Floodplain Expansion and Ecosystem Restoration at Dos Rios Ranch

San Joaquin River Mile 82-87
Tuolumne River Mile 0-3.5
Stanislaus County, California

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Prepared for:

California Department of Water Resources
Flood Protection Corridor Program

RIVER PARTNERS

912 11th Street, Suite LL2
Modesto, CA 95354
info@riverpartners.org

Phone: (209) 521-1700
Fax: (209) 521-7327
www.riverpartners.org

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ACKNOWLEGEMENTS
The following individuals have contributed to this restoration plan:

Name	Affiliation
Jeff Holt	River Partners
Julie Rentner	River Partners
Andrew Rayburn, Ph.D.	River Partners
John Carlon	River Partners
Stephen Sheppard	River Partners
Heyo Tjarks	River Partners
Karl Kraft	USDA Natural Resource Conservation Service
Eric Hopson	U.S. Fish and Wildlife Service
Kim Forrest	U.S. Fish and Wildlife Service
Ron Melcer	California Department of Water Resources
Terri Gaines	California Department of Water Resources
David Martasian	California Department of Water Resources
Thomas Gardali, Ph.D.	Point Blue Conservation Science
Chris Hildebrandt	Ducks Unlimited
Patrick Koepele	Tuolumne River Trust
Chris Unkel	American Rivers

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EXECUTIVE SUMMARY

The Riparian Restoration Plan for the Floodplain Expansion and Ecosystem Restoration Project at Dos Rios Ranch describes the activities and procedures River Partners will implement to restore ecological processes and native riparian vegetation on approximately 1000 acres of the 2,100-acre Dos Rios Ranch (Stanislaus County, CA), the total acreage of which includes the former Hidden Valley Dairy. The primary goals of the Project are to restore this acreage to native habitat types for the benefit of terrestrial and aquatic wildlife including threatened and endangered species; reconnect historic floodplains to the San Joaquin and Tuolumne rivers to allow flooding for habitat benefits, transient floodwater storage, and sediment deposition; and, to promote physical river processes of scour and deposition along eight river miles.

The Project location at the confluence of the Tuolumne and San Joaquin rivers is a critically important ecological area in a region of near-total conversion of natural habitats due to agricultural and urban development. The Project site will provide high-quality habitat for federally-endangered riparian brush rabbits (*Sylvilagus bachmani riparius*), and may already host a small population of either wild or captive-bred rabbits based on preliminary monitoring data. The Project will also provide important habitat for other declining native wildlife species including riparian songbirds, waterfowl, small mammals, insects, and fish. Restoration of the Project site will be conducted according to climate-smart restoration principles, and will increase landscape-scale resiliency to projected effects of climate change in the San Joaquin Valley. Restoration of the Project site will also lead to the permanent retirement of thousands of acre-feet of water presently used on irrigated farmland, increasing regional water supply availability.

Reflecting the interdisciplinary and collaborative nature of the Project, River Partners will implement this Project in cooperation with the California Department of Water Resources, Reclamation District 2092, East Stanislaus Resource Conservation District, Point Blue Conservation Science, Tuolumne River Trust, US Fish and Wildlife Service, US Bureau of Reclamation, California Department of Fish and Wildlife, U.S. Department of Agriculture Natural Resources Conservation Service, FishBio, the Endangered Species Recovery Program of California State University Stanislaus, cbec eco-engineering, adjacent land-owners, and other local and regional stakeholders.

Based upon the site evaluation, and leveraging 15 years of River Partners' experience conducting riparian restoration (including Phase 1 of restoration efforts at Dos Rios Ranch and 12 years' experience at the adjacent San Joaquin River National Wildlife Refuge), this Plan was developed to guide additional phases of restoration efforts at Dos Rios Ranch. Habitat restoration strategies include creating a mosaic of riparian forest communities with a high diversity of native overstory and understory species to benefit a suite of wildlife species. Dense riparian thickets and high-ground flood refugia ("bunny berms") will be established to facilitate survival of riparian brush rabbits and other terrestrial species during flood events. Ephemeral swale features will be

constructed to provide seasonally-inundated wetland habitat for target waterfowl species, to facilitate positive field drainage to prevent fish stranding, and to encourage sediment deposition in targeted areas. Floodplain benches will be graded to enhance rearing habitat for juvenile salmonids, supporting ongoing integration of Dos Rios Ranch into broader-scale initiatives focused on the benefits of reconnected floodplains for native fish. Existing farmer berms will also be modified to enhance floodplain connectivity, to increase habitat value for wildlife, to encourage sediment deposition, and to protect adjacent landowners from flooding.

Wildlife targets include federal- and state-listed endangered or threatened species such as the riparian brush rabbit, San Joaquin riparian woodrat (*Neotoma fuscipes riparia*), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), least Bell's vireo (*Vireo bellii pusillus*), Western yellow-billed cuckoo (*Coccycus americanus occidentalis*), Swainson's hawk (*Buteo swainsoni*), bank swallow (*Riparia riparia*), little willow flycatcher (*Empidonax traillii brewsteri*), tricolored blackbird (*Agelaius tricolor*) and other Neotropical migrant songbirds, year-round resident and wintering migrant songbirds, shorebirds, waterfowl and California quail (*Callipepla californica*). Chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss*) and white sturgeon (*Acipenser transmontanus*), will also benefit from the enhanced floodplain.

Specific restoration activities include site preparation, irrigation installation including installation of National Marine Fisheries Service-approved fish screens on existing river pumps, native plant species propagation and installation, site maintenance, and monitoring of restoration performance, wildlife usage, and site conditions.

The restoration actions described in this Plan will be implemented in phases pending the issuance of permits and securing additional funds for the Project. Restoration phases 2-4 and a small portion of phase 5 are included in this Plan to facilitate permitting – these phases represent all those areas of Dos Rios Ranch (including the former Hidden Valley Dairy) that are located within the Central Valley Flood Protection Board's Designated Floodway. Actions within these phases will require an encroachment permit from the CVFPB.

Monitoring and adaptive management are integral components of the Project. An annual monitoring timeline and phased approach to restoration will allow for rapid adjustment of management actions. The planting pattern is stored in an electronic database that will allow for quick information retrieval and future hypothesis testing of the success of this planting design relative to site factors such as soil textures and depth to water table. Wildlife monitoring conducted by collaborating organizations will further contribute to effective adaptive management.

FLOODPLAIN EXPANSION AND ECOSYSTEM RESTORATION AT DOS RIOS RANCH, STANISLAUS COUNTY, CALIFORNIA

I. INTRODUCTION

A. Project Overview

The Riparian Restoration Plan (Plan) for the Floodplain Expansion and Ecosystem Restoration Project (Project) describes the activities and procedures River Partners will implement to restore ecological processes and native riparian vegetation on approximately 1000 acres of the 2,100-acre Dos Rios Ranch property (comprising the 1,603-acre Dos Rios Ranch and the 497-acre former Hidden Valley Dairy) in Stanislaus County, CA (Fig. 1). Accompanying this Plan is a draft supplemental document entitled "Conservation Vision for the Dos Rios Ranch Project", prepared by River Partners in December 2014 for submission to the California Department of Water Resources. Once finalized after review by DWR staff, this supplemental document will provide a comprehensive overview of the background of the Dos Rios Ranch project as a whole, providing additional context for current and future implementation plans.

Restoration of Dos Rios Ranch will continue in phases over the next 8-10 years, an approach that will allow River Partners to systematically restore the property based on availability of funding, permitting requirements, and organizational capacity. The phased approach also allows for the gradual retirement of farming operations, minimizing impacts to local farms and dairies, as well as adaptive management decisions based on the performance of prior plantings. The Project acreage includes approximately 948 acres of Dos Rios Ranch proper (restoration phases 2-4), and approximately 52 acres of the former Hidden Valley Dairy (a portion of restoration phase 5), including all lands currently located within the Central Valley Flood Protection Board (CVFPB) designated floodway (Fig. 2).

The Project supplements River Partners' ongoing restoration work on the San Joaquin River National Wildlife Refuge (Refuge) and previously-implemented (Phase 1) restoration efforts at Dos Rios Ranch by increasing total riparian habitat near the confluence of the San Joaquin River and its largest tributary, the Tuolumne River. Phase 1 of restoration at Dos Rios Ranch included 198 acres of leveled agricultural fields, portions of Steenstrup Slough and a field leading to the higher upland terrace (Phase 1A, River Partners 2013a), and 401 acres of Dos Rios Ranch land-side the USACE levee (Phase 1B, River Partners 2013b).

The primary goals of the Project are to restore this acreage to native habitat types for the benefit of terrestrial and aquatic wildlife including threatened and endangered species, reconnect this acreage (all historic floodplains) to the San Joaquin and Tuolumne Rivers to allow flooding for habitat benefits and transient floodwater storage, and to promote physical river processes of scour and deposition along eight river miles. Hydrodynamic and hydraulic studies will be conducted to a) support an encroachment

permit application from the CVFPB, and b) examine the possibility of optimizing transient floodwater storage on lands currently protected by the US Army Corps of Engineers (USACE) levee at Dos Rios Ranch within Reclamation District (RD) 2092 through installation of a water control structure. Actual modification of the USACE will require coordination with USACE, Reclamation District 2092, and the Central Valley Flood Protection Board (CVFPB), and is outside the scope of this Plan and Project.

This Project will increase and improve riparian habitat for the endangered riparian brush rabbits (*Sylvilagus bachmani riparius*). Relevant habitat restoration goals include creating a network of dense riparian shrub cover - the habitat structure most preferred by brush rabbits - and high-ground flood refugia for brush rabbits and other terrestrial wildlife species. Recent wildlife photograph monitoring results suggest that riparian brush rabbits are already present in remnant habitat bordering the Project site along the Tuolumne River, although it is currently unknown if this is a wild population or if it was established through dispersal of captive-bred brush rabbits from the Refuge.

Additional wildlife targets include federal- and state-listed endangered and threatened species such as the San Joaquin riparian woodrat (*Neotoma fuscipes riparia*), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), least Bell's vireo (*Vireo bellii pusillus*), western yellow-billed cuckoo (*Coccycus americanus occidentalis*), Swainson's hawk (*Buteo swainsoni*), bank swallow (*Riparia riparia*), tricolored blackbird (*Agelaius tricolor*), little willow flycatcher (*Empidonax traillii brewsteri*), and other Neotropical migrant songbirds, year-round resident and wintering migrant songbirds, shorebirds, waterfowl, and California quail (*Callipepla californica*). Chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss*) and white sturgeon (*Acipenser transmontanus*), which have recently been documented spawning near the restoration site (Gruber 2012), may also benefit from access to the enhanced floodplain. A detailed monitoring program will allow for adaptive management decisions (River Partners 2008).

B. Cooperative Relationships and Funding Sources

The acquisition of Dos Rios Ranch for conservation purposes in 2012 was a collaboration amongst the California Department of Water Resource (DWR), U.S. Department of Agriculture Natural Resource Conservation Service (USDA NRCS), California Wildlife Conservation Board (WCB), California River Parkways Program, U.S. Bureau of Reclamation (BOR), USFWS, San Francisco Public Utilities Commission, River Partners, and the Tuolumne River Trust (TRT). The acquisition of the Hidden Valley Dairy for conservation purposes in 2013 was a collaboration amongst the California DWR FloodSAFE Environmental Stewardship and Statewide Resources Office, the California Department of Fish and Wildlife (CDFW), and California DWR Flood Protection Corridor Program (FPCP), American Rivers, the Natural Heritage Institute, the Natural Resource Defense Fund, and TRT.

Funding for activities detailed in this Plan was provided by the California DWR FPCP, the USDA NRCS Wetland Reserve Program (WRP) and other partners to be identified at a later date.

For many years, River Partners has collaborated with the USFWS on restoration planning and implementation, including past and present restoration phases at Dos Rios Ranch. With the adjacency of the San Joaquin River National Wildlife Refuge (across the San Joaquin River from the Project area), the decade-plus of riparian restoration conducted at the SJRNWR by River Partners, and the mutual goals of threatened and endangered species conservation, this partnership will be essential to restoration success at Dos Rios Ranch. In addition, the USFWS may emerge as a long-term management partner after completion of restoration efforts at Dos Rios Ranch and is therefore assisting River Partners in planning habitat restoration and maintenance.

TRT provided the initial impetus for this restoration effort and will continue to be a valuable partner assisting in public outreach and community involvement. Point Blue Conservation Science (Formerly PRBO) and the Endangered Species Recovery Program at California State University – Stanislaus (ESRP) will provide support in avian and mammalian wildlife monitoring to be conducted at the Project site over the course of restoration. East Stanislaus RCD will participate in the project through community outreach and managing educational activities associated with the Project.

C. Purpose of Restoration Plan

The purpose of this Plan is to identify Project goals, objectives, and special considerations, to summarize site characteristics including our current understanding of the physical and biological factors that influence site ecology, to describe target wildlife species habitat requirements, and to detail an appropriate restoration strategy.

D. Project Goals and Objectives

The overall goals of the Project are to restore river-floodplain connectivity and physical river processes, improve flood management, restore riparian habitat types, and recover endangered species. Specific objectives include:

- Restore flooding and transient floodwater storage to approximately 1,000 acres of historic floodplain;
- Promote physical river processes of scour and deposition through development of dedicated sediment trapping zones and removal of haphazard bank revetment;
- Establish native woody vegetation within the Designated Floodway in configurations compatible with design flood conveyance;
- Complete a Water Control Structure Study to identify levee breaching configurations and locations that optimize transient floodwater storage and wildlife habitat values on the dry side of the federal levee at Dos Rios Ranch;
- Link riparian habitats at the San Joaquin River NWR and upstream parks and conservation projects on the Tuolumne and San Joaquin Rivers;

- Establish flood-resilient riparian scrub habitat for terrestrial species, including the riparian brush rabbit and riparian woodrat;
- Improve nesting and migrating habitat for dozens of avian species, including focal riparian species such as the least Bell's vireo and little willow flycatcher;
- Create wintering habitat for Central Valley waterfowl;
- Establish marsh habitat for the tricolored blackbird;
- Enhance elderberry shrub habitat for the endangered valley elderberry longhorn beetle (VELB);
- Improve foraging and migratory habitat for native fish including steelhead trout, Chinook salmon, and white sturgeon;
- Establish self- sustaining native plant communities within a three-year period by planting over ~260,000 native trees, shrubs, and vines on the Project site;
- Reduce invasive weeds by planting a dense herbaceous understory across the Project site and controlling weeds along road edges and within wetlands;
- Plan and implement the Project according to climate-smart restoration principles,, increasing landscape-scale resiliency to projected effects of climate change in the San Joaquin Valley; and
- Evaluate the Project within an adaptive management framework.

E. Summary of Special Considerations

- Target creation of high-ground flood refugia near existing high ground and existing remnant habitat, while including some refugia away from high ground and remnant habitat in anticipation of future connections between these areas and restored forests;
- Design ephemeral swales and berm breaches to provide flood management benefits (sediment trapping and transient small floodwater attenuation) as well as wildlife habitat value while providing positive drainage to prevent fish entrapment;
- Create floodplain benches to enhance fish access to floodplain habitat in locations that compliment observed channel migration;
- Optimize use of existing irrigation infrastructure and screen river pumps to prevent fish entrainment;
- Work with many Project partners from local community groups and federal agencies; and
- Use lessons learned from 12+ years working on adjacent restoration projects to inform design and implementation.

II. SITE DESCRIPTION

A. Location

The Project site is located at the confluence of the Tuolumne and San Joaquin rivers, approximately 9 miles west-southwest of downtown Modesto (Fig. 1). The Project site is bordered by the Tuolumne River (river mile 0 – 3.5) to the north, by the San Joaquin River (river mile 82 – 87) to the west, and farmland to the east and south. The Project

site occupies approximately 5 miles of San Joaquin River frontage and 3.5 miles of Tuolumne River frontage (Fig. 2).

The Project site is located in an ecologically critical location—the confluence of the San Joaquin River and its largest tributary. Ecological benefits of this Project will be magnified by its location and close proximity to existing habitat and other restoration projects. The Refuge is immediately west of the Project site, across the San Joaquin River. The Refuge was created in 1987 to provide foraging and roosting habitat for the threatened Aleutian cackling goose (*Branta hutchinsii leucopareia*) as well as other endangered species and migratory birds. In 1997, the USFWS began a multi-phase project of providing long-term protection and restoration of over 3,000 acres of fish and wildlife habitat. Over 2,500 acres of riparian habitat and wetlands have been or are currently being restored on the Refuge by River Partners in collaboration with many State and Federal partners. This is the largest contiguous block of riparian habitat restoration in the Central Valley. The Refuge's remnant riparian forests and extensive restored areas create high quality bird habitat immediately adjacent to the Project site (Seavy et al. 2012). On the Sacramento River, restoration sites adjacent to existing riparian vegetation were recolonized by riparian birds more rapidly than sites without nearby bird habitat (Gardali and Holmes 2011).

B. Land Use History

In the Project area, similar to much of the Central Valley, widespread loss of riparian habitat has been caused primarily by conversion to agriculture, flow regulation, and private/public levees that have disconnected rivers from floodplains. Agriculture, including row crops, orchards, and cattle operations, has been the dominant land use within the Project area for the last century. Although large areas supported native vegetation and contained several natural oxbow lakes, historic aerial photography from 1937 show that some levee construction had taken place, as well as land clearing on the high terrace, large areas along the Tuolumne River, and most of the floodplain currently protected by the USACE levee (described in detail in the Conceptual Restoration Plan for Dos Rios Ranch, River Partners 2006, Appendix A; also see the Phase 1A Restoration Plan for Dos Rios Ranch, River Partners 2013a). Undisturbed portions of the lower floodplain supported dense stands of mixed riparian vegetation of differing successional states along both rivers. Historic aerial photography from 1950 shows accelerated land conversion, levee construction, and farming intensification, although much of the Dos Rios Ranch floodplain still supported dense stands of riparian vegetation (River Partners 2006; River Partners 2013a).

