					Yes, high; additional fish species that would benefit are Sacramento splittail and Delta smelt. Additional wildlife species that would benefit include western pond turtle, and other songbird species	Moderate to high depending on implementation of other efforts including Stone Lakes and Zacharius Slough.	Yes, low moderate.	Yes	No	
O-6	Lower Sacramento River /Delta North (RFMP) PCS-15 Zacharias Island/ Snodgrass Slough Enhancements		•					Yes, up to 600 acres	Shallow Subtidal - Open Water or Potential for Tidal Marsh - 100 acres Tidal Marsh - approximately 100 acres Riparian Scrub - approximately 60 acres Riparian Woodland - approximately 40 acres Floodplain Agriculture - approximately up to 300 acres	Yes, but minimal; edges are already vegetated.		•	•	Yes, high; additional fish species that would benefit are Sacramento splittail and Delta smelt. Additional wildlife species that would benefit include western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), tricolored blackbird, other songbird species	Yes, high; would provide important connectivity between Stone Lakes and Delta Meadows State Park	Yes; high. Important opportunity for all habitat types.	Yes	Yes		

Attachment D-3b. Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Existing and New Restoration Opportunities
Contribution to CVFPP and Delta Plan Metrics

Figure D-2 Number	Site Name	Hood	Courtland	W. Walnut Grove/Ryde	Locke	E. Walnut Grove	Isleton	Inundated Floodplain	Ecosystem Benefits				Contribution to Delta Plan Output and Outcome Performance Measures							
									Habitats and Approximate Acreages	Shaded Riverine Aquatic Habitat	Threatened & Endangered Species ¹	Reduce Invasive Species ²				Strategy 4.2. Restore Habitat			Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts	Strategy 5.2: Plan to Protect the Delta's Lands and Communities
												Arrudo donax	Tamarisk sp.	Sesbania punicea	Rubus discolor	Increase special-status species fish and wildlife abundance	Increased habitat, connectivity, functionality and more favorable spatial distribution of habitat types.	Increase in floodplain, tidal and subtidal, emergent wetland, shaded riverine aquatic and upland or riparian forest habitats.		
O-7	Grand Island Setback Levee			●	●			Subtidal Open Water - 25 acres	N/A		●	●								
								Shallow Subtidal - Open Water or Potential for Tidal Marsh - 35 acres												
								Tidal Marsh - 60 acres												
								Riparian Scrub - 20 acres												
								Riparian Woodland - 10 acres												
O-8	Delta Meadows State Park				●		Yes, up to 100+ acres	Shallow Subtidal - Open Water or Potential for Tidal Marsh - 40 acres	Yes, but minimal. Edges are already vegetated.		●	●								
								Tidal Marsh - 60 acres												
								Riparian Scrub - 10 acres												
O-9	East Walnut Grove Sewage Ponds						No	Freshwater marsh - managed marsh could be created for giant garter snake;	N/A											
								Wildlife-friendly Agriculture - consider potential to return these ponds to agriculture and leverage conversion of other agriculture to habitat where habitat value and potential for connectivity is higher.												TBD
O-10	Staten Island			●	●	●	Yes	Tidal Marsh - approximately 5 acres	Yes; up to approximately 22 miles of bank depending upon removal of hardened bank.		●									
								Riparian Scrub - approximately 10-15 acres												
								Riparian Woodland - approximately 5 acres												
								Floodplain Agriculture - approximately 1,500-2,300 acres of infrequent flooding (10-year return interval) would inundate; benefits for fish species would be dependant on timing, duration and frequency of flooding.												
								Native perennial grassland - 15-20 acres												
O-11	Bouldin Island					●	Yes; up to 530 acres	Tidal marsh - Approximately 530 acres - associated with the construction of a permanent tunnel facility in the center of the island, reusable tunnel material would be used to raise elevations on the waterside of a setback levee to support tidal marsh.	N/A		●									
								Riparian - Approximately 240 acres - expand existing riparian habitat species benefit would depend on corridor width, species planted and proximity San Joaquin or Mokelumne Rivers.												

Attachment D-3b. Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Existing and New Restoration Opportunities
Contribution to CVFPP and Delta Plan Metrics