Lyons Investments LP purchased Dos Rios Ranch in the late 1980's from a cattle company that farmed row crops, almonds, and raised cattle on the property. The Lyons currently lease portions of Dos Rios Ranch from River Partners to farm almonds on the high terrace and rotate alfalfa, corn, and winter forage grain mix (wheat, barley, oats) on the remaining floodplain. Additionally, other crops including pumpkins, watermelons, tomatoes, and fruit orchards have been grown within the Project area. Over the last 25 years, Dos Rios Ranch has also accepted solid food processing wastes as a soil

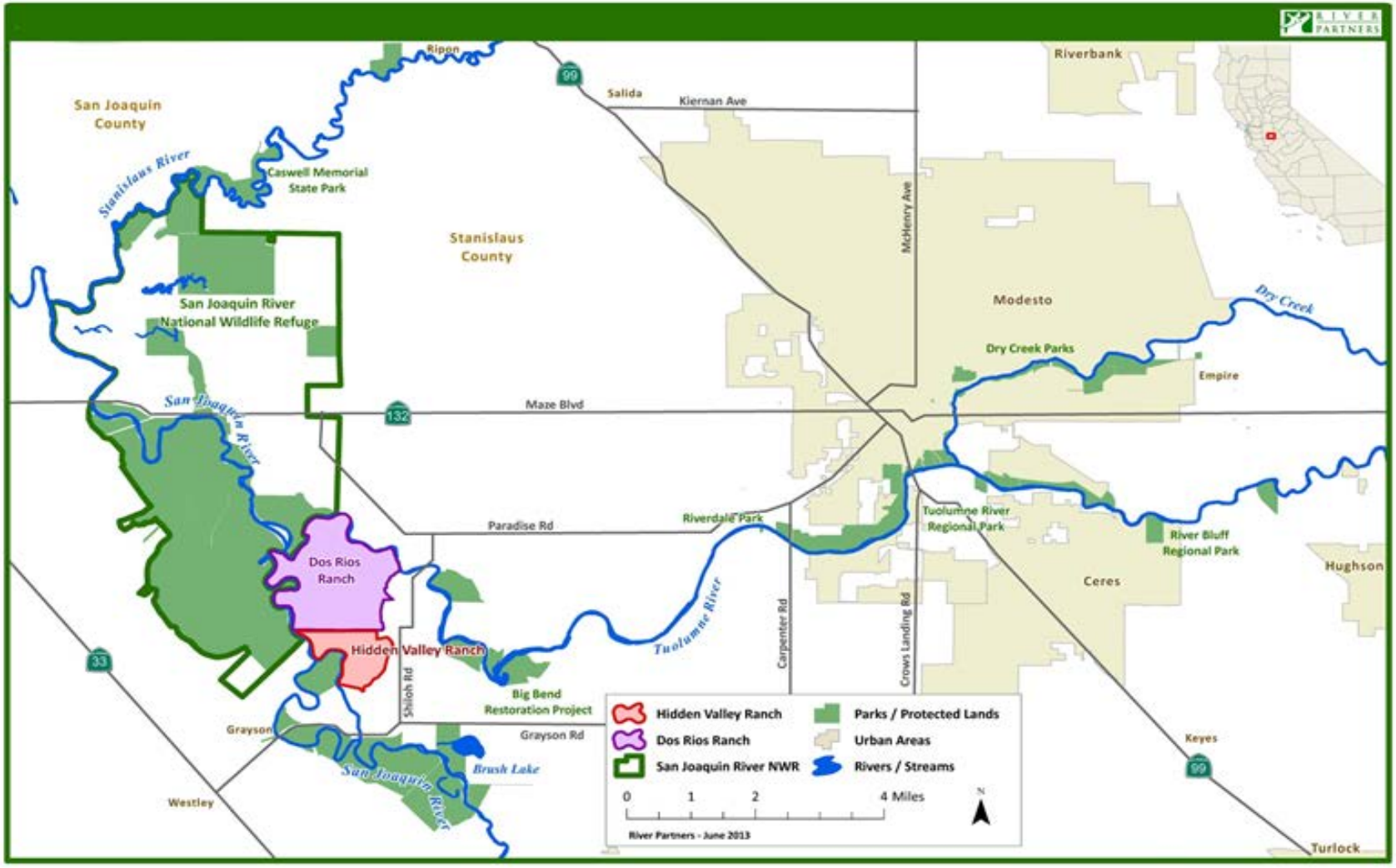

Figure 1. Location of Dos Rios Ranch and former Hidden Valley Dairy, Stanislaus County, CA.

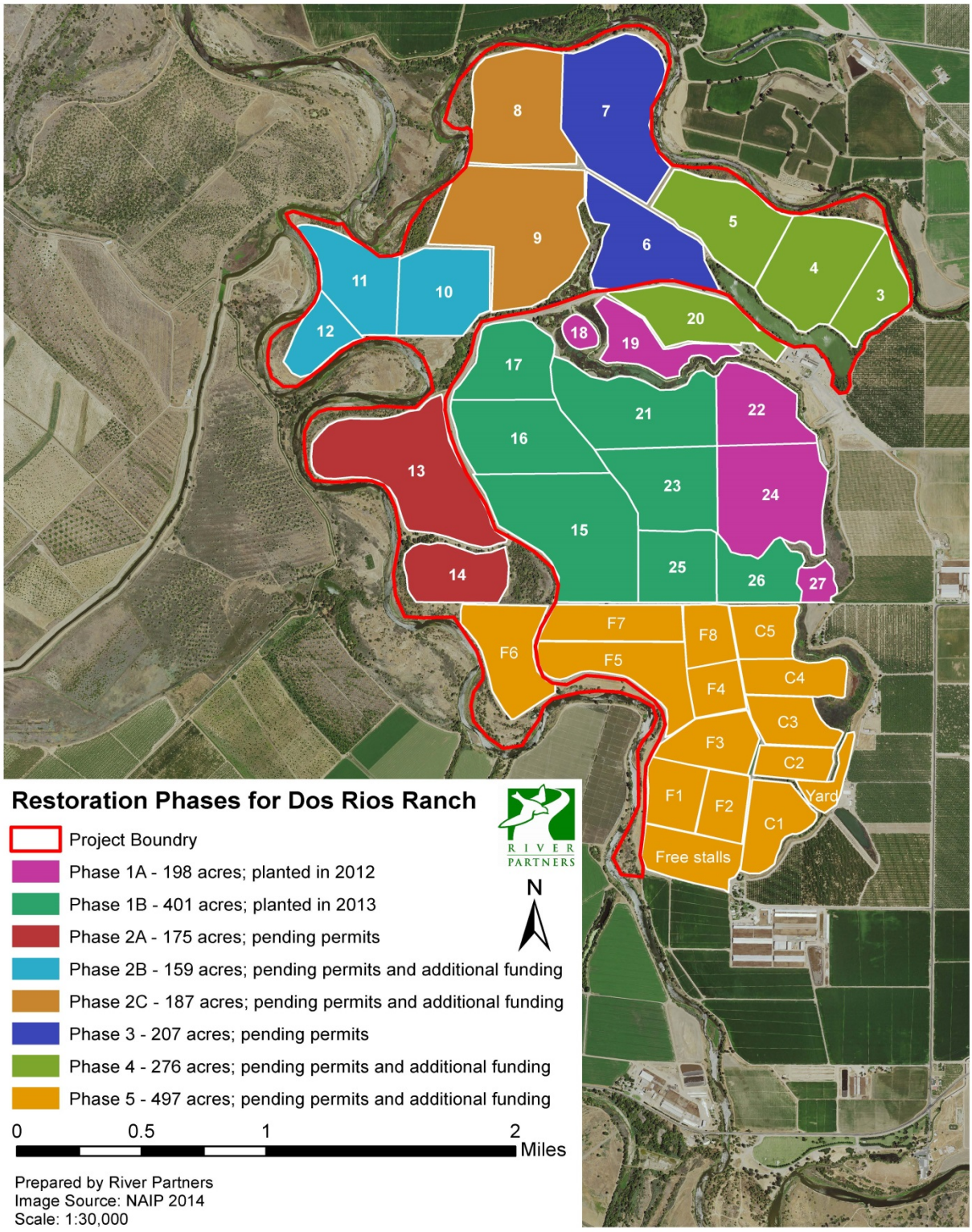

Figure 2. Dos Rios Ranch restoration phases with approximate Project boundary in red, Stanislaus County, CA.

amendment. These wastes included corn syrup, apricots, peaches, pears, tomatoes, and grape stems. This Program was overseen by the Stanislaus County Ag Commissioner, and positively reviewed by the Central Valley Regional Water Quality Control Board several times. Surrounding land use includes a mix of cultivated land (almond and walnut orchards, cherries, grapes, blueberries, corn and other grain crops, and dairies) and small remnants of riparian woodland.

The Hidden Valley property, now included in Dos Rios Ranch, was a working dairy since the late 60's to early 70's. Prior to dairy operations, the property was in active agricultural production. Dairy operations ceased after River Partners' acquisition of the Hidden Valley property in 2013, however alfalfa and other forage crops are still grown on the property and heifers are stored in the stalls for adjacent dairies.

C. Soils

Variable soil characteristics, created by dynamic river processes, greatly affect vegetation composition, structure, and patterns. For example, soil texture is influenced by flooding as slowly settling floodwaters deposit silts and sands across the floodplain sporadically, creating local zones of low water-holding capacity in the surface soil, encouraging the growth of drought-tolerant species. As these zones are enriched with organic matter by growth and decay of early pioneer species, they are able to hold more water and thus support the establishment of different (later seral) plant communities. Over time, the process of flooding and sediment deposition creates complex mosaics of vegetation patterns across the floodplain, and these patterns continue to change with continued disturbance. Restoration designs must incorporate these soil factors as well as the depth to water table for successful plant establishment, growth, and long-term survival.

Soils on the Project site are complex because of the confluence of two major rivers and proximity to the Sacramento / San Joaquin Delta (mean sea level). Most of the Project site has been formed by the fluvial processes of the San Joaquin River and the Tuolumne River, confluent with the San Joaquin River at the northwest corner of the property. The Soil Survey for East Stanislaus County (NRCS Web Soil Survey 2006) identifies four soil series within the Project area: Columbia, Grangeville, Temple, and Tujunga soils (Fig. 3). The soil series are made up of several soil mapping units (SMUs) varying in texture, permeability, available water holding capacity, and frequency of flooding (Table 1). Temple loams are present in areas of moderate flooding and are relatively fertile. Coarse, sandy Tujunga soils occur in small pockets along the Tuolumne River and are currently being successfully farmed.

In addition to the information provided by the soil survey, seven backhoe pits were excavated by River Partners in October 2005 to assess site conditions. These results can be found in the Conceptual Restoration Plan for Dos Rios Ranch (River Partners 2006). The principle soil and hydrologic information gathered from this survey included: 1) soil texture and structure, 2) stratification of textual classes, 3) depth to water table, and 4) rooting depth of existing vegetation.

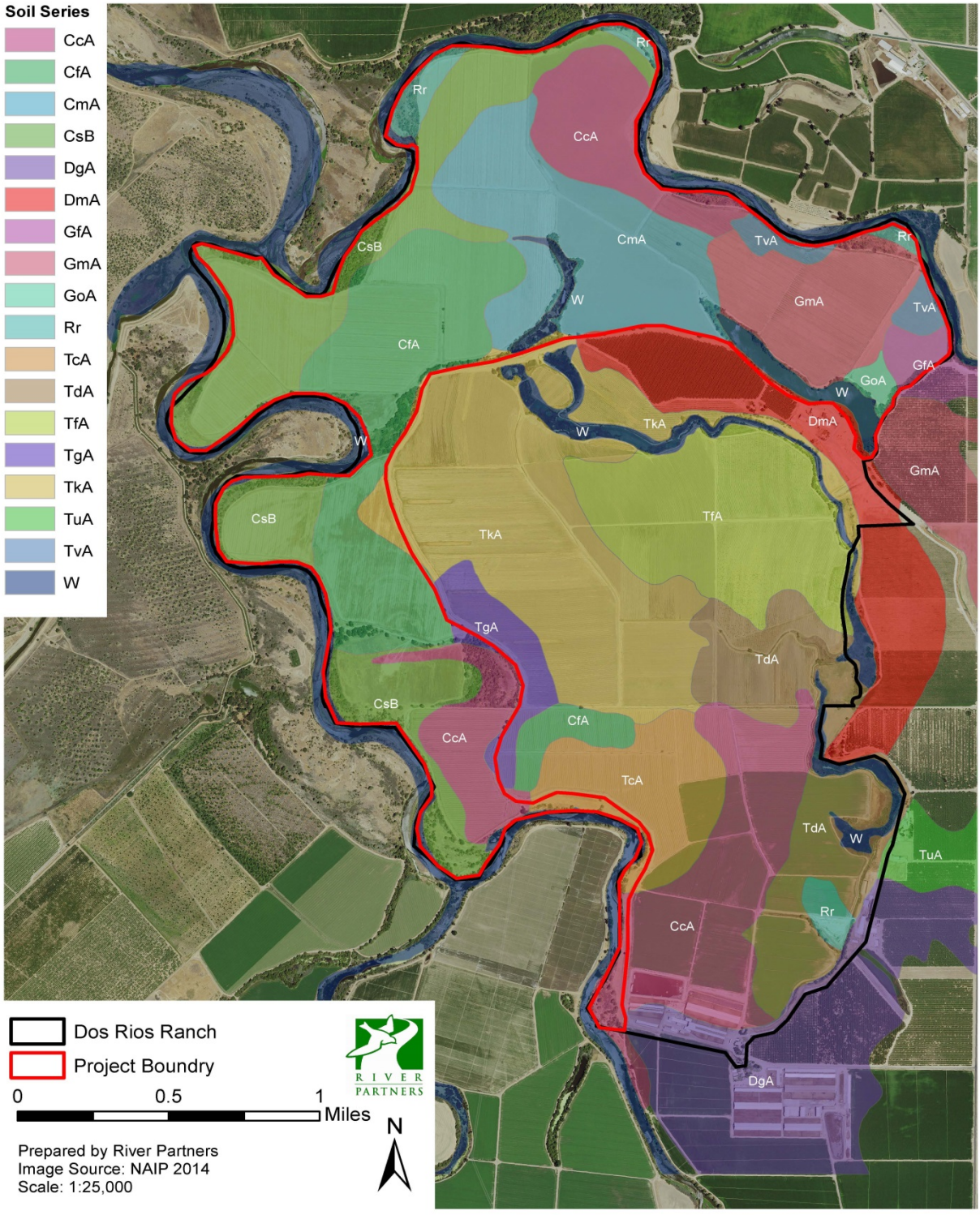

Figure 3. Soil mapping units on the Project site (see also Table 1), Dos Rios Ranch, Stanislaus County, CA.

Table 1. Summary of typical soil conditions found on the Project site (Soil Survey of Eastern Stanislaus County), Dos Rios Ranch, Stanislaus County, CA.

Soil Series	Columbia loams	Columbia soils, channeled	Grangeville fine sandy loams	Temple soils	Tujunga sand
Mapping Unit	CcA, CfA, CmA	CsB	GfA, GmA, GoA	TcA, TgA, TkA	TvA
Percent Slope	0-1%	0-8%	0-1%	0-1%	0-3%
Textures	Fine sandy loam, silt loam	Stratified sand, loamy fine sand, loam	Very fine to fine sandy loam	Loam, silty clay, silty clay loam	Sand
Drainage	Imperfect	Imperfect	Imperfect	Poor to imperfect	Excessive
Permeability	Moderate to moderately rapid	Variable; Moderate to very rapid	Moderate to moderately rapid	Slow	Very rapid
Available water capacity	Moderate to high	Variable; Low	Moderate	Moderate to high	Very low
Fertility	Moderate to high	Moderate	Low to high	Low to high	Very low
Plant growth limitations	Flooding; High water table; salinity (CmA)	Low water holding capacity; Flooding	Slightly to moderate saline-alkali (GgA, GoA)	Moderately saline; Fluctuating high water table; Flooding	Sandy; low nutrients

D. Topography

Topography and elevation of the Project area will determine the frequency of flooding and direction of incoming flood-flows, as well as how the water will drain from the Project area as flows recede. Most of the Project area has been historically graded and leveled to accommodate agricultural needs including irrigation and drainage.

The elevation across the Project site ranges between approximately 30-35 ft. above mean sea level (Fig. 4). Historical channel migration across the site is evident by the many sloughs and oxbows; although some still exist on site, many natural flow and drainage channels, wetlands, and oxbows have been filled and variable topography has been largely eliminated. The higher terrace is to the east of the Project site and an elevated flood control levee runs along the Project area boundary from north to southwest providing potential high-ground flood refugia for terrestrial species.

Project fields are water-side of the federal levee and are subject to regular flooding from the Tuolumne and San Joaquin Rivers. To optimize returns from farming, the prior owners developed a system of berms ("farmer berms") around these field edges (immediately adjacent to the river channels) to control flooding (Fig. 5). Berms are currently ~2-4 feet above field level and wide enough to accommodate the movement of large farm equipment. These berms were designed to hold flood flows off of these fields until weaker locations were overwhelmed. These locations were at the downstream end of fields to encourage floodwater to backfill the fields to minimize damages (and associated recovery costs) from flow, sediment and debris. Berms were maintained by repairing post-flood damage in anticipation for the next round of flooding. Occasionally in the past, large floods have breached these berms in unplanned locations. The farmer berms are not part of the authorized federal flood control project (Fig. 5). As described in later sections of this Plan, these berms will be modified as a component of the Project to facilitate floodplain reconnection and flood attenuation, sediment deposition, and habitat restoration.

E. Hydrology

1. Historical Conditions

Historically, flooding on the San Joaquin River was generally caused by rainfall runoff during late fall/winter and snowmelt during spring/summer. The vast majority of all the water runoff from the entire San Joaquin River Basin south of the Tuolumne watershed passed through the San Joaquin River at its confluence with the Tuolumne River. Prior to the construction of Friant Dam (1942) northeast of Fresno, high flows in late spring and early summer declined gradually with low flows occurring in the fall and early winter. During flood events, tremendous volumes of water would flow through the Project area. The velocity of the San Joaquin River slowed here as it approached sea level, between the confluence of the Tuolumne River and the Delta.