Figure D-2 Number	Site Name	Hood	Courtland	W. Walnut Grove/Ryde	Locke	E. Walnut Grove	Isleton	Inundated Floodplain	Ecosystem Benefits				Contribution to Delta Plan Output and Outcome Performance Measures							
									Habitats and Approximate Acreages	Shaded Riverine Aquatic Habitat	Threatened & Endangered Species ¹	Reduce Invasive Species ²				Strategy 4.2. Restore Habitat			Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts	Strategy 5.2: Plan to Protect the Delta's Lands and Communities
												Arruda donax	Tamarisk sp.	Sesbania punicea	Rubus discolor	Increase special-status species fish and wildlife abundance	Increased habitat, connectivity, functionality and more favorable spatial distribution of habitat types.	Increase in floodplain, tidal and subtidal, emergent wetland, shaded riverine aquatic and upland or riparian forest habitats.		
O-12	Webb Tract						●	No	Native perennial grassland - Approximately 550 acres.	N/A		●	●	Yes, high; additional wildlife species that would benefit include western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), and other songbird species.	Yes, high; completing the entire restoration project would provide connectivity to Bouldin and Twitchell islands.	Yes, high.	Yes	Yes		
									Seasonal wetland - Approximately 1,000 acres in lower elevation areas unsuitable for farming, a mosaic of seasonal wetland and freshwater marsh habitat could be created.											
									Freshwater marsh - Approximately 2,300 acres in lower elevation areas unsuitable for farming, a mosaic of seasonal wetland and freshwater marsh habitat could be created.											
									Riparian - Approximately 1,300 acres and 8 miles of channel margin SRA habitat. Species benefit would depend on corridor width, species planted and proximity San Joaquin or Mokelumne Rivers. Shaded riverine habitat along channel margins of the sloughs and rivers would provide benefit for special-status fish species.											
ER-1	McCormack-Williamson Tract			●	●		Yes; up to 1,300 acres	Subtidal Open Water	N/A		●	●	Yes, high; additional fish species that would benefit are Sacramento splittail and Delta smelt. Additional wildlife species that would benefit include western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), tricolored blackbird, other songbird species.	Yes, high; would provide important connectivity between Stone Lakes, Cosumnes River Preserve, and Delta Meadows State Park	Yes, high.	Yes	Yes			
								Shallow Subtidal - Open Water or Potential for Tidal Marsh - 650 acres												
								Tidal Marsh - 650 acres												
								Riparian Scrub - 70 acres												
								Riparian Woodland - 100 acres												
ER-2	Twitchell Island - 23,000 linear feet along San Joaquin River					●	Yes; up to 100 acres	Native perennial grassland - 15 acres	Yes; up to approximately 5 miles of bank depending upon removal of hardened bank.		●	●	Moderate to High - Additional fish species that would benefit are Sacramento splittail and Delta smelt. Additional wildlife species that would benefit include western pond turtle, and other songbird species.	Yes, moderate; provides important SRA along the San Joaquin River and represents an important opportunity.	Yes, high.	Yes	No			
								Tidal Marsh - approximately 10 acres												
								Riparian Scrub - approximately 30 acres												
								Riparian Woodland - approximately 10 acres												
ER-3	Brannan Andrus					●	No	Freshwater Marsh - approximately 30 acres	N/A		●	●	Yes, moderate; additional wildlife species that would benefit include western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), tricolored blackbird, other songbird species	Yes, low to moderate; small parcel, but provides some additional habitat connection between Twitchell, Bouldin, and Webb islands.	Yes, moderate.	Yes	Yes			
								Riparian Scrub - approximately 10 acres												
								Riparian Woodland - approximately 10 acres												

Notes:

¹ Threatened and endangered species that may benefit from incorporation of habitat into project footprints are identified using the following symbology:

- | | |
|---|--|
| Valley elderberry long-horn beetle | California black rail (<i>Laterallus jamaicensis coturniculus</i>) |
| Salmonids (California Central Valley Steelhead DPS (<i>Oncorhynchus mykiss</i>), Chinook salmon Central Valley fall-/late fall-run ESU, Central Valley spring-run ESU, and Sacramento River winter-run ESU (<i>Oncorhynchus tshawytscha</i>). | Greater Sandhill Crane (<i>Grus canadensis tabida</i>) |
| Green sturgeon - southern DPS (<i>Acipenser medirostris</i>) | Swainson's hawk (<i>Buteo swainsoni</i>) |
| Giant garter snake (<i>Thamnophis gigas</i>) | Western yellow-billed cuckoo |
| | Least bell's vireo (<i>Vireo bellii pusillus</i>) |

² Due to the potential for spread of invasive species, acreages have not been provided because occurrence data is up to 5-7 years old. however, the Cal-IPC weed mapper (<https://weedmap.cal-ipc.org/weedmapper/>) was consulted to review potential footprints and occurrences of the four priority species identified in Appendix E of the CVFPP Conservation Strategy (DWR 2016a).

**Attachment D-3c. Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Integrated Multi-benefit Opportunities
Contribution to CVFPP and Delta Plan Metrics for Multi-benefit Opportunities**