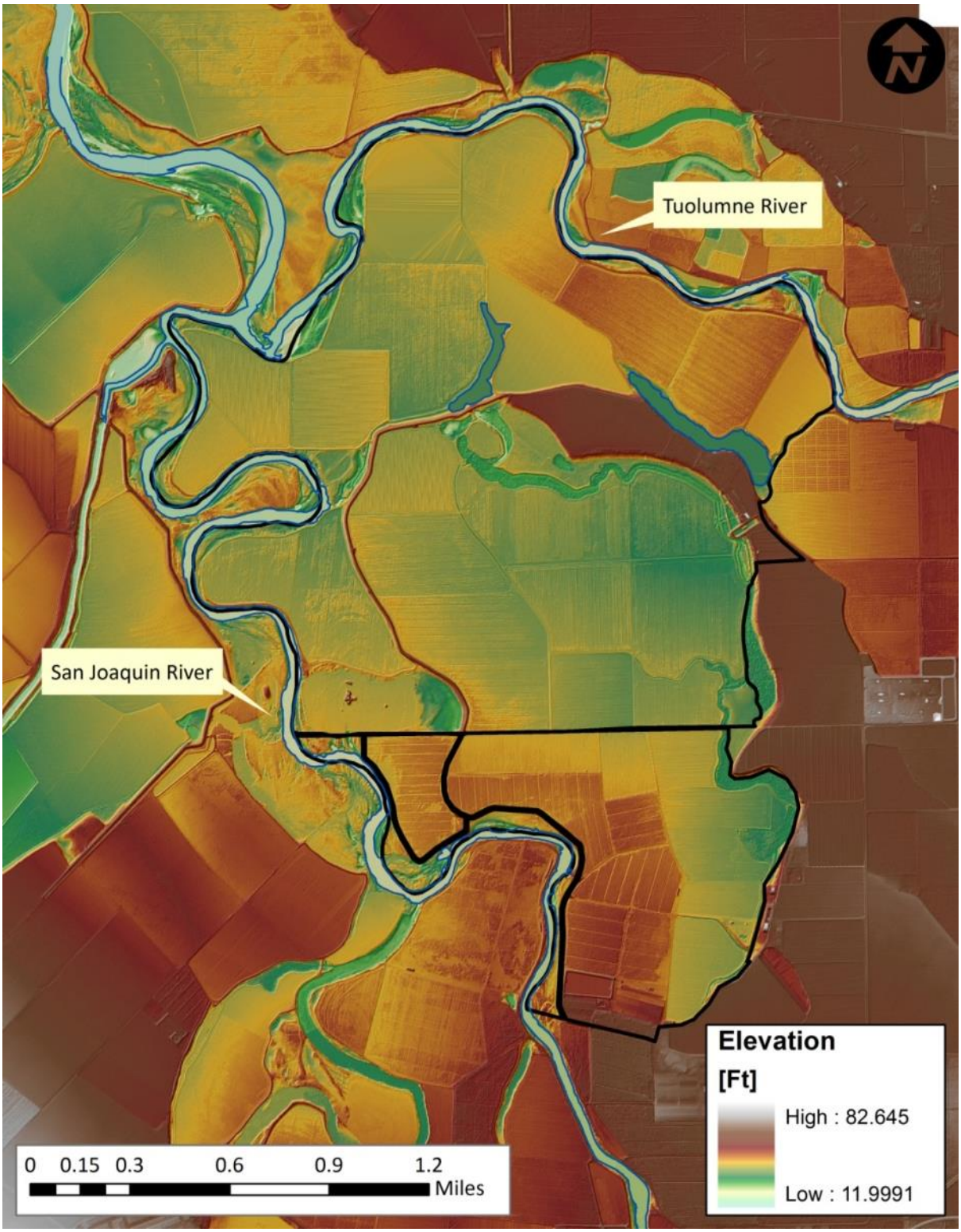

Figure 4. CVFED LiDAR-derived topography (2010) for Dos Rios Ranch including Project site, Stanislaus County, CA.

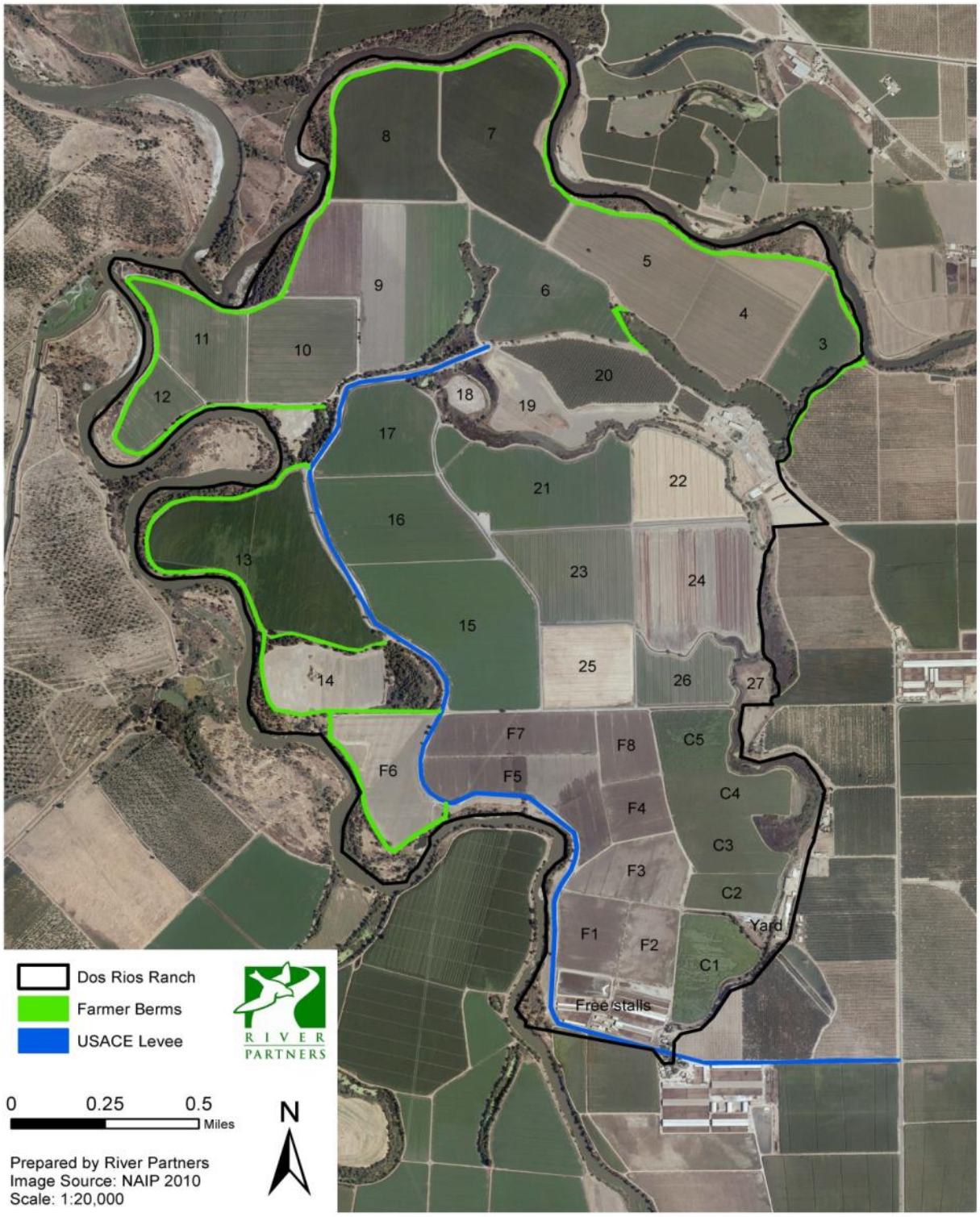

Figure 5. USACE levee and farmer berm locations on the Project site, Dos Rios Ranch, Stanislaus County, CA.

Slower river flow velocity, coupled with the consequent sediment deposition, resulted in the historic channel meander patterns found on the Project site. Historic aerial photographs show that this highly sinuous river was surrounded by an extensive floodplain including oxbow lakes, sloughs, ponds, and sandbars (River Partners 2006).

The historical flow regime of the Tuolumne River, the largest tributary of the San Joaquin River, included large variation in the magnitude, timing, duration, and frequency of stream flows (McBain and Trush 2000). Before dam construction, the annual hydrograph of the Tuolumne River was characterized by relatively low base flows in the fall with short, small floods. Highly variable flows increased in magnitude and duration throughout the winter, with larger magnitude and short duration floods caused by rainfall or rain-on-snow storm events (McBain and Trush 2000). Lower magnitude, longer duration floods would occur in spring to early summer during snowmelt. Flows were at their lowest, on average, during the late summer (McBain and Trush 2000).

2. Current Conditions

The hydrology of the San Joaquin and Tuolumne Rivers have been significantly altered by flow regulation and water diversion for irrigation, power, and municipal uses. Dams have reduced the magnitude, duration, and frequency of high flows and increased the duration and frequency of lower flows. These dams can capture more than the average annual amount of runoff.

The San Joaquin River is regulated by dams on all of its major tributaries (including the Tuolumne and Merced rivers) and by Friant Dam. Dams, including La Grange Dam (built in 1893) and the New Don Pedro Dam (built in 1971), along with several water storage reservoirs have reduced the Tuolumne River's summer and winter base flows, the inter-annual and seasonal variation of stream flows, and the annual water yield by 60% (McBain and Trush 2000).

Historical hydrologic processes that once created and sustained healthy riparian forests no longer occur along the corridors of the San Joaquin and Tuolumne Rivers. Channel-floodplain connectivity is critical for a healthy river system. The river processes that formed the meandering channels of the San Joaquin River near the Project area no longer operate at magnitudes necessary to maintain this dynamic pattern. The San Joaquin River is currently "fixed" in place by levees and is no longer connected to its floodplain, which includes fields in the Project area. Although not restricted by an extensive system of public levees, the Tuolumne River's reduced peak flows, private levees, and bank protection have essentially halted channel migration and limited channel-floodplain connectivity.

The banks of the San Joaquin and Tuolumne Rivers in this region are haphazardly reinforced with concrete rubble and other debris placed over the years by landowners without systemic planning or analysis. River Partners and DWR mapped the existing debris in early 2012, the removal of which is a desired future action. Debris removal

from high-priority areas will facilitate the development of desired habitat characteristics and river fluvial processes on Dos Rios Ranch while minimizing external effects (Fig. 6). Debris removal from other lower-priority areas can be achieved with coordination and engagement with local stakeholders (Fig. 6).

A large USACE levee bisects a portion of the property (Fig. 5), which was completed in 1961. Historic photos show what appears to be a smaller berm in the same general location from as early as 1937 (River Partners 2013a). The sole purpose of this levee is to protect agricultural fields from inundation during flood events. Structures associated with farming the ranch and adjacent properties are all located on the higher elevation bluff to the east of the levee, which do not experience flooding. The levee is managed by Reclamation District 2092.

The Project area is not protected by the USACE levee and is within the 100-year floodplain. Flood recurrence on the lower floodplain along the San Joaquin River, if it was not protected by levees or berms, would likely be similar to that modeled for the Refuge (PWA 2001 and 2004), immediately west of the project area at approximately 8,500 cfs. Relatively small flood events (<8,500 cfs), which occur approximately every 3-5 years, inundate portions of the lower floodplain on Dos Rios Ranch, particularly along the San Joaquin River (Fig. 7). The ~1,100 acres of floodplain at Dos Rios Ranch protected by the USACE levee, including Phase 1A and 1B project areas as well as the majority of the former Hidden Valley Dairy, do not flood during these high water events. However, groundwater seepage typically saturates the fields creating small ponds in certain lower elevation locations.

In the past 30 years, Dos Rios Ranch and the surrounding area (including the SJRNWR) has experienced significant flooding approximately once every 5 years, most recently in 1983, 1986, 1995, 1997, 2005, 2006, and 2011. In early January 2011, a significant flood-fighting effort successfully spared Dos Rios Ranch from flooding on the lower floodplain (Fig. 7). Floods typically stand 3 ft deep across the floodplain, and remain from 5-70 days depending on the duration of dam releases. Floodplain inundation at Dos Rios Ranch is controlled by the flow conditions in both the San Joaquin and Tuolumne Rivers, as well as the current farmer berm configuration. According to the previous owner, Dos Rios Ranch starts to flood when the Tuolumne River reaches 8,200 cfs with low flows on the San Joaquin River; however, if the San Joaquin and the Tuolumne Rivers concurrently run high flows, Dos Rios Ranch floods well below this flow. Along the San Joaquin River, flooding of Dos Rios Ranch typically occurs when the flow volume reaches 11,000 cfs as measured at DWR's San Joaquin gaging station near Patterson (SJP). At this level, several fields riverside of the levees on the adjacent SJRNWR have already inundated, however significant attenuation is not achieved at the SJRNWR until flows in the San Joaquin River reach above 16,000 cfs.

A representative aerial photograph (Fig. 8) shows the San Joaquin River inundating portions of Dos Rios Ranch in 1967 at 18,500 cfs (USGS Vernalis gauging station). The Tuolumne River is not at flood stages, flowing at 2,180 cfs at the USGS Modesto gauging station and provides an example of early attempts at flood detention cells on the property.

All irrigation runoff at Dos Rios Ranch is currently recycled through a system of drain channels, sloughs, and ponds (historic oxbow lakes). This system of utilizing the oxbow lakes as tailwater ponds will be maintained and improved to continue to trap and filter sediment and nutrients from agricultural drainage and provide wetland habitat for wildlife (Imhoff 2003).

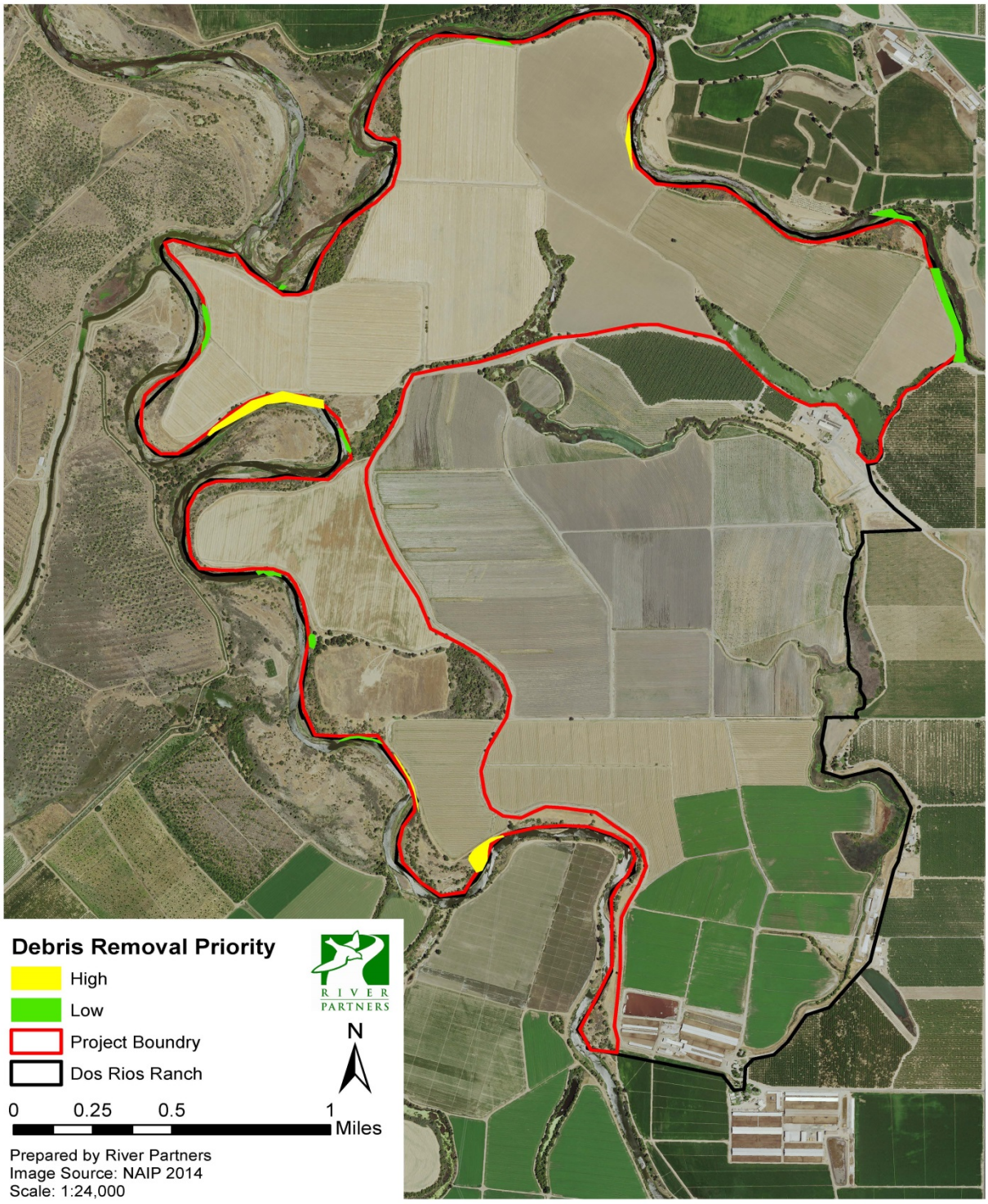

Figure 6. Location of concrete debris on the Project site along San Joaquin and Tuolumne Rivers; locations are classified as high-priority or lower-priority (future removal) areas, Dos Rios Ranch, Stanislaus County, CA.

Figure 7. Flooding on the Project site on March 31, 2011; aerial view looking North with restored riparian habitat on the San Joaquin River National Wildlife Refuge on the left, Dos Rios Ranch, Stanislaus County, CA.

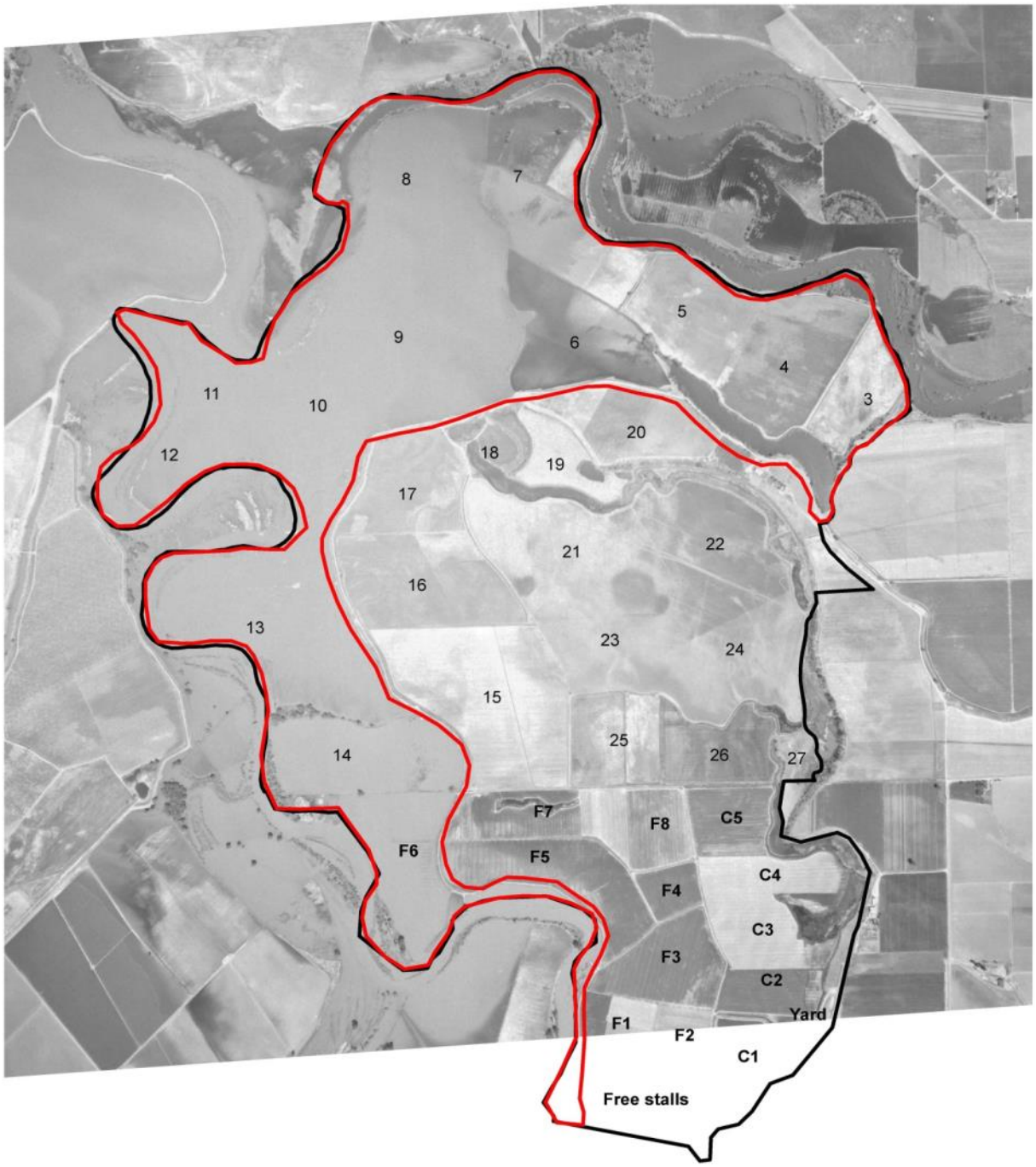

Figure 8. May 15, 1967 flood event on the San Joaquin River. Note the farmer berm protecting fields along the Tuolumne River from inundation, Dos Rios Ranch, Stanislaus County, CA.

F. Vegetation

1. Pre-development Conditions

Based on soils, flooding frequency, and the proximity to the river, pre-development site conditions likely supported a mixed riparian forest with valley oak (*Quercus lobata*) dominating in more elevated areas and more mesic species such as Fremont cottonwood (*Populus fremontii*), sandbar willow (*Salix exigua*), and Box elder (*Acer negundo*) occupying lower areas. Native grasses, forbs, and sedges likely dominated the understory.

2. Current on-site Conditions

Currently, only a fragmented, narrow band (0-400 ft. wide) of native riparian vegetation exists along the edges of the San Joaquin and Tuolumne Rivers (Fig. 9). Existing riparian corridor width mostly ranges from 0-50 ft. with some isolated patches as wide as 400 ft. Very narrow, linear bands of native vegetation can also be found along the remaining slough channels. A large, relatively isolated patch (~30 acres) of riparian vegetation also exists in the southwestern corner of the Project site. These riparian areas support large Fremont cottonwoods, numerous valley oaks (some likely over 100 years in age), and a mix of other native woody and herbaceous species (Table 2). While the remaining patches of native habitat are fragmented and highly variable, they still provide valuable habitat. River Partners will enhance portions of these native patches by removing invasive species and will require our farming partners to avoid all contact with these sensitive areas.

All areas of the Project site are being actively farmed except for the oxbow lakes, sloughs, and areas of existing riparian vegetation. Agricultural operations have minimized non-native weeds in farmed areas, although noxious weeds including Johnson grass (*Sorghum halepense*), perennial pepperweed (*Lepidium latifolium*), Russian knapweed (*Acroptilon repens*) and common reed (*Phragmites australis*) are present along the unfarmed riparian areas. Other common non-native species on site include milk thistle (*Silybum marianum*), tree tobacco (*Nicotiana glauca*), black mustard (*Brassica nigra*), eucalyptus (*Eucalyptus spp.*), curly dock (*Rumex crispus*), fig (*Ficus carica*), and poison hemlock (*Conium maculate)*. Without weed control efforts, distribution of many of these species will increase within the riparian corridor, displacing native vegetation. A large eucalyptus tree located in remnant habitat will be girdled and left to function as raptor nesting habitat.

3. Current off-site Conditions

Surrounding land use on the east side of the San Joaquin River includes a mix of cultivated land (orchards, row crops, and dairies/grazing pasture) and small remnants of riparian woodland. A dairy is directly south of the Project site and produces forage crops for their dairy operations. The Mapes and Faith Ranch are north of the Project and provide valuable habitat for wintering waterfowl on their rangeland. Forage crops and rangeland provide useable habitat as opposed to the many orchards in the area which provide little or no habitat value for native wildlife.

Figure 9. Remnant riparian habitat on the Project site, Dos Rios Ranch, Stanislaus County, CA (see Table 2 for species).

Table 2. Existing native plant species in riparian areas on the Project site, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name
Woody	
Arroyo willow	*Salix lasiolepis*
Black willow	*Salix goodingii*
Box elder	*Acer negundo*
Buttonbush	*Cephalanthus occidentalis*
California blackberry	*Rubus ursinus*
California rose	*Rosa californica*
Golden currant	*Ribes aureum*
Elderberry	*Sambucus Mexicana*
Fremont cottonwood	*Populus fremontii*
Oregon ash	*Fraxinus latifolia*
Sandbar willow	*Salix exigua*
Valley oak	*Quercus lobata*
Herbaceous Species	
Western goldenrod	*Euthamia occidentalis*
Creeping wildrye	*Elymus triticoides*
Evening primrose	*Oenothera hookeri*
Gumplant	*Grindelia camporum*
Mugwort	*Artemisia douglasiana*
Spikeweed	*Hemizonia pungens*
Stinging nettle	*Urtica dioica*
Hedge nettle	*Stachys ajugoides*
Milkweed	*Asclepias fascicularis*

A riparian corridor is basically non-existent along the north bank of the Tuolumne River except for the area immediately east of the confluence, which is owned by USFWS. Over 1,400 acres of remnant riparian habitat exists on the Refuge, immediately west of the Project site. Additionally, over 2,500 acres of riparian habitat and wetlands have been restored by River Partners on the Refuge. In remnant areas sandbar willow, box-elder, buttonbush, and Oregon ash are frequent; California rose is occasional; Fremont cottonwood is present as widely spaced individuals or small groups; valley oak occur as scattered individuals and a few closed canopy groves occur on Christman Island. Sapling valley oaks (5-20 ft. tall) are common. Elderberry is very rare but can be found where flood water recedes more rapidly. Native species dominate the understory of much of the riparian area, unlike most other riparian areas in the state. California blackberry, mugwort, Western goldenrod, Santa Barbara sedge, and creeping wildrye are common, and in many places have excluded non-native species.

G. Wildlife

Remnant riparian and wetland habitat on the Project site support some wildlife and waterfowl species. Most notably, a photograph of a riparian brush rabbit was taken in July 2014 by River Partners' summer interns who were conducting preliminary wildlife monitoring in remnant habitat along the Tuolumne River using wildlife cameras donated by a researcher from the University of California Davis. More detailed future monitoring efforts will seek to determine if a viable population (versus a few scattered individuals) of brush rabbits already exists at Dos Rios Ranch, as well if brush rabbit(s) on site represent a previously-unknown wild population versus a captive-bred population established via dispersal from the Refuge. ESRP has reported that a collared, captive-bred rabbit crossed the San Joaquin River in 2004, but survived only a few days. There is a long history of Aleutian cackling geese utilizing corn and winter wheat fields on Dos Rios Ranch. However, agricultural fields in general provide poor habitat for riparian-obligate species. The Project site, which has many of the same physical site characteristics as the Refuge, has the potential to support the same richness of wildlife species as the Refuge and nearby NRCS easements (Table 3).

Currently, the Refuge supports a variety of at-risk species such as the endangered riparian brush rabbit, endangered riparian woodrat, Central Valley fall-run Chinook salmon, threatened Central Valley steelhead, recently delisted Aleutian cackling goose, threatened (State-listed) Swainson's hawk, and other riparian bird species. Additionally, Point Blue observed yellow warblers (*Dendroica petechia*; California species of special concern; see Dybala et al. 2014) and relatively high densities of nesting song sparrows (*Melospiza melodia*; California species of special concern) and blue grosbeaks (*Guiraca caerulea*; reduced in much of their historical range) on the Refuge. In June 2005, Point Blue also observed a breeding and nesting pair of endangered least Bell's vireos in a recently restored field. A breeding pair of least Bell's vireos returned to the same area in 2006 and another male was sighted along Hospital Creek in 2011 (Howell et al. 2010). The Merced NWR has also monitored a nesting pair of vireos, and vireos have also been observed in the Yolo Bypass.

Although valley elderberry longhorn beetle (VELB) presence has not been monitored on the Refuge since 2006, numerous elderberry shrubs exist in restored fields and remnant habitat. Elderberry shrubs at the Refuge, in addition to areas along the Tuolumne and San Joaquin Rivers on the Project site may support the threatened valley elderberry longhorn beetle.

Table 3. Target wildlife species that could benefit from Project, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name	Listed Status
Riparian brush rabbit	*Sylvilagus bachmani riparius*	Endangered (State and Federal)
Riparian woodrat	*Neotoma fuscipes riparia*	Endangered (Federal)
Least Bell's vireo	*Vireo bellii pusillus*	Endangered (State and Federal)
Valley elderberry longhorn beetle	*Desmocerus californicus diamorphus*	Threatened (Federal)
Swainson's hawk	*Buteo swainsoni*	Threatened (State)
Western yellow-billed cuckoo	*Coccycus americanus occidentalis*	Threatened (State and Federal)
Bank swallow	*Riparia riparia*	Threatened (State)
Little willow flycatcher	*Empidonax traillii brewsteri*	Endangered (State)
Northern harrier	*Circus cyaneus*	CA Species of Special Concern
Yellow warbler	*Dendroica petechia*	CA Species of Special Concern
Song sparrow	*Melospiza melodia*	CA Species of Special Concern
Tricolored blackbird	*Agelaius tricolor*	CA Species of Special Concern
Loggerheaded shrike	*Lanius ludovicianus*	CA Species of Special Concern
Chinook salmon	*Oncorhynchus tshawytscha*	Threatened (State and Federal)
Steelhead trout	*Oncorhynchus mykiss*	Threatened (Federal)
White sturgeon	*Acipenser transmontanus*	Threatened (Federal)

1. Riparian Brush Rabbit

Historically, this species occurred in riparian forests along portions of the San Joaquin River and its tributaries on the valley floor (Williams et al. 1998; Kelt et al. 2014). One of most critically endangered species in California, riparian brush rabbit populations have been threatened by clearing and leveling of riparian habitat for conversion to agriculture, wildfire, disease, predation, and flooding. Approximately 6% of native riparian forests remain in the San Joaquin Valley (Kelt et al. 2014), mirroring broader-scale loss of riparian habitat across the Central Valley (Seavy et al. 2012). Creating high-quality habitat for the riparian brush rabbit and providing an additional potential re-introduction site within the Project area would directly contribute towards recovery.

Although precise habitat needs of the riparian brush rabbit are still being studied by ESRP, riparian corridors with abundant shrubs, vines, and an herbaceous understory that allow rabbits to successfully live and move between bigger patches of habitat are critically important. The corridor must be continuous and can be narrow, although it should not be very narrow for long distances. A riparian corridor 76 m (250 ft.) wide should be adequate to provide quality habitat for the rabbit (Dan Williams, personal communication), although large patches of contiguous habitat would be the most desirable option. The 2014 discovery of a riparian brush rabbit at Dos Rios Ranch described above supports the assertion that rabbits can use narrow corridors, since the rabbit was located in just such a habitat patch along the Tuolumne River. The elevation

of the habitat in relationship to flood water levels and the distance between flood-prone habitat and non-flooded uplands also needs to be considered.

Existing conditions on the Project site, including small habitat patch sizes, narrow and discontinuous riparian corridors, and lack of adequate flood refugia, are not suitable habitat for riparian brush rabbit. Portions of the Project site have similar characteristics to habitat in the South Delta where small pockets of brush rabbits continue to persist. With active restoration the Project site will provide the necessary habitat characteristics and high-ground flood refugia for the species.

2. Riparian Woodrat

The endangered riparian woodrat historically occurred along the San Joaquin, Stanislaus, and Tuolumne Rivers. Currently, the only known populations of woodrats are at Caswell Memorial State Park (Caswell) on the Stanislaus River and on the Refuge (Matocq et al. 2012). Both of these populations are small and isolated, increasing the possibility of localized extinction due to a devastating flood or fire. Loss and fragmentation of habitat through conversion of riparian habitat to agriculture and altered hydrology of Valley Rivers by dam construction are primary reasons for the decline of the riparian woodrat (Williams et al. 1998; Matocq et al. 2012).

Riparian woodrats inhabit areas with dense shrub cover, typically willow thickets with a valley oak overstory. This species eats leaves, fruits, flowers, and nuts. Woodrats live in stick nest houses positioned against logs on the ground, often located in dense brush, or occasionally in cavities of trees and in hollow logs (Williams et al. 1998). These houses are quite common in Caswell State Park, where the population seems to be more robust. It is interesting to note that on the Refuge, where the woodrat is known to exist, a stick house has never been located.

As with the riparian brush rabbit, historic habitat and refugia from flooding have been converted to cultivated fields, orchards, and vineyards, which do not provide suitable habitat for this species. Many habitat requirements of the woodrat are similar to the riparian brush rabbit. Therefore, recommendations for riparian corridors would be similar to those for the rabbit. For reasons similar to those listed for the riparian brush rabbit, current site conditions on most of the Project site are not suitable habitat for the riparian woodrat, although the narrow bands of riparian habitat along the San Joaquin and Tuolumne Rivers could possibly support a small population.

3. Valley Elderberry Longhorn Beetle

The threatened valley elderberry longhorn beetle is endemic to riparian oak woodlands in California's Central Valley (Barr 1991). The beetle is found only in association with its host plant, elderberry (*Sambucus* spp.), where it spends its entire life cycle that takes 1-2 years to complete.

Adults feed on the foliage and possibly flowers. Females lay eggs in bark crevices and, after hatching, larvae bore into the pith of larger stems. The beetle spends most of its life cycle in the larval stage, living within the stems of the elderberry plant and, after

maturity, it emerges through an exit hole in the stem. Barr (1991) conducted extensive surveys, which determined the extent of the beetle's distribution and established that it requires elderberry with stems of a minimum diameter of approximately 2.5 cm (1 in). Research has also indicated that VELB has limited dispersal abilities, which suggests isolated riparian habitat is less likely to be colonized (Collinge et al. 2001). Additionally, VELB or its host plant may be negatively impacted by insecticide or herbicide drift.

4. Least Bell's Vireo

The historic range of the endangered least Bell's vireo extended from Tehama County, California to Baja California in Mexico. Formerly abundant in riparian forests of the Central Valley of California, loss of habitat through conversion to agriculture and urban uses, as well as the invasion of California by the parasitic brown-headed cowbird (*Molothrus ater*) have contributed to its decline (RHJV 2004). Currently, least Bell's vireo is restricted to eight counties in southern California and Yolo County.

Breeding habitat includes 3-5 year old willow thickets within a dense herbaceous understory (e.g., native mugwort). Nests are usually low in a shrub or tree, near the edge of a thicket. A critical structural component is a dense shrub layer 0.6-3 meters above ground (TNC 2000).

Brood parasitism by brown-headed cowbirds is a significant threat to vireo populations. Grazing in riparian areas has reduced the habitat preferred by the least Bell's vireo. Grazed areas, row crops, and orchards provide foraging habitat for the brown-headed cowbird (RHJV 2004). Vireos that are forced into fragmented or marginal nesting areas are more vulnerable to parasitism. Minimizing habitat patchiness may reduce rates of cowbird parasitism and restoration projects targeting the vireo should be located in areas free of brown-headed cowbirds. A recent analysis of brown-headed cowbird parasitism on the Refuge suggested that, for other species with nesting habits similar to the vireo, rates of parasitism are not so high that they should cause concern for restoring vireo habitat (Dettling et al. 2012). Restoring quality breeding habitat and cowbird control have led to population recovery in some areas (Kus 1998, TNC 2000), and current research also suggests that habitat restoration does not lead to an increase in cowbird nest parasitism in vireos (Dybala et al. 2014). Water availability, vegetation structure, and proximity to natural habitat are known to be key components of restoration success and habitat use by the vireo (Kus 1998).

The last documented nesting in the Central Valley was during the 1940s and the vireo was considered extirpated from the Valley by 1980. In June 2005, Point Blue discovered a breeding pair with young in a former agricultural field recently restored to riparian habitat on the Refuge (Howell et al. 2010). This 3-year-old cottonwood/willow stand with a dense native herbaceous understory (native mugwort) is located directly across the San Joaquin River west of the Project site. A pair was also documented on the Refuge in 2006 and a single male was found in 2011 and 2012. However, adequate breeding and nesting habitat for the least Bell's vireo does not currently exist on the Project site.

5. Other Riparian Bird Species

Songbirds are excellent indicators of ecosystem health because they are abundant, distributed within and across habitats, and are sensitive to changes in food supply, vegetation cover, and predator densities (RHJV 2004). The Riparian Habitat Joint Venture has identified several species of birds, termed riparian focal species, as indicators of ecologically healthy riparian systems. Reproductive success on breeding grounds, which is affected by many factors including habitat patch size and shape, fragmentation, and surrounding land use, is the primary factor limiting populations of migrant land birds (RHJV 2004). Twelve of the focal species currently breed on or near the Project site, or would likely do so with some amount of restoration. These species utilize different areas on the floodplain (e.g., gravel bar, woodland, and wetland) and are found in different types of vegetation (e.g., dense shrubs, tree-tops, various understory structures; Fig. 10). As one would expect, there is a wide range of spatial and structural habitat requirements among the species. For example, the common yellowthroat (*Geothlypis trichas*) can have a breeding and foraging territory as small as 0.5 ha (1 ac), while the western yellow-billed cuckoo needs a minimum of 20 ha (50 ac). Some species are not compatible living adjacent to agricultural operations, while the blue grosbeak will nest along roadways and forage in certain types of cultivated crops (RHJV 2004). In general, by creating larger blocks of vegetation with more opportunities for songbirds to nest away from edges, the Project should increase diversity and abundance (and potentially reproductive success) of many species. Size of riparian forest patches has been shown to be a critical determinant of avian response to restoration in the Central Valley (Gardali and Holmes 2011).

The western yellow-billed cuckoo, listed as federally threatened in 2014, is the focal bird species with the largest territory requirement. Thus, this species can be used to evaluate if restoration projects are designed in a way that will provide benefits to the larger community. Restoration projects benefiting the western yellow-billed cuckoo should restore habitat patches a minimum of 20-40 ha (50-100 ac) in size, with a minimum width of 100-200 m (325-650 ft), which would provide marginal habitat. Optimal habitat for a pair would be greater than 80 ha (200 ac), with a width of greater than 600 m (1970 ft). Sites less than 15 ha (38 ac) in size and less than 100 m wide are unsuitable for the western yellow-billed cuckoo (RHJV 2004). The cuckoo also relies on upland areas in addition to riparian areas for consistent food sources. The cuckoo's primary food source, katydid and sphinx moth larvae, hibernate underground and are not available in lowland floodplains during late-spring flooding. Therefore, upland refugia habitats for foraging in wet years should also be a component of cuckoo habitat restoration projects (RHJV 2004).