	Hood	Courtland	W. Walnut Grove/Ryde	Locke	E. Walnut Grove	Isleton	Inundated Floodplain	Ecosystem Benefits				Contribution to Delta Plan Output and Outcome Performance Measures				
								Habitats	Shaded Riverine Aquatic Habitat	Threatened & Endangered Species ¹	Reduce Invasive Species ²	Strategy 4.2. Restore Habitat			Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts	Strategy 5.2: Plan to Protect the Delta's Lands and Communities
												Increase special-status species fish and wildlife abundance	Increased habitat, connectivity, functionality and more favorable spatial distribution of habitat types.	Increase in floodplain, tidal and subtidal, emergent wetland, shaded riverine aquatic and upland or riparian forest habitats.		
Ring Levee		●	●			●	No	<p><i>Freshwater marsh</i> - post-construction elevations within parcels that are used to provide borrow materials to construct new levees may be too low to continue active agriculture; in that event managed marsh could be created for giant garter snake.</p> <p><i>Riparian</i> - establish wind-wave riparian woodland corridor on waterside, or interior corridor on landside of levee to provide Swainson's hawk nesting habitat; potential for benefit to Yellow-billed cuckoo, and/or Least-bells vireo depending on corridor width, species planted and proximity to Sacramento River.</p> <p><i>Native perennial grassland</i> - establish native perennial grassland on newly constructed levee slopes, seepage berms and/or maintenance corridors to provide Swainson's hawk foraging habitat.</p>	N/A	    	Yes	Yes, moderate; additional wildlife species that would benefit include, multiple waterbird guilds (waders, dabblers, and divers), and other songbird and raptor species	Yes, low to moderate depending on locations of borrow and amount of riparian habitat created.	Low; potential for riparian or upland woodland habitat only.	Yes	Yes, if freshwater marsh is created.
Cross Levee	●	●	●	●	●	●	No	<p><i>Freshwater marsh</i> - post-construction elevations within parcels that are used to provide borrow materials to construct new levees may be too low to continue active agriculture; in that event managed marsh could be created for giant garter snake.</p> <p><i>Riparian</i> - establish wind-wave riparian woodland corridor on waterside levee to provide Swainson's hawk nesting habitat; potential for benefit to Yellow-billed cuckoo, and/or Least-bells vireo depending on corridor width, species planted and proximity to Sacramento River.</p> <p><i>Native perennial grassland</i> - establish native perennial grassland on newly constructed levee slopes, seepage berms and/or maintenance corridors to provide Swainson's hawk foraging habitat.</p>	N/A	    	Yes	Yes, moderate; additional wildlife species that would benefit include, multiple waterbird guilds (waders, dabblers, and divers), and other songbird and raptor species	Yes, low to moderate depending on locations of borrow and amount of riparian habitat created.	Low; potential for riparian or upland woodland habitat only.	Yes	Yes, if freshwater marsh is created.
Landside Slope Stability Remediation or Berm	●	●	●	●	●	●	No	<p><i>Riparian</i> - establish wind-wave riparian woodland corridor on waterside, or interior corridor on landside of levee to provide Swainson's hawk nesting habitat; potential for benefit to Yellow-billed cuckoo, and/or Least-bells vireo depending on corridor width, species planted and proximity to Sacramento River.</p> <p><i>Native perennial grassland</i> - establish native perennial grassland on repaired levee slopes, stability berm and/or maintenance corridors to provide Swainson's hawk foraging habitat.</p>	N/A	   	Yes	Yes, low to moderate; additional wildlife species that would benefit include other songbird and raptor species	Yes, low to moderate depending on locations and extent of riparian habitat created.	Low; potential for riparian or upland woodland habitat only.	Yes	No
Landside Seepage Berm	●	●	●			●	No	<p><i>Riparian</i> - establish wind-wave riparian woodland corridor on waterside, or interior corridor on landside of levee to provide Swainson's hawk nesting habitat; potential for benefit to Yellow-billed cuckoo, and/or Least-bells vireo depending on corridor width, species planted and proximity to Sacramento River.</p> <p><i>Native perennial grassland</i> - establish native perennial grassland on re-constructed levee slopes, landside berms, seepage berms and/or maintenance corridors to provide Swainson's hawk foraging habitat.</p>	N/A	   	Yes	Yes, low to moderate; additional wildlife species that would benefit include other songbird and raptor species	Yes, low to moderate depending on locations and extent of riparian habitat created.	Low; potential for riparian or upland woodland habitat only.	Yes	No