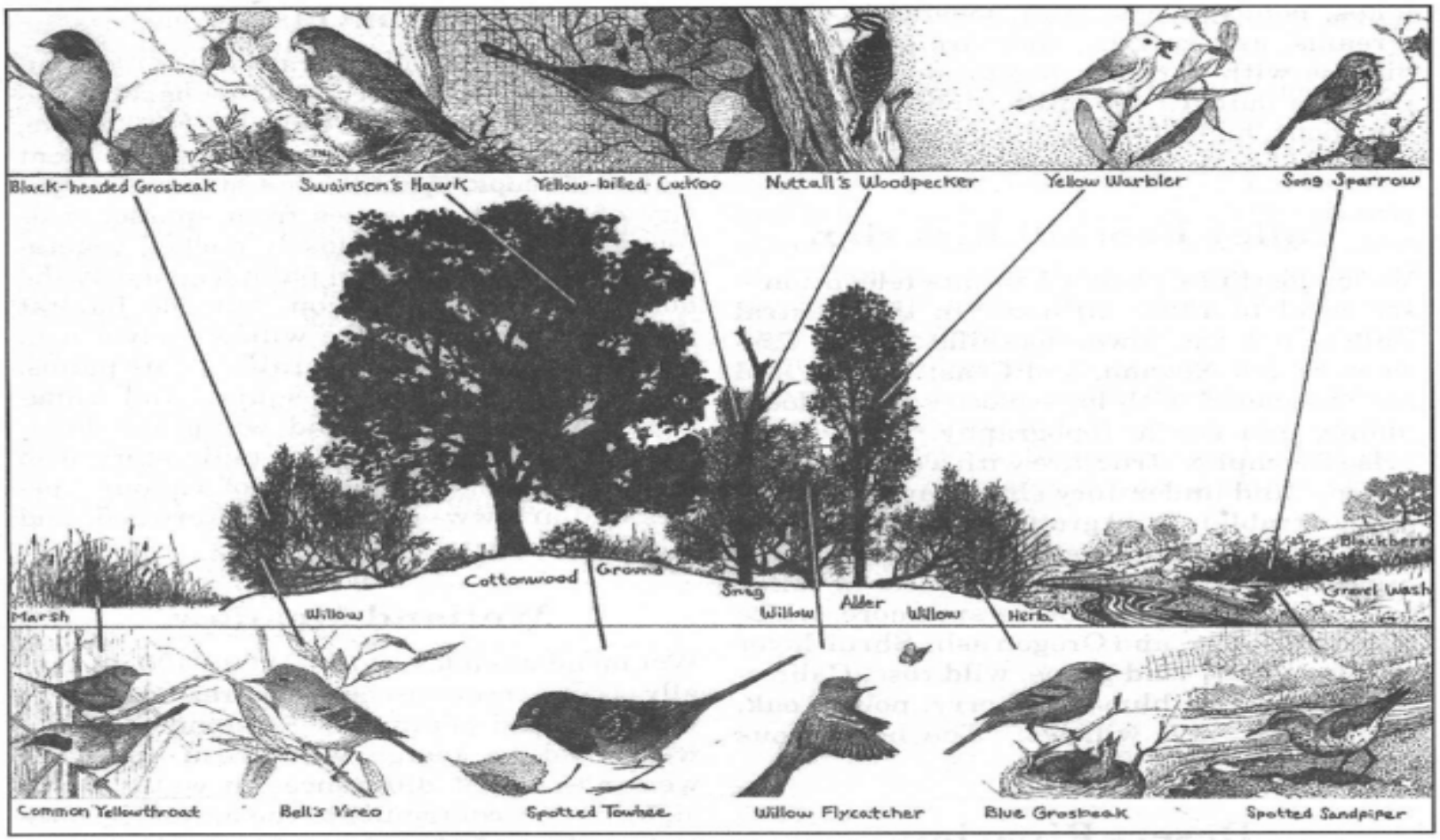

Figure 10. Avian riparian habitat usage and species requirements (RHJV 2004), Dos Rios Ranch, Stanisluas County, CA.

The tricolored blackbird would also benefit from restoration activities with the addition of both nesting and foraging habitat on the Project site. Tricolored Blackbird Statewide Survey, bulrush and cattails are critical nesting substrate (Meese 2014) and are abundant in the Steenstrup Slough. Interestingly, there is also a historic account from 1914 of a breeding colony of tri-colored blackbirds in Steenstrup Slough (Mailliard 1914), adding impetus to efforts to enhance the slough through present-day restoration activities.

6. Anadromous Fish

The USFWS Anadromous Fish Restoration Program (AFRP) calls for habitat restoration and flow management for the benefit of fall-run Chinook salmon and steelhead in the San Joaquin and Tuolumne Rivers. Furthermore, the recent National Marine Fisheries Service (NMFS) Recovery Plan for evolutionarily significant units of Chinook salmon and steelhead populations highlights riparian and floodplain habitat restoration along the San Joaquin River as priority Recovery Actions for these species (NMFS 2014).

Riparian restoration and floodplain reconnection at the Project site will directly support native fish conservation and species recovery efforts in the San Joaquin Valley. Planting native riparian forests in fields adjacent to the San Joaquin and Tuolumne Rivers (Fig. 11) will create additional shaded riverine aquatic habitat, enhance in-stream habitat conditions, and increase terrestrial inputs to aquatic environments. Construction of floodplain benches will create frequently-activated floodplain habitat benefiting native fish, which will also benefit from the broader-scale reconnection of the Project site floodplain to both rivers. These benefits dovetail with regional planning efforts by conservation stakeholders across the Central Valley to create viable floodplain habitat for various fish species as part of large-scale restoration efforts.

In addition, although planning for these activities are still in the conceptual stages and are outside the scope of this Plan, we are collaborating with USFWS AFRP, California Trout, and academic researchers from the University of California Davis to explore the potential of inundating portions of restored fields at Dos Rios Ranch with river water in non-flood years to create floodplain rearing habitat for juvenile anadromous fish. One potential outcome of this initiative is the establishment of experimental research sites on Dos Rios Ranch to examine effects of factors such as water source (San Joaquin versus Tuolumne Rivers) and vegetative substrate (such as different native species associations) on juvenile native fish survival and growth.

Table 4. Summary of riparian bird focal species habitat requirements (RHJV 2004), Dos Rios Ranch, Stanislaus County, CA.

Bird Species	Territory/Patch Size	Proximity to Water	Vegetation Structure	Nesting
Least Bell's vireo (*Vireo bellii pusillus*)	0.8-1.2 ha (2-3ac); >250 m wide patch	Within 300 m	Dense willow shrubs 3-5 m tall; mugwort understory	Nest low, within 1 m of ground
Bank swallow (*Riparia riparia*)	8-20 cm between nest burrows	In riparian zone	----	Burrows in alluvial soils
Black-headed grosbeak (*Pheucticus melanocephalus*)	200 m x 50 m	50-300 m	Vertical complex - Cottonwood, willows, wild grape	Nest height 3-4 m
Blue grosbeak (*Guiraca caerulea*)	----	In riparian zone	Low herbaceous, upright stems, open canopy	Nest height 0.6-3 m
Common yellowthroat (*Geothlypis trichas*)	0.4-2 ha (1-5 ac)	In riparian zone	Tall emergent wetland edges	Nest height 0-0.6 m
Song sparrow (*Melospiza melodia*)	Variable	Near, within 50 m	Open canopy; dense herbaceous layer	Low to ground; <1 m
Swainson's hawk (*Buteo swainsoni*)	Variable, depending on proximity to foraging habitat	Not riparian obligate	Tall trees in riparian zone near open foraging areas	Nest in tall trees
Warbling vireo (*Vireo gilvus*)	1.2 ha (3 ac)	Associated with streams	Large trees with semi-open canopy	Variable height
Willow flycatcher (*Empidonax traillii*)	<1.0 ha (<2.5 ac)	Nests near water	Dense willows; 0-3 m height of dense cover, low tree cover	Nests near water; height 0.6-3 m
Wilson's warbler (*Wilsonia pusilla*)	0.4-1.2 ha (1-3 ac)	Nests near water	Willow, alder, and shrub thickets	Usually nests on ground
Yellow-breasted chat (*Icteria virens*)	<5 ha (<12 ac)	Prefers near wetlands	Dense thickets of willows and blackberries	Nests in vines and shrubs
Western yellow-billed cuckoo (*Coccycus americanus occidentalis*)	20-80 ha (50-200 ac)	Nests near or over water	Willow-cottonwood thickets	Nest 1.3-13 m high
California yellow warbler (*Dendroica petechial brewsteri*)	0.06-0.75 ha (0.15-1.9 ac)	Wet areas	Willows, cottonwoods, early successional	----
Tricolored blackbird (*Agelaius tricolor)*	Variable	In riparian zone	Freshwater marshes with cattail and tule	1.5-3 m depending on nesting site

Figure 11. Active riverbank adjacent to Project field along the San Joaquin River, Dos Rios Ranch, Stanislaus County, CA.

H. Recreation

During the active stages of restoration, access will be limited to permitted activities such as site visits by funders and partners, volunteer events, and research collaborations. Upon completion of active restoration at Dos Rios Ranch and transference of the property to a agency for long-term management, a suite of public uses will be scoped and ultimately implemented by the managing agency. Public use planning for the Project site, and Dos Rios Ranch as a whole, will be described in more detail in the *Public Use Plan* currently in preparation for the California Department of Water Resources.

Given the breadth and duration of restoration activities planned for the Project site and for Dos Rios Ranch as a whole, there will be many volunteer opportunities for smaller groups to assist in the restoration process. Similar events have already occurred during planting of Phase 1 fields, and involved a variety of local teachers, students, and other community members. These volunteer activities allow participants learn about restoration, install plants in the ground and leave a lasting positive mark on the landscape.

III. CONCEPTUAL SITE MODEL

The principles described in this section will guide the implementation of the project. This conceptual site model:

- Presents our understanding of the physical and biological factors that influence site ecology;
- Outlines our restoration strategy;
- Provides an overview of the plant design; and
- Identifies ecological benefits and targeted wildlife species.

A. Past Environmental Conditions

Prior to European settlement, the Project site was part of a dynamic floodplain that supported structurally diverse riparian vegetation. Channel movement under undammed conditions resulted in numerous flood-channels across the floodplain where river processes created seedbeds for many woody species and sustained this vegetation long enough to provide habitat for a rich diversity of wildlife. Gold mining activities on the Tuolumne River in the 1800s and conversion of the floodplain to agricultural uses along the Tuolumne and San Joaquin rivers in the 1900s removed much of the riparian vegetation in the area, typically leaving a narrow band along the river. Based on our review of historic images, the Project site supported a mosaic of different conditions and communities prior to development.

B. Future Environmental Conditions

Regional climate models project mean annual temperature increases of 1.4-2.0°C by 2070 (Point Blue 2011). Warmer winter temperatures are expected, as well as earlier warming in the spring and increased summer temperatures. Local land use and land cover may interact with climate change to exacerbate changes in local temperatures (Point Blue 2011). Regional climate models also project a decrease in mean annual rainfall of 23-81 mm by 2070, although there is substantial uncertainty in precipitation predictions due to modeling assumptions (Point Blue 2011). Extremes in weather (e.g., longer, more pronounced heat waves) are also expected to increase across the state (California Climate Change Center 2012). These predictions have important implications for restoration planning in California's Central Valley, and necessitate a "climate-smart" restoration approach to the Project described in more detail in later sections of this Plan.

C. Likely Successional Patterns without Restoration

Without restoration, the Project site will provide unsuitable conditions and poor habitat for riparian obligate species, including the species being targeted by the Project. In the absence of farming, succession is likely to follow the pattern we have observed on abandoned flood-prone agricultural lands on many Central Valley rivers. Aggressive non-native species, such as common reed, Johnson grass, perennial pepperweed, yellow starthistle, and annual grasses would flourish on the rich soils and ample soil moisture found within the project area. These weeds compete for sunlight and moisture and often competitively exclude native seedlings. In addition, these weeds (and the lack of flooding to keep rodent populations in check) provide ideal habitat for rodents, which

in turn can girdle young trees or consume seeds and acorns. With these pressures, native plant recruitment can be slow and abandoned sites are likely to be dominated by non-native plants for decades.

D. Comparison of Site to Nearby Vegetation (Reference Sites)

One of the fundamental components of a restoration plan is the identification of reference sites to use as guides for developing the list of species to be planted and their pattern across the restoration site. Due to the long history of human modifications to flow patterns, vegetation, and topography of the Project site, reference sites on the property are very rare.

Historic aerial photographs (River Partners 2006) show diverse riparian vegetation, varying in individual plant stature and density across undisturbed areas on the Project site. Larger trees appear to be valley oak in a density that, in some areas, approaches the definition of a forest (>80% tree cover). Many areas support a shrubby understory while other areas appear more open, without trees or shrubs, which would suggest a different soil composition or depth to the water table.

“Natural” areas, dominated by black willow, valley oak, box elder and cottonwood, exist to the west on the Refuge (Christman Island and Gardner’s Cove). Black willow and valley oak are much more tolerant of fire and drought conditions compared to other riparian species, which may be greatly reduced in abundance or become completely lost (e.g., arroyo willow). Consequently, many of the recommendations listed below are derived from inferences based upon the presence of species on the Refuge. For example, nowhere on Gardner’s Cove are there examples of mixed riparian forest; only small patches (< 1 ac) of black willow-buttonbush scrub exist along Hospital Creek as it flows north along a former channel of the river. Small groves (<10 ac) of valley oak forest (without elderberry) can be found and support a very rich understory composed exclusively of natives. Arroyo willow can be found at only a few locations, where it is growing on the Columbia soil type.

E. Restoration Strategies for the Project

1. Employ Both Active and Passive Restoration Techniques

Active restoration employs modern farming techniques to efficiently and rapidly establish native riparian vegetation. This type of restoration has been extremely successful on over 2,500 ac of the Refuge, Phase 1 restoration at Dos Rios Ranch, and numerous past and present projects throughout the Central Valley. Tasks include site preparation, native plant species propagation and planting, ongoing weed control, and irrigation throughout the growing season for up to three years. Advantages of this method include the ability to conduct large-scale restoration resulting in diverse riparian vegetation and high-quality wildlife habitat in a relatively short amount of time. Since this method utilizes essentially the same techniques as those used to establish commercial orchards, overall costs can be reduced and local farmers can be contracted to carry out portions of the implementation - a great outreach benefit.

Active restoration techniques are contrasted with passive restoration techniques that often involve minimal input to restore riparian forests, typically limited to site preparation and managed flooding to mimic the historic recession limb of the annual hydrograph (Holl and Aide 2011). In contrast to active restoration, passive restoration does not involve the direct reintroduction of native propagules via seeds, cuttings, or container stock. In certain situations where natural recovery is anticipated, such as on project sites with minimal weeds and a well-stocked native soil seed bank (or robust dispersal of native seeds via wind or water), passive restoration can be effective in re-establishing some degree of native plant communities. In the Central Valley, however, purely passive restoration approaches have been largely unsuccessful for large-scale restoration projects due to the vast numbers of exotic species that may rapidly outgrow, and outcompete native tree and shrub seedlings. Native understory species are also largely absent with direct human intervention. There are additional concerns that purely passive restoration may result in forests of low species and structural diversity, which would limit wildlife value compared to a more diverse mixture of trees and shrub species. In addition, there are challenges to using a purely passive restoration approach to effectively create wildlife habitat, given the often highly specific habitat structural requirements of target species previously discussed.

At Dos Rios Ranch, the adjacent Refuge, and other project sites throughout California, River Partners primary active restoration techniques are being augmented by elements of passive restoration – especially floodplain reconnection and managed floods that have multiple benefits including flood attenuation and re-establishment of active river processes that will enhance the trajectory of habitat development into the future.

2. Recognize Current Site Conditions and Management Objectives

The riparian vegetation to be restored is a pragmatic design that considers current physical and biological site conditions (e.g., leveled fields, altered hydrograph, weed pressure, etc.), wildlife needs, and landowner and neighbor concerns. The design is not based strictly on a “historical” or “climax” vegetation target, although it is strongly influenced by historical presence of native species.

3. Consider Multiple Time Frames

Restoration can have long- and short-term successional endpoints. For example, in the long run (greater than 30-80 years) some areas planted with Fremont cottonwood will convert via succession to valley oak woodland. In the meantime, fast growing, but relatively short-lived plants will provide important habitat for threatened and endangered species (i.e. structure, large woody debris, etc.), as the more shade-tolerant valley oaks mature. The advantage of this “two forest” approach is that the faster growing species, such as Fremont cottonwood and willows, will provide almost immediate structure and cover for wildlife, as the more shade-tolerant valley oaks mature. Once established, these species may persist for decades.

4. Implement Climate-smart Restoration Strategies

In recognition of present and future impacts of climate change, River Partners plans and implements climate-smart restoration designs to ensure projects are resilient to future

conditions. Point Blue Conservation Science has adopted a framework for climate-smart restoration that also aligns with River Partners' approach, based on five core principles: (1) set goals informed by historical conditions, but that also consider future climatic conditions; (2) consider the broader context of individual projects, including regional or landscape-scale prioritization and non-climate change stressors; (3) incorporate ecological insurance into restoration projects by emphasizing redundancies and ecological diversity such that projects are robust to a range of future scenarios; (4) incorporate evolutionary resilience by seeking to increase patch size and connectedness, and ensuring species used in restoration will be adapted to future conditions; and (5) include the human community to build public support and foster environmental stewardship into the future. More broadly, riparian restoration has been identified as one of the most directly beneficial conservation actions to address climate change in California (Seavy et al. 2009).

5. Use an Adaptive Management Approach to the Project

Using an adaptive management approach provides a framework to evaluate project progress and respond to new information. Maintaining feedback between project planning, implementation, monitoring, and evaluation is essential to making recommendations on future restoration activities, site management (short- and long-term), and ultimately project success.

6. Construction of High-ground Flood Refugia

To mimic historic floodplain topography and support wildlife conservation, high-ground flood refugia ("bunny berms") will be constructed in strategic locations in Project fields. A similar approach was taken during Phase 1 restoration efforts, as well as at the Refuge. Refugia will be constructed of compacted fill and built large enough to provide viable wildlife habitat and high enough to prevent submersion during severe floods. Refugia will range in shape from rectangular to irregular and cover an area of approximately 2.5-5+ acres each depending on location in the floodplain (Fig. 12). Refugia elevation will be sufficiently high to provide dry land during large flood events (e.g., a 50-yr event) and will be densely planted with native vegetation (described in detail in a later section). Project fields 4, 8, 10, 12, and 14 have been selected as locations for refugia (Fig. 12), with some constructed near remnant habitat patches and others constructed in more open locations to maximize the provision of high ground during flood events. An additional consideration for refugia location and configuration is the need to minimize erosion of refugia during large flood events. In addition to vegetated refugia on the floodplain, it would be beneficial to wildlife to eventually install native vegetation on the banks of the USACE levee that borders the Project area.

7. Modification of Existing Farmer Berms

Restoration actions regarding the network of existing farmer berms on the Project site are guided by topography, historic patterns of flooding, concerns about impacts to adjacent landowners, the relationship of berms to planned locations of high-ground flood refugia, floodplain benches, and ephemeral swales, as well as Project goals of floodplain reconnection, small flood attenuation and habitat restoration. Berms in locations that are integral to floodplain reconnection and flood attenuation will be

modified or removed altogether (Fig. 12). Berms protecting neighboring fields to the east of the Project site will be reinforced, as will be berms on the low side of the small lake in order to prevent native fish from being stranded during flood events (Fig. 12). Berms in other locations will either be allowed to naturally revegetate with native species to provide additional high-ground habitat, or will be left in their present state (Fig. 11).

8. Construction of Floodplain Benches and Ephemeral Swales

In order to improve off-channel rearing and foraging habitat for anadromous fish, as well as habitat for a range of other wildlife species, a series of floodplain benches will also be constructed on the Project site in order to produce frequently-activated floodplain (Fig. 11). These benches will be graded to an elevation allowing for approximately 2 to 3 year flood return intervals. During bench construction, existing native riparian habitat will be retained to add habitat complexity, pockets of higher ground, and secondary channels. Ephemeral swales will be constructed on the Project floodplain to increase habitat heterogeneity, provide habitat for waterfowl and wading birds, enhance drainage, and reduce potential fish entrainment following flood events (Fig. 12). Swales will be graded to achieve the latter two objectives. A balanced cut-fill approach will be used during earthwork activities: materials excavated to modify berms and to construct swales and benches will be used to reinforce other berms and to construct high-ground flood refugia to minimize costs of construction.

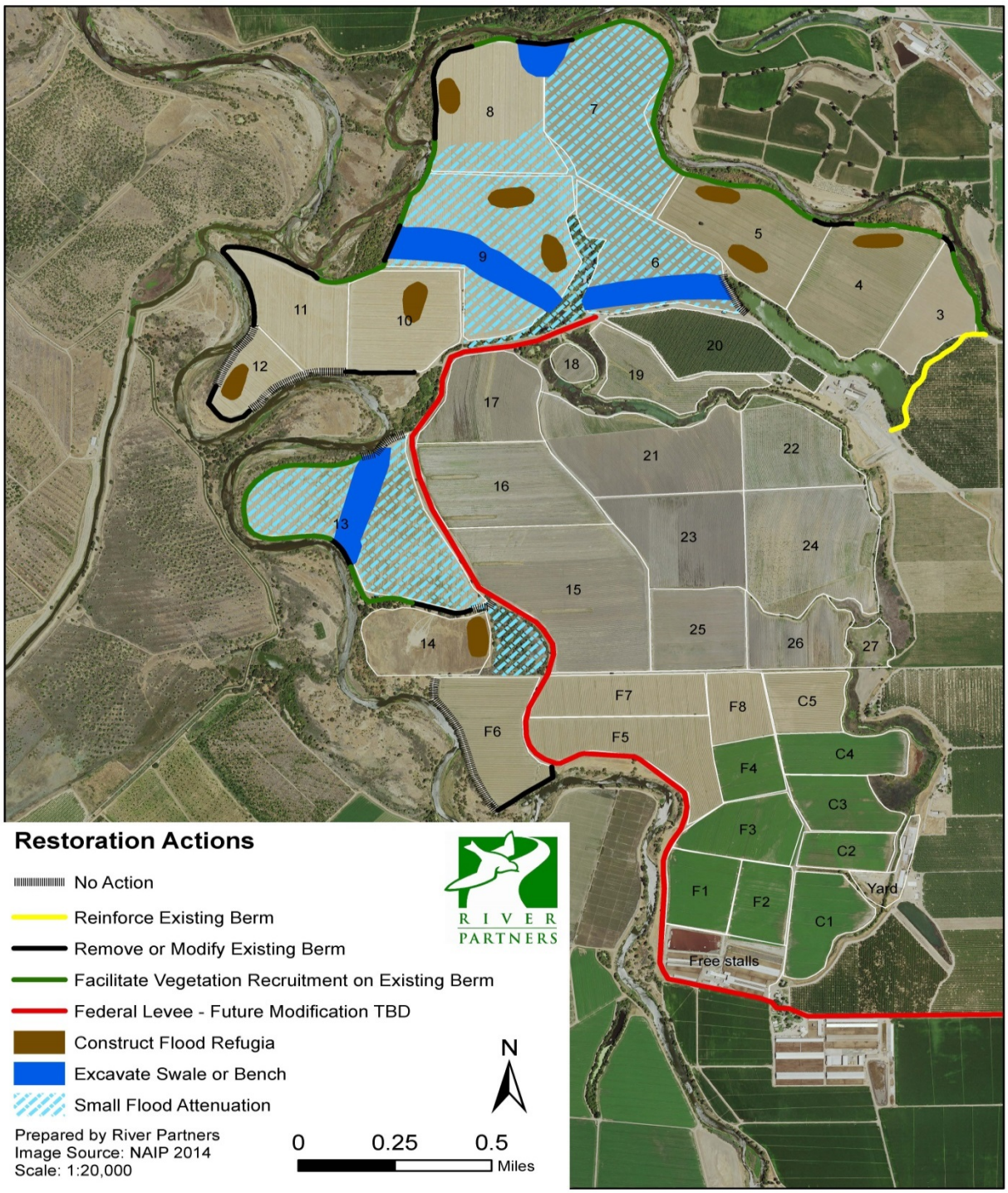

Figure 12. Restoration actions regarding existing flood control berms ("farmer berms"), the USACE levee, high-water flood refugia, ephemeral swales, and floodplain benches, overlain with predicted regions of flood attenuation, Dos Rios Ranch, Stanislaus County, CA.

F. Identification of Ecological Benefits and Target Wildlife Species

Riparian areas harbor the most diverse array of wildlife species of any other habitat in California. This Project has considerable potential for converting the floodplain to flood-compatible uses, improving floodplain-river channel connectivity, and restoring critical wildlife habitat for endangered and other at-risk species. Actively restoring the site will provide critical habitat and conditions for a variety of species over a relatively short time, which will be enhanced through passive reconnection of the two rivers to historic floodplains. Benefits will be enhanced by the Project's location and close proximity to existing habitat and other restoration projects:

- Flooding and potential transient floodwater storage on approximately 1,000 acres of historic floodplain will be facilitated via floodplain reconnection;
- Physical river processes of scour and deposition will be promoted through development of sediment trapping zones and removal of bank debris;
- The riparian brush rabbit, riparian woodrat, and other terrestrial wildlife species will benefit from the abundance of low, dense shrub cover in this planting design that will provide nesting habitat and predator cover for survival and dispersal;
- During flood events, constructed high-ground refugia will provide important flood refugia as well as food and cover for the endangered riparian brush rabbit, as well as other terrestrial wildlife;
- Multiple species of migratory and resident birds, including least Bell's vireo, will use the structurally diverse vegetation for breeding, migration stopover, and overwintering;
- Rearing and foraging habitat for native anadromous fish including Chinook salmon and steelhead trout will be enhanced via shaded riverine aquatic habitat and the reconnected floodplain; and
- Suitable habitat will also be enhanced for the valley elderberry longhorn beetle
- Regional-scale resilience to climate change will be increased through large-scale, climate-smart riparian restoration.

IV. PLANTING DESIGN

River Partners' planting designs focus on plant associations based on the vegetation series concept described by Sawyer and Keeler-Wolf (1995). Plant series are named for the dominant plant species, but every series also contains other associated plant species. The similar "association" concept provides a useful descriptive label for vegetation differences that allows for design flexibility depending upon project goals. The association concept does not specify arrangement, density, or other quantifiable factors that must also be addressed to translate the conceptual design to field implementation.

A. Design Considerations

Physical and biological factors such as soil characteristics, topography, flood regime, and proximity to remnant vegetation influence the selection of vegetation associations,

as do wildlife habitat goals and various management issues. Collectively, these factors represent the principle design considerations for the Project that are in turn linked directly to the Project objectives (Table 5).

Table 5. Project objectives and design considerations, Dos Rios Ranch, Stanislaus County, CA.

Project Objective	Relevant Design Considerations
Restore flooding and transient floodwater storage to approximately 1,000 acres of historic floodplain and promote physical river processes of scour and deposition through development of sediment trapping zones and removal of bank debris.	Design berm modifications, floodplain benches, and ephemeral swales to provide flood management benefits (sediment trapping and small transient floodwater attenuation) as well as habitat value (see Fig. 11): • Farmer berms in locations that are integral to floodplain reconnection and flood attenuation will be modified or removed (portions of berms bordering fields 7-9, 12-14, and F6; see Fig. 11 for details); • Farmer berm reinforcement will occur in strategic locations to protect neighboring property (SE border of field 3) and to prevent native fish stranding in small lake adjacent to fields 4-6; • Floodplain benches will be constructed in portions of fields 7 and 8 (adjacent to Tuolumne River), as well as field 12 (adjacent to San Joaquin River), in order to increase frequently activated floodplain; • Ephemeral swales will be constructed in fields 9,10, and 13 to complement floodplain reconnection by enhancing drainage, reducing possibility of native fish stranding, and providing additional habitat complexity.
Using local seed and cutting sources, rapidly (< 3 yrs.) establish a mosaic of self-sustaining riparian habitat across the Project site, and maintain high plant species and vegetative structural diversity.	Matching planting associations to different Project areas to create site-appropriate plant communities: • Use locally occurring species designed to promote quick growth of mixed riparian forest with a dense low shrub cover with trellis support species; • Consider influence of soils, topography, hydrology, land-use history, and proximity to remnant habitat; • Utilize a “two-forest” approach using both early- and late-successional species; • Plant dense herbaceous understory layer in year 2 of the Project to control weeds and increase diversity; • Integrate existing irrigation system and maintenance of native vegetation after planting; • Enhance remnant native vegetation and consider interactions with planted species.

Project Objective	Relevant Design Considerations
Restore and enhance habitat for the endangered riparian brush rabbit and riparian woodrat, including provision of high-ground refugia during flood events.	Integrate a network of dense shrubby habitat, on the floodplain and on high-ground flood refugia, in recognition of known rabbit and woodrat habitat preferences: • Use a high proportion of dense, low-stature shrub species such as California blackberry, California rose and golden currant (*Ribes aureum*), and trellis species such as sandbar willow, coyote brush (*Baccaharis pilularis*) and elderberry; • Include a layer of native forbs and grasses (creeping wildrye, mugwort, and gumplant [*Grindelia camporum*]) in close proximity to shrub cover as forage vegetation; • Optimize locations and vegetation composition of high-ground flood refugia based on proximity to remnant habitat, and the existing levee (additional high ground).
Improve nesting and migrating habitat for dozens of avian species, including: • Migratory bird species, including least Bell's vireo, yellow warbler, tricolored blackbird, black-headed grosbeak (*Pheucticus melanocephalus*), fox sparrow (*Passerella iliaca*), white-crowned sparrow (*Zonotrichia leucophrys*), golden-crowned sparrow (*Zonotrichia atricapilla*), Lincoln's sparrow (*Melospiza lincolnii*), hermit thrush (*Catharus guttatus*), and ruby-crowned kinglet (*Regulus calendula*),and other species; • Resident bird species including wrentit (*Chamaea fasciata)*, song sparrow, California quail, and spotted towhee (*Pipilo maculatus*).	Integrate plant associations that will provide a mosaic of species and vegetative structure: • Include specific vegetative and structural elements to mimic known habitat preferences for threatened and endangered avian species, including least Bell's vireo, yellow warbler; • Point Blue data suggests avian diversity is highest in areas with 5-7 shrub spp. over a 50-m^2 area, with goal of varying density to allow light gaps and create structural differences, creating vegetation patches, and herbaceous plantings between plant rows (Geupel et al. 1997); • Enhance habitat along Steenstrup Slough to provide potential habitat for tricolored blackbird, a State and federal species of concern; • Reduce habitat for Brown-headed cowbirds by reducing forest-field edge habitat, increasing core habitat, and reducing weeds in Steenstrup Slough; • More broadly, increase riparian forest patch size in the San Joaquin Valley region.
Restore and enhance habitat for the valley elderberry longhorn beetle (VELB).	Plant elderberry on Project site where appropriate and protect existing remnant elderberry shrubs.
Improve foraging and migratory habitat for steelhead trout, Chinook salmon, and white sturgeon.	• Restore riparian forests near rivers to produce shaded riverine aquatic habitat; • Screen river pumps to prevent fish entrainment; • Create floodplain benches to enhance fish access to floodplain habitat in locations that compliment channel migration; • Design ephemeral swales and modify berms to reconnect floodplains while providing positive drainage to prevent fish entrapment.
Conduct the Project according to climate-smart restoration principles to prepare for future change; reduce the vulnerability of the Project to extreme weather events by including features to maximize resilience to longer and/or more frequent periods of drought or floods.	• Include a mix of woody and understory plant species that are adapted to prolonged dry conditions and also prolonged flood conditions; • Consider possibility of larger future flood events when determining elevations of wildlife flood refugia.

Based on these design considerations, River Partners has developed a Project planting design (Fig. 13) that represents a synthesis of the available information on the site conditions, project objectives, and recommendations from the Department of Water Resources, ESRP, the Riparian Mammals Technical Group, USFWS, Point Blue Conservation Science, USDA NRCS, and other funding and project partners.

B. Rationale for Plant Associations

River Partners' planting design for the Project has six plant associations which includes an herbaceous understory layer (Fig. 13, Table 6). The planting pattern has been designed to achieve a network of dense riparian thickets for flood resiliency, enhanced nesting and foraging cover for wildlife, and dispersal corridors for endangered riparian mammals and other wildlife of conservation concern, as described above. High-density plantings will benefit the riparian brush rabbit and many of the Neotropical migrant songbirds that require dense shrubby vegetation (RHJV 2004). Abundant blackberry rose, golden currant, and sandbar willow in the planting design will form dense thickets that will expand forming a lush riparian shrub habitat. Coyote brush, blue elderberry, and shrubby willows will function as trellis species and provide habitat structure. The recommended plant associations are based upon both what remains along the San Joaquin and Tuolumne rivers and upon inferences based upon soil types, depths to water table, and conditions which support more diverse communities elsewhere in the Central Valley.

Many focal riparian bird species depend upon structurally diverse riparian habitat with dense understory cover (RHJV 2004). Studies by Point Blue suggest that shrub cover is the most important variable influencing nest site and there may be a positive relationship between tree and shrub richness and bird diversity (Geupel et al. 1997; Small et al. 1999, but see Gardali and Holmes 2011). Additionally, Point Blue recommends planting dense shrub patches interspersed with tree/shrub patches, resulting in a semi-open canopy (Hammond et al. 2002).

As previously noted, the Project footprint is within the designated floodway. The result will be that restored vegetation will interact directly with floodwater. In order to accomplish this objective the plantings will need to remain as flood neutral as possible. Riparian plant species have evolved with the flooding cycle and have adapted to these higher flow events. This is due to the dynamic process whereby the plant leaves and stems adopt to a more streamlined position as water pushes against them, especially for more flexible-stemmed species (Chen et al. 2009). The four proposed woody planting associations all contain substantial percentages of flexible stem species (Fig. 13), and 100% of the herbaceous species have flexible stems as well.

River Partners commits to 70% survival of its restoration plantings at the end of the 3 yr. maintenance period. After maintenance is discontinued, plant survival will depend upon differences in soil characteristics, water table depths, disturbance, climate and other factors. Variable plant survival may result in a network of shrub patches at this site with heterogeneous habitat structure that will still enhance wildlife survival and dispersal.

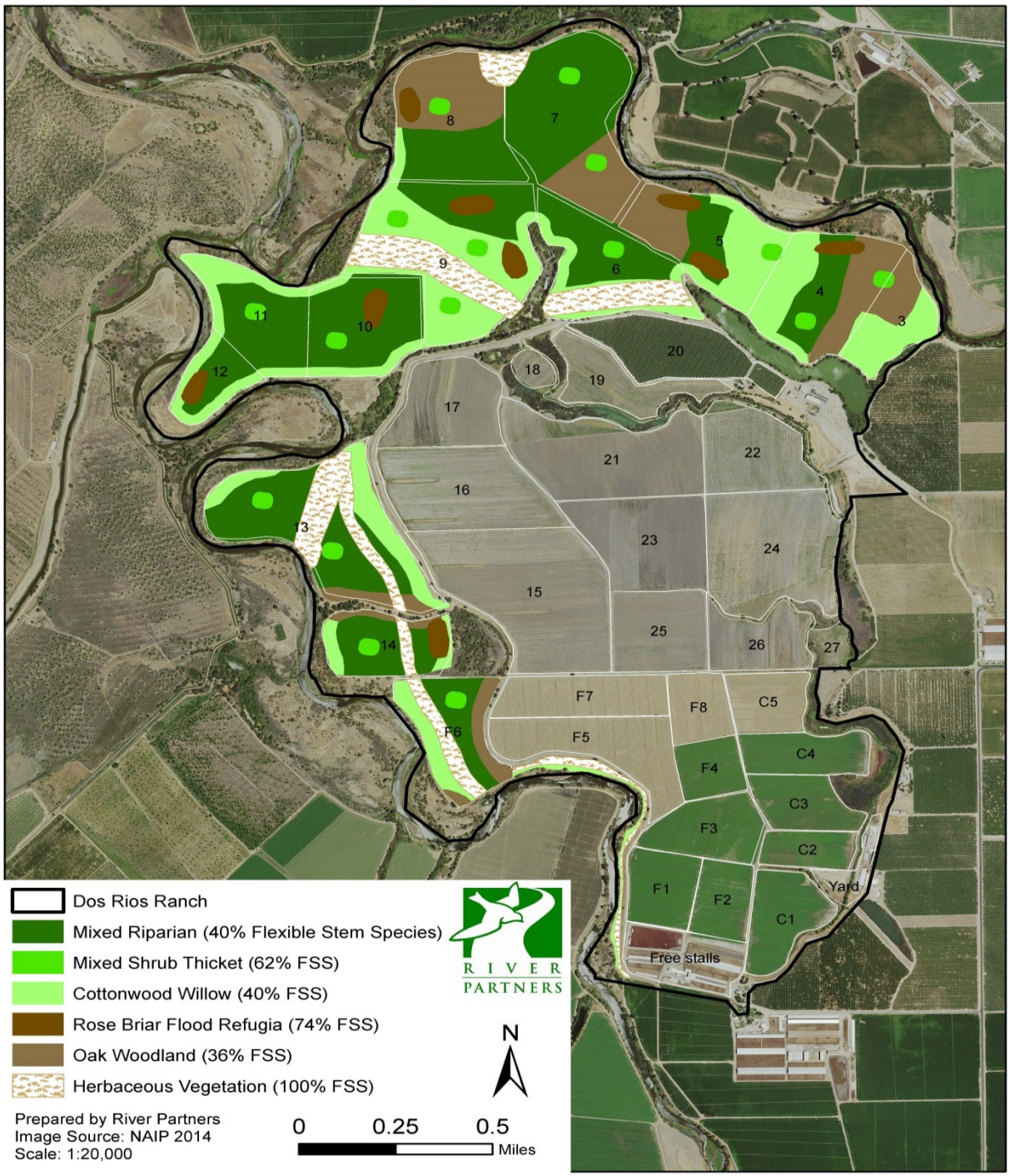

Figure 13. Proposed native plant associations for the Project site, with percentage of flexible-stemmed species for each association, Dos Rios Ranch, Stanislaus County CA.