**Attachment D-3c. Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies - Integrated Multi-benefit Opportunities
Contribution to CVFPP and Delta Plan Metrics for Multi-benefit Opportunities**

	Hood	Courtland	W. Walnut Grove/Ryde	Locke	E. Walnut Grove	Isleton	Inundated Floodplain	Ecosystem Benefits				Contribution to Delta Plan Output and Outcome Performance Measures				
								Habitats	Shaded Riverine Aquatic Habitat	Threatened & Endangered Species ¹	Reduce Invasive Species ²	Strategy 4.2. Restore Habitat			Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts	Strategy 5.2: Plan to Protect the Delta's Lands and Communities
Erosion Remediation	●	●					Yes, if waterside improvements.	<p>Freshwater or tidal marsh - consideration will be made to creating a planting berm on the waterside of the levee slope to establish and/or expand emergent marsh vegetation lower on the waterside slope and/or where riparian vegetation is not possible due to hydraulic constraints.</p> <p>Riparian - for waterside and potentially landside improvements, consideration will be made to create a planting berm on the waterside to establish and/or expand waterside riparian vegetation (allowing for a minimum of 20' to the levee crown) to provide shaded riverine aquatic habitat. Consideration must be made to hydraulic constraints, and existing slope on the waterside of the levee to assess feasibility.</p> <p>Native perennial grassland - establish native perennial grassland on repaired levee slopes, seepage berms and/or maintenance corridors to provide Swainson's hawk foraging habitat.</p>	Yes, see description for riparian habitat.	     	Yes	Yes, moderate; additional wildlife species that would benefit include, multiple waterbird guilds (waders, dabblers, and divers), and other songbird and raptor species	Yes, low to moderate depending on locations and extent of tidal marsh and/or riparian habitat created.	Moderate to high depending on locations and extent of tidal marsh and/or riparian habitat created.	Yes	Yes, if freshwater marsh is created.
Correct Geometry Deficiencies	●	●	●	●	●	●	No	<p>Riparian - for waterside and potentially landside improvements, consideration will be made to create a planting berm on the waterside to establish and/or expand waterside riparian vegetation (allowing for a minimum of 20' to the levee crown) to provide shaded riverine aquatic habitat. Consideration must be made to hydraulic constraints, and existing slope on the waterside of the levee to assess feasibility.</p> <p>Native perennial grassland - establish native perennial grassland on re-constructed levee slopes, landside berms, seepage berms and/or maintenance corridors to provide Swainson's hawk foraging habitat.</p>	N/A	  	Yes	Yes, low to moderate; additional wildlife species that would benefit include other songbird and raptor species	Yes, low to moderate depending on locations and extent of riparian habitat created.	Low; potential for riparian or upland woodland habitat only.	Yes	No
Relief Cut	●	●	●	●	●	●	Yes, if waterside improvements.	<p>Freshwater or tidal marsh - consideration will be made to creating a planting berm on the waterside of the levee slope to establish and/or expand emergent marsh vegetation lower on the waterside slope and/or where riparian vegetation is not possible due to hydraulic constraints.</p> <p>Riparian - for waterside and potentially landside improvements, consideration will be made to create a planting berm on the waterside to establish and/or expand waterside riparian vegetation (allowing for a minimum of 20' to the levee crown) to provide shaded riverine aquatic habitat. Consideration must be made to hydraulic constraints, and existing slope on the waterside of the levee to assess feasibility.</p> <p>Native perennial grassland - establish native perennial grassland on re-constructed levee slopes that do not require hardened structures to provide Swainson's hawk foraging habitat.</p>	Yes, see description for riparian habitat.	     	Yes	Moderate to High - Additional fish species that would benefit are Sacramento splittail and Delta smelt. Additional wildlife species that would benefit include western pond turtle, and other songbird and raptor species.	Yes, low to moderate depending on locations and extent of tidal marsh and/or riparian habitat created.	Moderate to high depending on locations and extent of tidal marsh and/or riparian habitat created.	Yes	Yes, if freshwater marsh is created.