Table 6. Description and benefits of proposed native woody and herbaceous plant associations for the Project, Dos Rios Ranch, Stanislaus County, CA.

Association	Planting Location Characteristics	Design Characteristics	Habitat Benefits
Mixed Shrub Thicket	Soil: loams Water table: < 12 ft	Composed primarily of shrub species.	Dense thicket of shrubs; briar-patch; cover for riparian brush rabbit, riparian woodrat, and quail; favored by neotropical migrants.
Mixed Riparian	Soil: sandy loams Water table: < 12 ft	Large variety of woody and shrub species. Higher percentage of willow and cottonwood in design.	Favored by many riparian focal bird species (Common Yellow-throat, Western yellow-billed Cuckoo). Because of rapid growth, provides quick structure and habitat for wildlife.
Oak Woodland	Soil: silt and clay loams Water table: > 14 ft	Widely spaced drought tolerant species.	Provides a mixture of fast-growing species (cottonwood and willows) and slow-growing, drought tolerant species (oak), which provide short-term and long-term wildlife habitat.
Cottonwood willow	Soils: sandy loams Water table: < 10 ft	Higher density of cottonwood with accompanying willow and understory species.	Favored by many riparian focal bird species (Common Yellow-throat, Western yellow-billed Cuckoo). Because of rapid growth, provides quick structure and habitat for wildlife. Future roosting sites for egret and heron species.
Rose Briar Flood Refugia	High-water refugia	Composed primarily of shrub species. Multi-species clusters of herbaceous native perennials with creeping wildrye, mugwort and gumplant understory.	Provides thickets for riparian brush rabbits and other terrestrial species seeking refuge from flood waters.
Herbaceous Vegetation	All plant associations and ephemeral swales	Densely planted; composed of aggressive herbaceous understory species. Goal is 80% cover by native species.	Provide varied vegetative mosaic. Reduce invasions by non-native weeds. Provides nesting habitat and substrate for riparian focal bird species including Wilson's warbler and Swainson's thrush. Provides habitat for waterfowl in swale locations. Flexible stems enhance conveyance of floodwater.

C. Composition and Location of Planting Associations

The overall density and numbers of each tree and shrub species are summarized for the Project area (Table 7), for each of the five woody associations (Tables 8-12), and for the herbaceous vegetation association (Table 13). Flexible-stemmed species are represented with an (f) following the common name (see Fig. 13).

Table 7. Total trees and shrubs for the Project, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name	Percent Composition (%)	Density (plants/acre)	Total Number
Tree Species				
Arroyo willow	*Salix lasiolepis*	8%	21	16,624
Black willow	*Salix goodingii*	6%	15	11,481
Fremont cottonwood	*Populus fremontii*	7%	18	13,696
Oregon ash	*Fraxinus latifolius*	4%	9	7,382
Box-elder	*Acer negundo*	6%	15	11,899
Sandbar willow[f]	*Salix exigua*	6%	16	12,589
Valley oak	*Quercus lobata*	9%	21	16,768
Total Trees		**46%**	**116**	**90,439**
Shrub Species				
Blackberry[f]	*Rubus ursinus*	12%	30	23,748
California rose[f]	*Rosa californica*	12%	31	24,256
Coyote brush[f]	*Baccharis pilularis*	4%	11	8,489
Buttonbush	*Cephalanthus occidentalis*	5%	13	10,055
Elderberry	*Sambucus mexicana*	5%	12	9,455
Mulefat	*Baccharis salicifolia*	2%	5	4,292
Golden currant[f]	*Ribes aureum*	10%	25	19,717
Quail Bush	*Atriplex lentiformis*	3%	9	6,716
Total Shrubs		**54%**	**137**	**106,728**
Totals		**100%**	**252**	**197,167**

[f] represents flexible stem plant species

1. Mixed Shrub Thicket Association

The Mixed Shrub Thicket association (Table 8), with its high percentage of rose and blackberry, will form structurally complex, dense shrubby vegetation to target the riparian brush rabbit, riparian woodrat, and many focal riparian bird species. This association will be planted at density of 545 plants/acre on approximately 42 acres of the Project site, and will buffer the high-ground flood refugia (Fig. 13). The higher density of elderberry shrubs will provide habitat for the valley elderberry longhorn beetle. This association has a lower number of large woody plants such as black willow and cottonwood.

Table 8. Composition of the Mixed Shrub Thicket association, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name	Percent Composition (%)	Density (plants/acre)	Total Number
Tree Species				
Arroyo willow	*Salix lasiolepis*	8%	44	1,831
Valley oak	*Quercus lobata*	4%	22	916
Sandbar willow[f]	*Salix exigua*	2%	11	458
Black willow	*Salix goodingii*	2%	11	458
Box-elder	*Acer negundo*	2%	11	458
Fremont cottonwood	*Populus fremontii*	2%	11	458
Total Trees		**20%**	**109**	**4,578**
Shrub Species				
California rose[f]	*Rosa californica*	20%	109	4,578
Blackberry[f]	*Rubus ursinus*	20%	109	4,578
Buttonbush	*Cephalanthus occidentalis*	2%	11	458
Coyote brush[f]	*Baccharis pilularis*	8%	44	1,831
Elderberry	*Sambucus mexicana*	10%	55	2,289
Mulefat	*Baccharis salicifolia*	6%	33	1,373
Golden currant[f]	*Ribes aureum*	10%	55	2,289
Quail Bush	*Atriplex lentiformis*	4%	22	916
Total Shrubs		**80%**	**436**	**18,312**
Totals		**100%**	**545**	**22,890**

[f] represents flexible stem plant species

2. Rose Briar Flood Refugia Association

The Rose Briar association (Table 9), which is dominated by rose and blackberry, will provide quick dense shrub cover with some trellis support and winter foliage on constructed high-ground flood refugia (bunny berms). This association will be planted at a density of 871 plants/acre on approximately 20 acres of bunny berms (Fig. 13). Planted species will contribute to the structural complexity of the restored vegetation and enhance habitat particularly for the riparian brush rabbit and many focal riparian bird species including the least Bell's vireo.

Table 9. Composition of the Rose Briar Flood Refugia association, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name	Percent Composition (%)	Density (plant/acre)	Total Number
Tree Species				
Arroyo willow	*Salix lasiolepis*	8%	70	1,394
Total Trees		**8%**	**70**	**1,394**
Shrub Species				
Blackberry[f]	*Rubus ursinus*	20%	174	3,484
Elderberry	*Sambucus mexicana*	12%	105	2,090
Coyote brush[f]	*Baccharis pilularis*	12%	105	2,090
California rose[f]	*Rosa californica*	20%	174	3,484
Golden currant[f]	*Ribes aureum*	10%	87	1,742
Quail Bush	*Atriplex lentiformis*	10%	87	1,742
Mulefat	*Baccharis salicifolia*	8%	70	1,394
Total Shrubs		**92%**	**801**	**16,026**
Totals		**100%**	**871**	**17,420**

[f] represents flexible stem plant species

3. Mixed Riparian Association

The Mixed Riparian association (Table 10) has a diverse mix of tree and shrub species and will provide a robust understory of rose and blackberry. The willow species are more dominant in this association which should thrive with on high water table and fertile soils. Valley oak, Oregon ash and box elder are also included in the planting design for this association. This association will be planted at a density of 227 plants/acre on approximately 335 acres of the Project site (Fig. 13).

Table 10. Composition of the Mixed Riparian association, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name	Percent Composition (%)	Density (plants/acre)	Total Number
Tree Species				
Arroyo willow	*Salix lasiolepis*	8%	18	6,084
Black willow	*Salix goodingii*	8%	18	6,084
Fremont cottonwood	*Populus fremontii*	8%	18	6,084
Oregon ash	*Fraxinus latifolius*	4%	9	3,042
Box-elder	*Acer negundo*	8%	18	6,084
Sandbar willow[f]	*Salix exigua*	8%	18	6,084
Valley oak	*Quercus lobata*	10%	23	7,605
Total Trees		**54%**	**123**	**41,064**
Shrub Species				
Blackberry[f]	*Rubus ursinus*	10%	23	7,605
California rose[f]	*Rosa californica*	10%	23	7,605
Coyote brush[f]	*Baccharis pilularis*	4%	9	3,042
Buttonbush	*Cephalanthus occidentalis*	4%	9	3,042
Elderberry	*Sambucus mexicana*	4%	9	3,042
Golden currant[f]	*Ribes aureum*	10%	23	7,605
Quail Bush	*Atriplex lentiformis*	4%	9	3,042
Total Shrubs		**46%**	**104**	**34,981**
Totals		**100%**	**227**	**76,045**

[f] represents flexible stem plant species

4. Oak Woodland Association

The Oak Woodland association (Table 11) also has a diverse mix of species, including valley oak and box elder as the dominant tree species and a robust understory of rose and blackberry. This association also includes coyote brush, the only evergreen plant in the riparian zone, thereby providing cover for rabbits and other wildlife during the winter. This association will be planted at a density of 227 plants/acre on approximately 112 acres of the Project site (Fig. 13).

Table 11. Composition of the Oak Woodland association, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name	Percent Composition (%)	Density (plants/acre)	Total Number
Tree Species				
Arroyo willow	*Salix lasiolepis*	4%	9	1,017
Valley oak	*Quercus lobata*	18%	41	4,576
Sandbar willow[f]	*Salix exigua*	2%	5	508
Black willow	*Salix goodingii*	2%	5	508
Box-elder	*Acer negundo*	8%	18	2,034
Fremont cottonwood	*Populus fremontii*	2%	5	508
Oregon ash	*Fraxinus latifolia*	4%	9	1,017
Total Trees		**40%**	**91**	**10,170**
Shrub Species				
California rose[f]	*Rosa californica*	12%	27	3,051
Blackberry[f]	*Rubus ursinus*	10%	23	2,542
Buttonbush	*Cephalanthus occidentalis*	4%	9	1,017
Mulefat	*Baccharis salicifolia*	6%	14	1,525
Coyote brush[f]	*Baccharis pilularis*	6%	14	1,525
Elderberry	*Sambucus mexicana*	8%	18	2,034
Golden currant[f]	*Ribes aureum*	10%	23	2,542
Quail Bush	*Atriplex lentiformis*	4%	9	1,017
Total Shrubs		**60%**	**136**	**15,254**
Totals		**100%**	**227**	**25,424**

[f] represents flexible stem plant species

5. Cottonwood Willow Association

The 244 acres cottonwood willow community will be planted in all fields excluding field 7. This plant association will border some of the lower elevations of each field and along remaining sloughs or waterways. The majority of this association consists of mesic species such as buttonbush, willows and Oregon ash (Table 13). The cottonwood willow community has a 40% flexible stem plant composition.

Table 12. Composition of Cottonwood Willow association, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name	Percent Composition (%)	Density (plants/acre)	Total Number
Tree Species				
Arroyo willow	*Salix lasiolepis*	12%	27	6,647
Black willow	*Salix goodingii*	8%	18	4,431
Fremont cottonwood	*Populus fremontii*	12%	27	6,647
Oregon ash	*Fraxinus latifolius*	6%	14	3,323
Box-elder	*Acer negundo*	6%	14	3,323
Sandbar willow	*Salix exigua*	10%	23	5,539
Valley oak	*Quercus lobata*	6%	14	3,323
Total Trees		**60%**	**136**	**33,233**
Shrub Species				
Blackberry	*Rubus ursinus*	10%	23	5,539
California rose	*Rosa californica*	10%	23	5,539
Buttonbush	*Cephalanthus occidentalis*	10%	23	5,539
Golden currant	*Ribes aureum*	10%	23	5,539
Total Shrubs		**40%**	**91**	**22,155**
Totals		**100%**	**227**	**55,388**

6. Herbaceous Vegetation Association

The restoration of an herbaceous understory is an important component of the Project because invasive weeds, such as Russian knapweed, perennial pepperweed, Johnson grass and common reed threaten riparian habitat along both rivers including the existing riparian habitat fragments on the Project site. These invasive species tend to out-compete native species and form monotypic stands with little habitat value.

Maintenance activities during the restoration process will prevent these invasive species from establishing in the fields, just as farming activities have in the past. However, at the end of the maintenance period, restored areas will still be at high risk of re-invasion. Consequently, planting a dense, highly competitive, flood-tolerant understory association (Table 13) throughout the Project area, including approximately 25 acres of ephemeral swales, will significantly increase restored community resistance to weeds.

Through experimental plantings and adaptive management, River Partners has successfully established mugwort, gumplant, and creeping wildrye on over 2,500 ac of the Refuge, resulting in nearly 80% native cover after two growing seasons. We expect that once established, these cover species will compete against perennial pepperweed and Johnson grass while providing pollinator resources as well as nesting substrate and foraging habitat for wildlife.

Table 13. Composition of the Herbaceous Vegetation association, Dos Rios Ranch, Stanislaus County, CA.

Common name	Scientific name	Seeding Rate PLS
Creeping wildrye[f]	*Elymus triticoides*	0.5 lbs./ac
Gumplant[f]	*Grindelia camporum*	2.6 lbs./ac
Mugwort[f]	*Artemisia douglasiana*	6 lbs./ac

[f] represents flexible stem plant species

Additional herbaceous understory species (Table 14) can be opportunistically incorporated into the planting design near remnant habitat found along existing sloughs. Populations of these native herbaceous plants occur in a few small patches scattered on the Project site. These species were common in historical riparian forests prior to river flow regulation. Inclusion of these species would enhance provision of pollinator resources and habitat for wildlife.

Table 14. Potential additional herbaceous native species for the Project, Dos Rios Ranch, Stanislaus County, CA.

Common Name	Scientific Name
Creeping rush[f]	*Juncus balticus*
Basket sedge[f]	*Carex barbarae*
California loosestrife[f]	*Lythrum californicum*
Dogbane[f]	*Apocynum cannabininum*
Hedge nettle[f]	*Stachys ajugoides*
Milkweed[f]	*Asclepias fascicularis*
Marsh fleabane[f]	*Pluchea odorata*
Western goldenrod[f]	*Euthamia occidentalis*
Telegraph weed[f]	*Heterotheca grandiflora*
Evening primrose[f]	*Oenothera* spp.
Stinging nettle[f]	*Urtica dioica*

[f] represents flexible stem plant species

D. Planting Tiles and Baseline Data

River Partners has developed a digital database system that identifies the plant species at a particular row and planting location within the field. This planning tool allows us to develop specific planting patterns that will create a vegetation mosaic of structural patterns within the restoration planting. Each plant will receive a computer-generated label that lists its row and plant number, location, plant species name and numeric code. The labels will be installed on stakes in the field prior to planting, allowing us to clearly

communicate the plan to the planting crew. In the future, the database will be an important adaptive management tool because it will allow us to discern any patterns in a plant species' survival rate or growth patterns across a field.

Within each association the main planting subunits are expressed as "tiles". Each tile covers an area of 5 rows by 10 planting locations within each row and is approximately 1/5 of an acre. Each tile will be replicated as often as needed to fill in the area for a particular association. Within each tile, plants are arranged to create a mosaic of vegetative structure across the field in order to create the necessary structure for the target wildlife species.

E. Flood Management

The relationship between Dos Rios Ranch and the SJRNWR for floodway management is complimentary, with Dos Rios Ranch providing smaller, yet more frequent transient storage opportunities than the Refuge. When viewed together, the addition of transient storage at Dos Rios Ranch would increase flexibility for flood managers and wildlife habitat managers at SJRNWR, and reduce damages to downstream floodways even in non-catastrophic events. Although downstream flood damages are greatest during the larger, less-frequent flood events, the toll that smaller high-flow events take on downstream infrastructure cannot be overlooked.

Flood events rated at higher frequency (i.e., 5-25 yr. events) cause substantial damage to agricultural areas in this region. Floodwater attenuation at Dos Rios Ranch, even during events more frequent than the 20-yr event, will provide substantial reduction to these under-protected areas within the 100-yr floodplain. This Project will provide the opportunity to lower the stage of the Tuolumne and San Joaquin Rivers during floods both upstream and downstream and reduce sediment deposition in the channel, thereby maintaining or increasing channel capacity, creating greater flexibility for dam operations and potentially reducing long-term O&M costs.

Based on site topography and historic patterns of flooding, this Project would breach private berms along the margins of the San Joaquin and Tuolumne Rivers to optimize this transient storage opportunity, including core areas of small flood attenuation (Fig. 12). The restoration of wildlife habitat at Dos Rios Ranch will increase the flexibility with which wildlife managers at the Refuge can respond to flood events. By restoring ~1000 acres of floodplain habitat that specifically targets riparian-obligate species that are threatened by flooding, this project will provide USFWS wildlife managers with greater flexibility to fully utilize transient storage opportunities on the SJRNWR.

V. HYDRAULIC MODELING

Cbec, inc., eco-engineering (cbec) is retained under contract to perform tasks in support of the Project, including a) engineering support for the acquisition of a CVFPB encroachment permit to allow planting of woody vegetation on the Project site, the entirety of which lies within the designated floodway, and b) the design and evaluation of levee and berm breaching alternatives to optimize the detention of flood waters on the restored floodplain of Dos Rios Ranch for habitat, sediment deposition, and flood damage reduction purposes.

A primary component of this Project is the reconnection of the floodplain to active river processes. Data collect by cbec will allow River Partners to determine what level of field inundation can be projected for a specific river level. The channels of both rivers are highly incised adjacent to restoration fields. Target flows on the San Joaquin should reach the floodplain at 10,000 cfs as measured by the DWR gauging station near Patterson CA (SJP). Target flows on the Tuolumne should reach the floodplain at 6,000 cfs as measured by the USGS station in Modesto CA (USGS 11290000).