Notes: ¹ Threatened and endangered species that may benefit from incorporation of habitat into project footprints are identified using the following symbology:

- | | |
|---|--|
|  Valley elderberry long-horn beetle |  California black rail (<i>Laterallus jamaicensis coturniculus</i>) |
|  Salmonids (California Central Valley Steelhead DPS (<i>Oncorhynchus mykiss</i>), Chinook salmon Central Valley fall-/late fall-run ESU, Central Valley spring-run ESU, and Sacramento River winter-run ESU (<i>Oncorhynchus tshawytscha</i>). |  Greater Sandhill Crane (<i>Grus canadensis tabida</i>) |
|  Green sturgeon - southern DPS (<i>Acipenser medirostris</i>) |  Swainson's hawk (<i>Buteo swainsoni</i>) |
|  Giant garter snake (<i>Thamnophis gigas</i>) |  Western yellow-billed cuckoo |
| |  Least bell's vireo (<i>Vireo bellii pusillus</i>) |

²For all project related activities, invasive species would be removed within the project footprint. Additionally, recommended measures from CVFPP Invasive Species Management Plan.

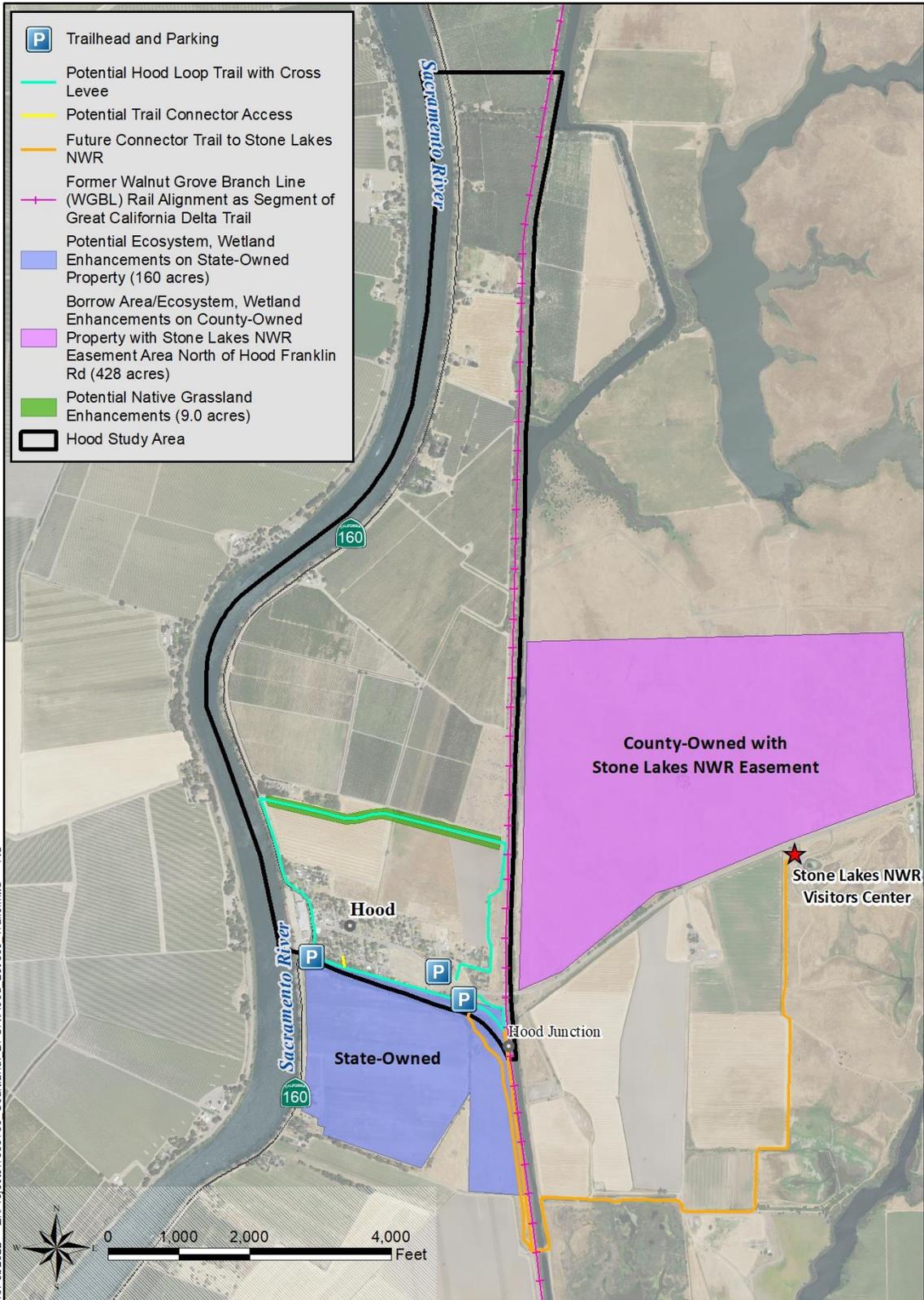


Figure D-3. Hood Restoration Opportunities

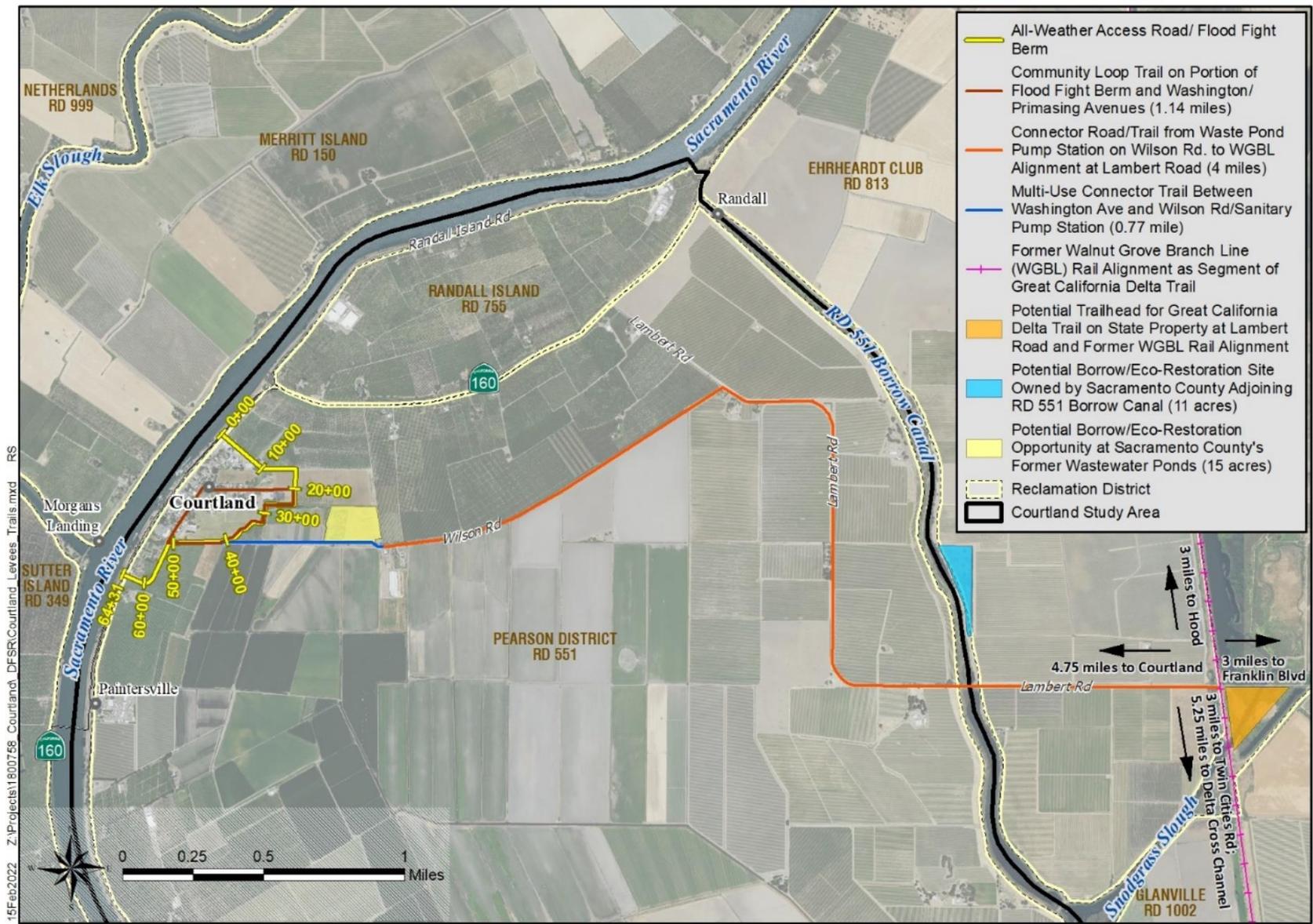


Figure D-4. Courtland Restoration Opportunities

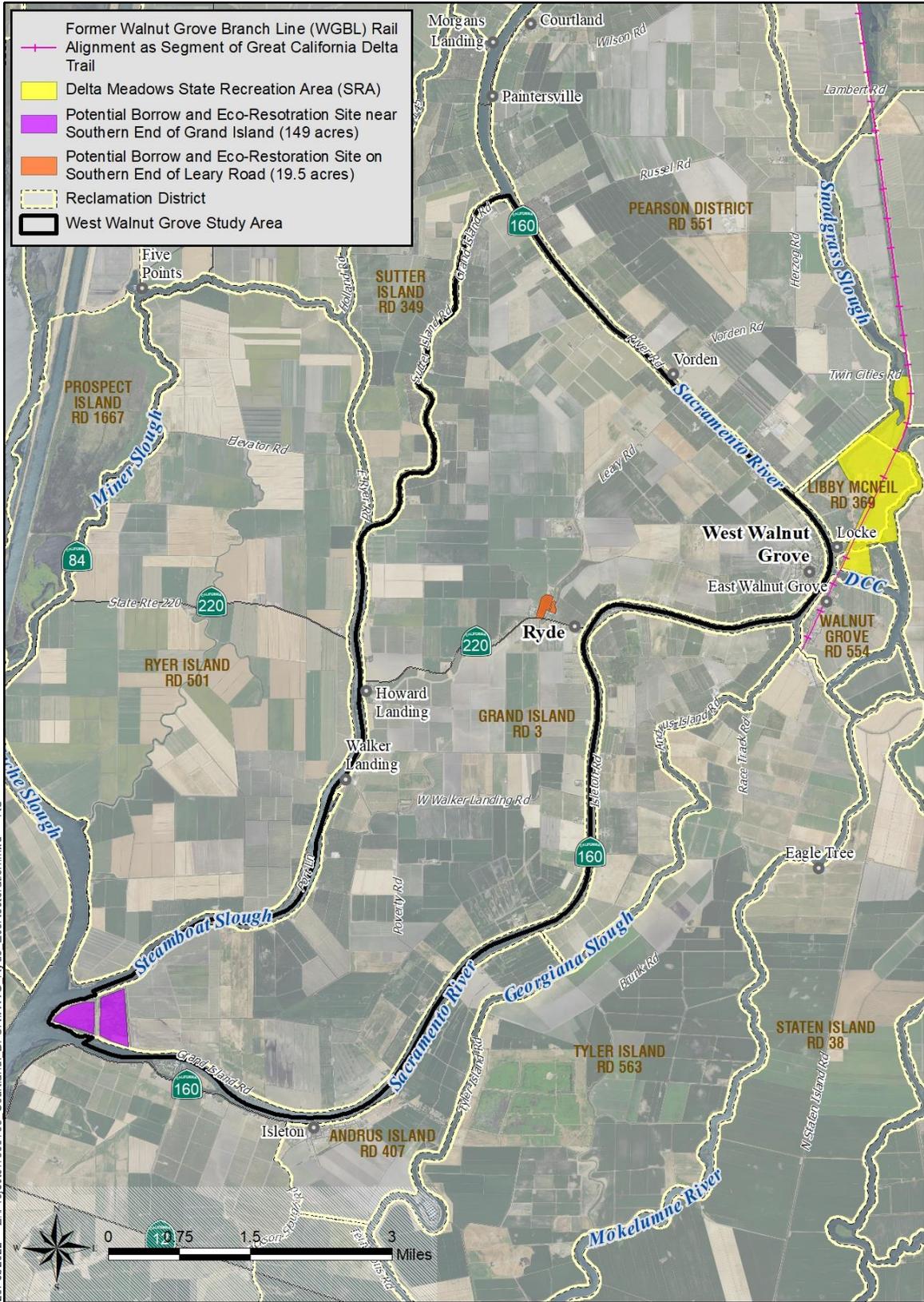
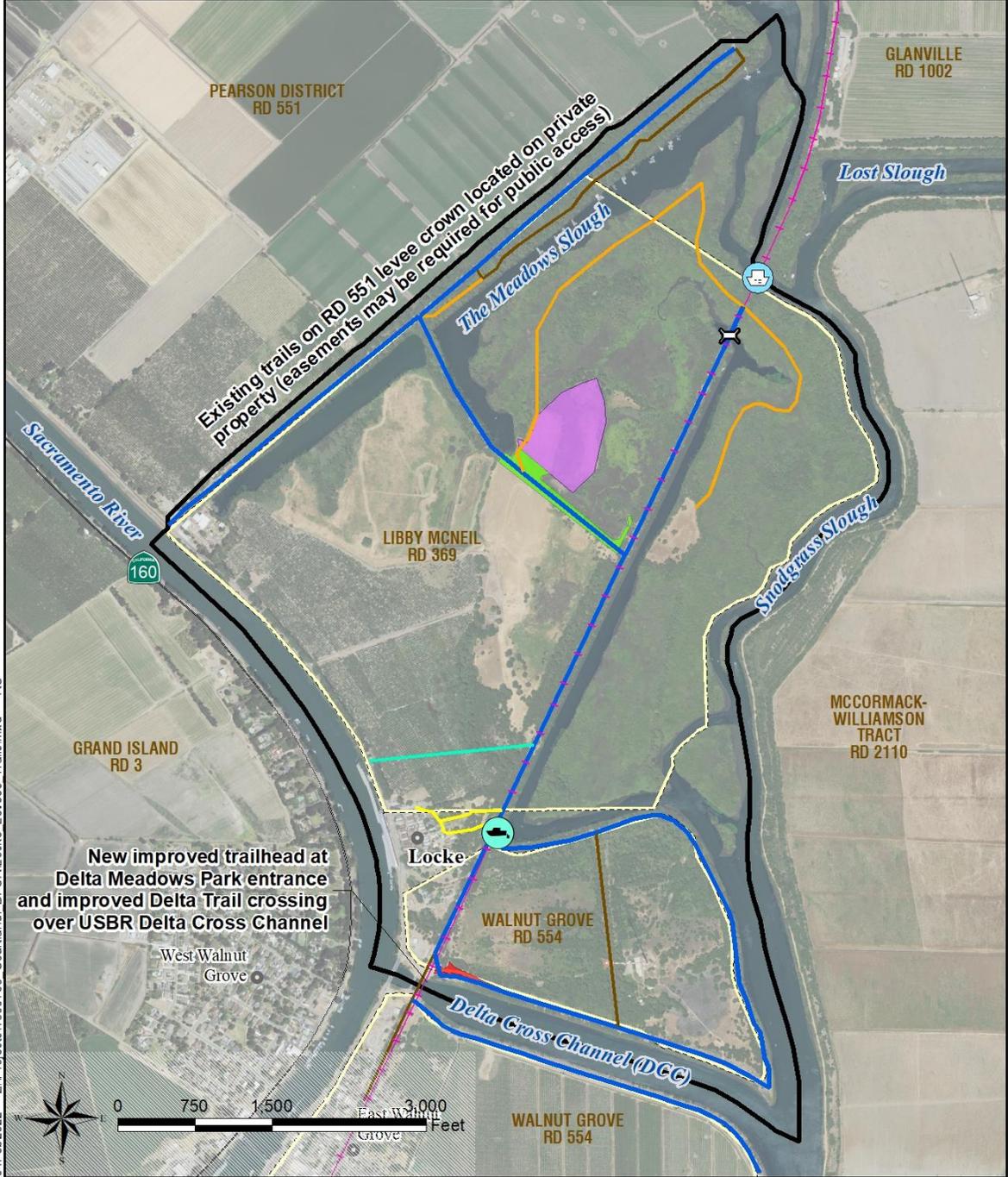
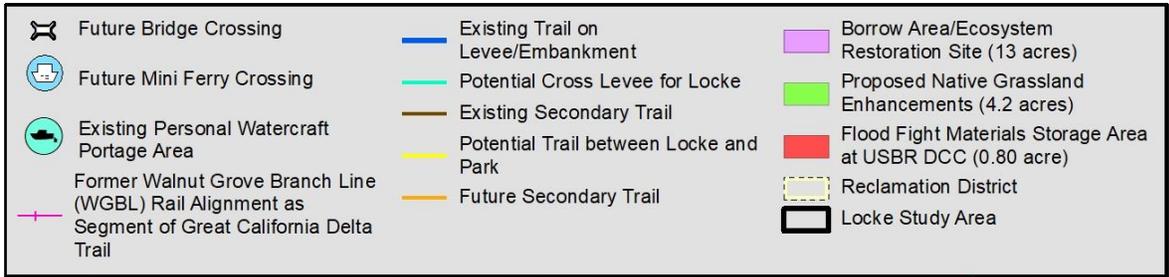


Figure D-5. West Walnut Grove/Ryde Restoration Opportunities



04Feb2022 Z:\Projects\1800756_Courtland.DFSR\Locke_Levees_Trails.mxd RS

Figure D-6 Locke Restoration Opportunities

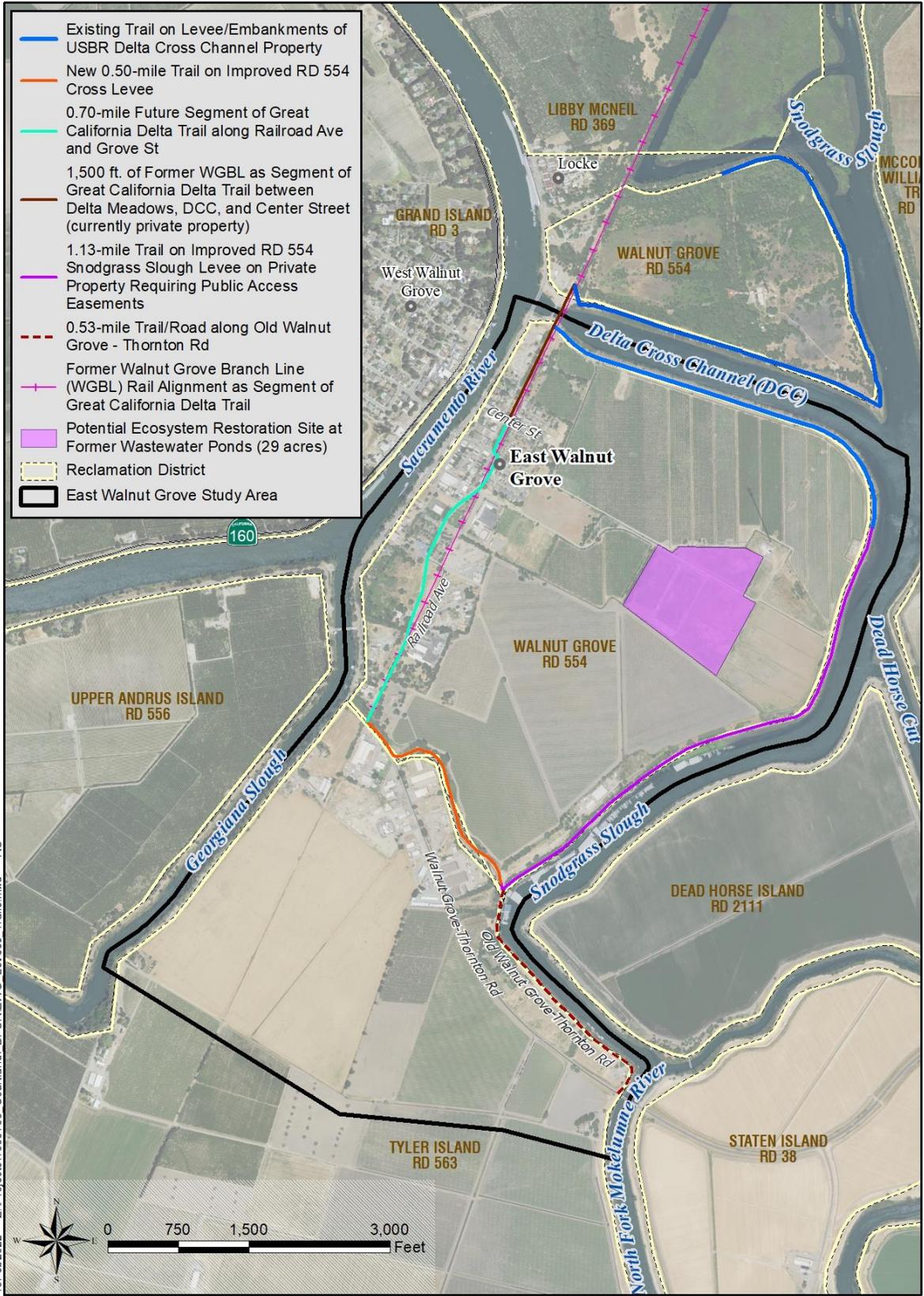


Figure D-6. East Walnut Grove Restoration Opportunities

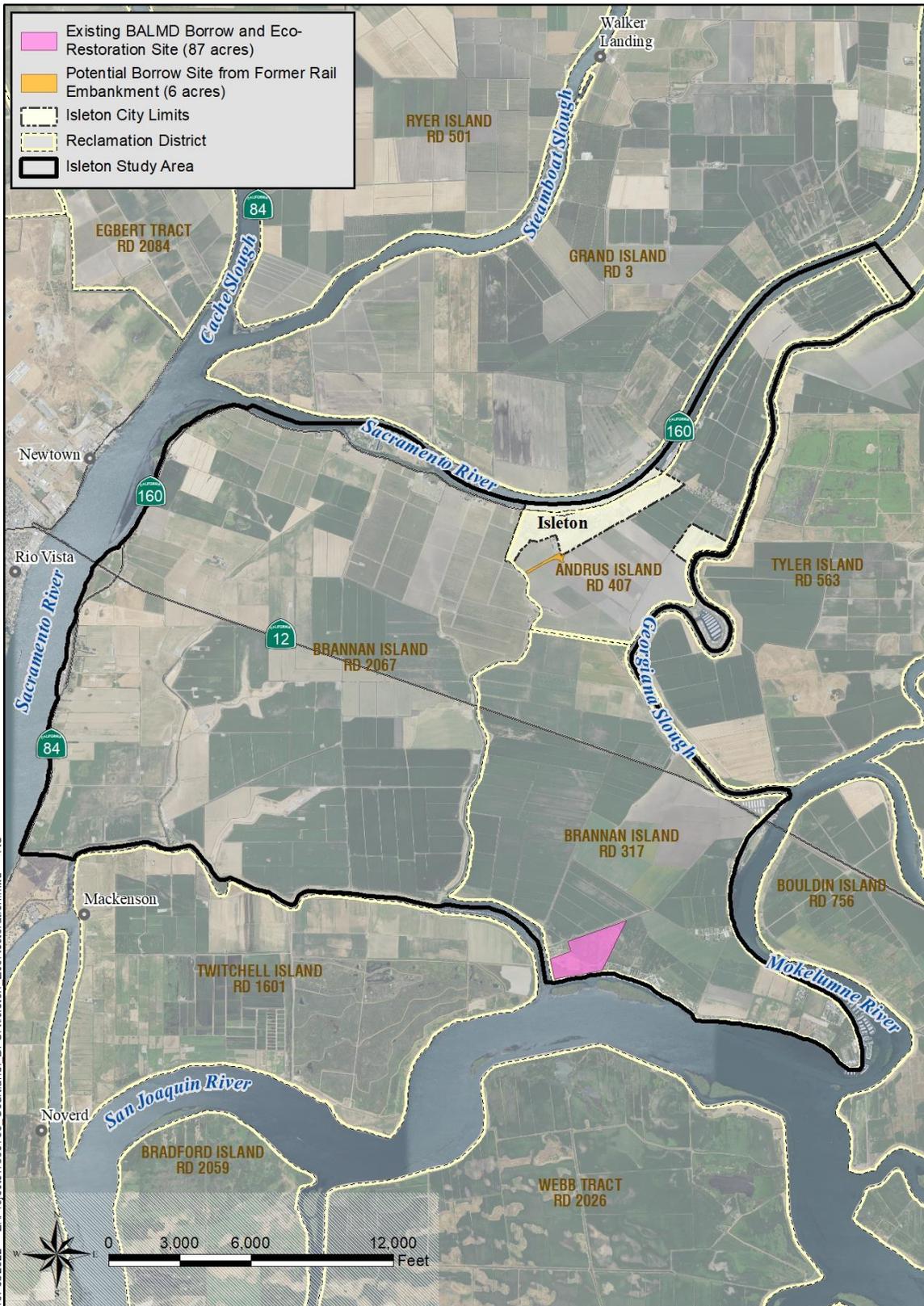


Figure D-7. Isleton Restoration Opportunities