VI. PROJECT IMPLEMENTATION

A. Environmental Compliance

1. Access

River Partners is the fee-title land owner and will provide access to the project site for its subcontractors during the stages of restoration.

2. CEQA

As funding is secured for restoration phases described in this Plan, supplemental CEQA will be required in addition to previous CEQA analyses completed for previous restoration phases. RD 2092 is poised to serve as CEQA lead, and associated state agencies (DWR and CDFW) have been identified as responsible agencies.

3. NEPA

Portions of Project site are held in easement with the NRCS Wetland Reserve Program. NRCS has agreed to take the lead in regards to any NEPA documentation. If additional actions on the ranch are deemed to initiate a federal nexus, we will consult with NRCS.

4. DFG Streambed Alteration Agreement

DFG Code section 1602 requires any person, state or local governmental agency, or public utility to notify DFG before beginning any activity that may affect the natural flow of a river. River Partners will obtain the required permits to remove material from the banks of the San Joaquin and Tuolumne Rivers, cement and other debris, to allow river processes to occur. These actions will require a consultation with NMFS, CDFW, and the U.S. Army Corps.

5. Central Valley Flood Protection Board Encroachment Permit

River Partners will be working with cbec eco-engineering, inc. to secure the appropriate permits for planting in the designated floodway prior to any restoration activities.

6. VELB

River Partners is working with its partners at the US Fish and Wildlife to obtain a 10(a)(1)(A) recovery permit to allow restoration activities around existing (Fig. 14) and restored elderberry shrubs on the Project site. River Partners received a draft of the Biological Opinion associated with this permit and expects to have the permit in hand by the end of 2014.

7. Herbicides

River Partners holds the appropriate permits to apply herbicides and reports monthly to the Stanislaus County Ag Commissioner. All application of controlled chemicals is planned and overseen by our staff Certified Pest Control Advisor. Roundup® (glyphosate) and 2,4-D are likely to be the most commonly used herbicides on the project. Rodeo® will be used in areas adjacent to water bodies and Garlon™ for woody species control.

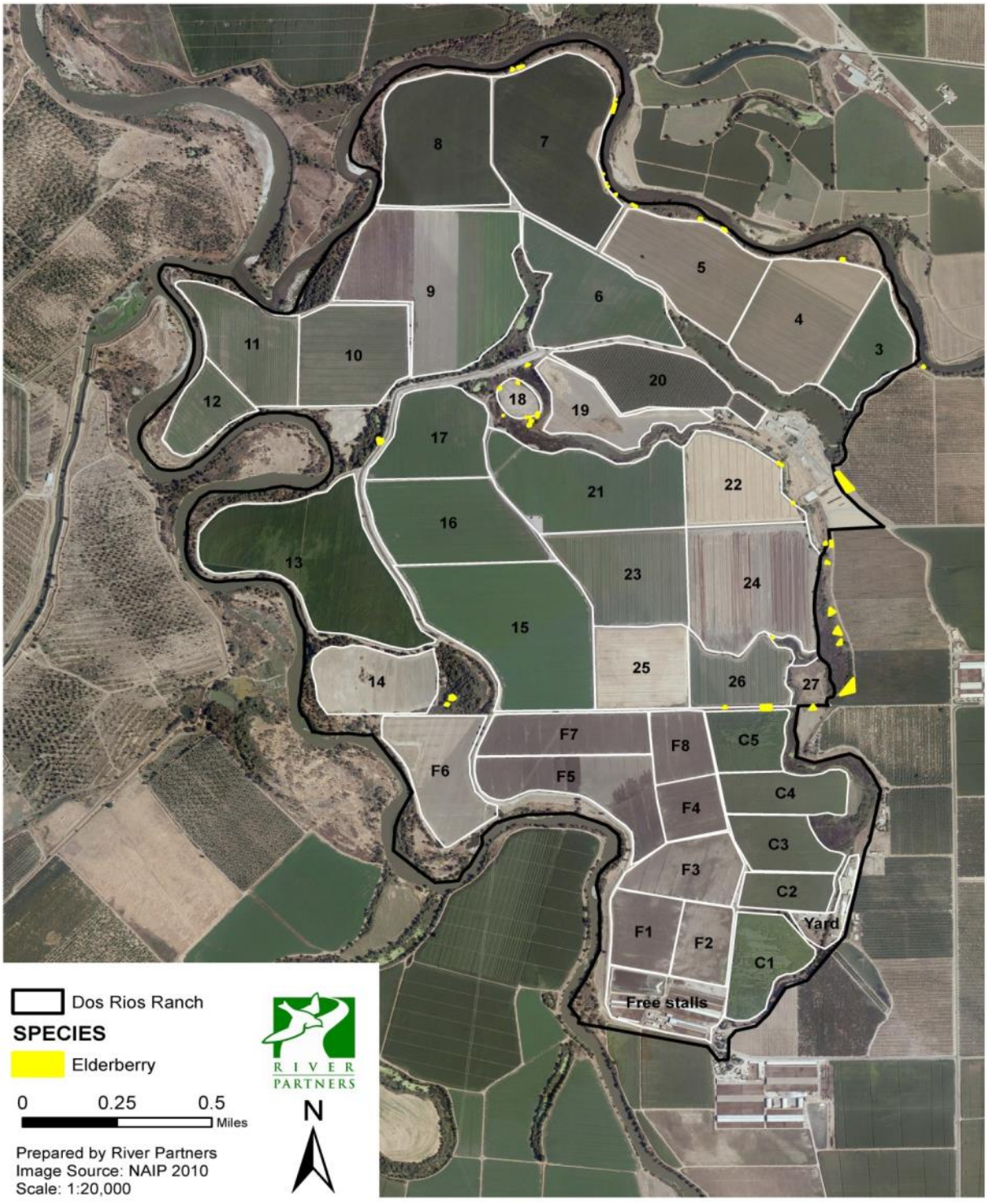

Figure 14. Location of native elderberry shrubs on Dos Rios Ranch, Stanislaus County, CA.

B. Field Layout

1. Mixed Riparian and Oak Woodland Associations

Portions of the Project site designated for Mixed Riparian and Oak Woodland associations (Fig. 12) and will be planted with native woody vegetation (trees and shrubs) at a density of 227 plants/acre (Tables 10-11). The planting rows in these fields will be approximately 16 feet apart. The rows in each field will be oriented approximately north-south or in the direction that best accommodates the flow of flood-irrigation water. Rows will be curved so as not to appear straight to the human eye. The in-row plant spacing will be approximately 12 feet. The 12 x 16 ft arrangement yields a plant density of 227 plants/ac, designed with the assumption that not all plants will survive.

2. Mixed Shrub Thicket Association

Portions of the Project site designated for the Mixed Shrub Thicket association (Fig. 12) will be planted with native trees and shrubs at a density of 545 plants/acre (Table 8). The planting rows in these fields will be approximately 16 feet apart. The rows in each field will be oriented approximately north-south, or in the direction that best accommodates the flow of flood-irrigation water. Rows will be curved so as not to appear straight to the human eye. The in-row plant spacing will be approximately 5 feet. This community will border the high-ground flood refugia on all sides to provide a transition zone from less dense to more dense habitat.

3. High-ground Flood Refugia (Bunny Berm Association)

Fields 4, 8, 10, 12, and 14 will have approximately 2.5-5 acre flood refugia, similar to refugia constructed in restoration Phase 1. Each will be planted with native woody vegetation (trees and shrubs) at a density of 871 plants/acre. Refugia will be oriented in a manner that best suits the overall field layout and facilitates the flow of irrigation and flood water. The in-row plant spacing will be approximately 5 ft. The planting rows on the refugia will be approximately 10 feet apart. The 5 x 10 ft arrangement yields a plant density of 871 plants/ac, designed with the assumption that not all plants will survive.

C. Site Preparation

For each Project phase or subphase being implemented, site preparation will include earthwork to construct high-ground flood refugia, ephemeral swales, floodplain benches, and berm modifications. In order to plant fields with native speices, the fields will be disked twice and then planting-beds will be formed by a disc-ridger. These planting-beds will be slightly above the soil surface to ensure drainage of water away from plant crowns.

D. Irrigation System

All fields will be flood irrigated in similar orientation as the former agricultural fields, excepting those areas that cannot be serviced with flood irrigation – such areas will be irrigated using specially-designed drip irrigation systems, as will the bunny berms. The water sources for these fields will be existing irrigation pumps and wells that have serviced Dos Rios Ranch in the past and which are being used to maintain Phase 1

restoration fields. With the exception of one pump near the former Hidden Valley Dairy, large river pumps have been outfitted with fish screens of size and form approved by NMFS in the summer of 2013. The unscreened pump will be screened with a NMFS-approved screen in 2015.

E. Plant Material Collection and Propagation

As Project phases and subphases are permitted and funded, field cuttings will be collected from the remnant habitat on Dos Rios Ranch. Additional species will be grown out as container stock at nurseries (e.g., blackberry, box elder, buttonbush, quail bush, coyote brush, elderberry, golden currant, Oregon ash, and California rose). Valley oak acorns and seeds of herbaceous species will be collected locally from remnant and restored habitat at Dos Rios Ranch and the Refuge. Creeping wildrye seed will be purchased from native plant nurseries.

F. Plant Installation

1. Woody Species

For each Project phase or subphase being planted, cuttings will be approximately 24” long and planted approximately 18” into the soil with the aid of a dibble stick during Winter and Spring seasons. Container stock will be delivered to the site in 1 gallon containers and planted in Spring. Valley oak acorns will be direct seeded, and two acorns will be used at each planting location to ensure that at least one seed is viable.

2. Herbaceous Species

For each Project phase or subphase being planted, seeds of native grass (creeping wildrye) and forbs (mugwort and gumplant) will be planted in year 2 on all fields and bunny berms. These plantings will be used as sources of seed for future dispersal to other areas of Dos Rios Ranch. Pure live seed (PLS) seeding rates for harvested species (mugwort and gumplant) will be calibrated based on bulk seed weight and viability. Mugwort PLS seeding rate will be approximately 0.5 lbs/ac. Gumplant PLS seeding rate will be approximately 2.6 lbs/ac. Creeping wildrye PLS seeding rate will be approximately 6 lbs/ac. Creeping wildrye will be drill seeded, while mugwort and gumplant will be broadcast seeded.

G. Plant Maintenance

1. Plant Protectors

For each Project phase or subphase being planted, milk cartons will be installed as plant protectors with 4 in of wood shavings applied as mulch to hold soil moisture and minimize weed growth. The cartons also protect the plant from herbivory and drift from herbicide applications. In addition, we will place additional protectors around any native trees that might colonize the site.

2. Weed Control

During the growing season, weeds will be controlled as needed by disking, mowing or spraying Roundup® herbicide or one of several new generic brands with glyphosate as the active ingredient on the planting rows. The aisles between the rows will be mowed

as needed to remove weeds during the growing season. This targeted weed control approach is intended to reduce the weed seed source and dispersal potential of existing weeds into restoration fields in the restoration maintenance period.

3. Irrigation Schedule

Because of the dry summers typical of the climate in the area, irrigation will be required for each Project phase or subphase being planted. Irrigation will be applied with the goal that plants will become self-sustaining after the third growing season.

In the first growing season, the rapidly growing seedlings have roots only in the surface (the top 1-2 ft) of the soil profile. The rooting zone must be kept moist through the season to ensure optimum growth and survival. On loam soils, a frequency of once every 10 days is sufficient; irrigation on sandy soils may need to be more frequent. The intervals between irrigations are dependent upon soil texture, depth to water table, the weather conditions, and plant water stress. Because we propose a mixture of species with different water demands, the plants must be carefully observed to maintain a balance of soil moisture that is acceptable for xeric species like valley oak and elderberry as well as more mesic species like sandbar and arroyo willow.

The strategy for the second and third year is to train the roots to grow deeper. Plants with roots at depth (5-15 ft) will need less water and may be able to tap into the shallow water table on the site and out-compete more shallow-rooted weeds. Less frequent deep watering will encourage roots to grow deeper, well below the roots of the weeds, allowing the trees exclusive use of this deep moisture. As the tree roots grow deeper, the times between irrigations become longer (4-8 weeks in year 2, 3-4 months in year 3), which allows the soil surface layers to dry, thereby reducing weed vigor.

4. Herbivore Control

Herbivores can have a large impact on young plants. A number of measures can help control or minimize their effects (Table 14). Cultural practices such as mowing or spraying can discourage most of these herbivores. One of the advantages of active restoration is that typically, more plants are planted than the herbivores can eat. Mortality of plants is expected to occur over time and is built into the planting design. Some damage by herbivores is tolerable and will not necessarily impact the success of the planting.

VII. MONITORING AND REPORTING

The goal of project monitoring will include evaluating the success of the project in achieving key project objectives, providing information to guide adaptive project management, and improving the knowledge base for restoration planning of future projects. Results will be measured through vegetation performance monitoring and wildlife monitoring with additional funding.

Table 15. Summary of herbivore control methods at the Project site, Dos Rios Ranch, Stanislaus County, CA.

Herbivore	Type of Damage	Comment on control measure(s) or plant response
Voles (*Microtus californicus*)	Eat bark and cambium at the base of sapling, usually girdling the entire stem. Dig-up and eat recently planted acorns.	Saplings resprout, unless vole population is high. Voles live only in dense herbaceous (weed) cover and never stop moving when in the open to avoid predators. Remove dense weed cover through herbicides or mowing.
Pocket Gophers (*Thomomys bottae)*	Eat root systems (probably killing more saplings than any other vertebrate pest).	Control of weed cover allows predators to hunt gophers. However, gophers can persist in an open, weed-free field. Frequent disking, weed mulch control or flooding reduces populations. A variety of birds will prey on gophers if given the opportunity. Raptor perches and owl boxes may increase predation.
Ground Squirrels (*Otospermophilus beecheyi*)	Dig up and shred plants and protectors.	Flooding or disking can reduce populations.
Rabbits and Hares	Browse early spring growth.	Rabbits are target wildlife species, plant at high densities to provide forage and cover.

A. Vegetation Performance Monitoring

Vegetation performance monitoring is critical for assessing planting success, reacting to implementation challenges, and informing adaptive management decisions. For a given phase or subphase of the Project planted with native woody species, a full census of all individual plants will be conducted in year 1 to assess survivorship and identify species for which replanting may be necessary. Permanent monitoring plots, typically one tile in size (5 rows x 10 planting location) will be established in each Project field and surveyed in years 2 and 3 (and possibly beyond, pending funding for long-term monitoring). Plot and plant locations will be recorded with a GPS, and measurements will be conducted to quantify plant growth (plant height, canopy area, diameter at breast height [DBH, only for species without numerous stems]) and plot-scale cover by species. After planting of understory species in year 2, additional monitoring will be conducted to assess performance of native understory species. Longer-term monitoring of permanent plots, currently unfunded, would be extremely valuable for quantifying species performance, dynamics of carbon sequestration, response to disturbance (e.g., flooding), and overall restoration trajectory of the Project site.

B. Photo Points

Photographs can provide qualitative information in vegetation changes at a restoration site. Photographs taken over time can provide a compelling picture of a project's success with a minimum of time and expense. When pictures are taken, the monitor documents the location, direction, focal point, and camera lens.

C. Wildlife Monitoring

River Partners will be working closely with its partners at Point Blue and ESRP, who will be conducting thorough wildlife monitoring on Dos Rios Ranch and the adjacent San Joaquin River National Wildlife Refuge if funding permits such actions. Currently only the Phase I fields are funded for avian monitoring, and additional wildlife monitoring efforts are still unfunded and in the planning stages. Additional funds would allow for more comprehensive monitoring efforts on the Project site and Dos Rios Ranch as a whole.

D. Additional Monitoring Options

Aerial photography, LiDAR, and other applications of remote sensing technology are increasingly used to monitor changes through time on large-scale natural resource management projects such as Dos Rios Ranch. These technologies provide powerful options for landscape-scale data collection and visualization. For example, repeat aerial photography could produce georectified imagery of Dos Rios Ranch as phased restoration continues into the future. In addition, sequential LiDAR imagery could be used to quantitatively measure fine-scale changes in microtopography resultant sediment deposition and redistribution from small and large flood events. Additional funding will need to be secured to implement these additional monitoring options on the Project site and on Dos Rios Ranch as a whole.

E. Annual Reports

The annual report documents the monitoring data, reviews the site activities, provides a budget analysis, and recommends future management actions. These are produced following the end of season meeting to help managers prioritize the project's needs.

F. Final Report

The final report summarizes the project, including information developed in the end of season memos. We will also analyze our activities in terms of the restoration plan and provide long-term management recommendations.

VIII. SAFETY ISSUES

The health and safety of our employees are an integral part of our work. Prior to any work on Dos Rios Ranch, River Partners staff will be briefed on safety issues associated with the site. Employees will have a safety binder that will entail safety procedures and emergency information. All employees will be responsible for complying with safe work practices. In addition, River Partners will comply with the requirements of

the Drug-Free Workplace Act of 1990 (Government code Section 8350 et seq.) and will provide a drug-free workplace.

In case an employee incurs any injuries or illnesses while on the job, they are instructed to contact the office to inform someone of the situation and to contact the nearest health care provider.

A. Standard Field Procedures

All employees have a safety binder that describes safe work practices, and they are responsible for complying with these practices. In case of injuries or illnesses while on the job, employees will:

- Call 911, or
- Call US Healthworks Medical Group at (209) 575-5801 located at 1524 McHenry Ave # 500, Modesto CA.
- Contact the River Partners office at (530) 894-5401 and immediate supervisor.

B. Flood and Fire Contingencies

Flooding is likely to have minimal impact on restoration activities on the site in regards to public safety. Regulated flows on the both rivers have reduced the frequency of widespread flooding, although out of bank flooding will occur with heavy precipitation, if San Joaquin and Tuolumne River flows are high. River Partners will monitor river levels and move people and equipment to safety in the event of a flood.

There is historical data of wildfire on the site. During the implementation of the restoration, weed control activities will reduce the abundance of dry vegetative fuels, thus lowering the probability of wildfire. Access roads have been mapped for fire escape routes (Fig. 15). The Westport Fire Protection District is responsible for responding to fire emergencies on the property. The project is designed to be resilient to fire and we do not expect wildfire recovery to necessitate replanting. During the project period, River Partners will work closely with the Westport Fire Department to minimize loss of property and damage to the project and adjacent properties associated with fire.

C. Utilities

Currently, Dos Rios Ranch has TID high voltage transmission lines running through a portion of the property. There is also a network of lower voltage power lines supplying electricity to the on-site infrastructure. As fields become established and the power is no longer needed to run river pumps and wells, many of these lower voltage lines will be removed. River Partners will contact the appropriate agency to safely remove these power lines. The poles may be left in place to serve as nesting perches or raptor roosts. Access will also be maintained to service lines that run through restoration fields and primary roads will be left intact to access the high voltage lines on the southern portion of the property (Fig. 16).

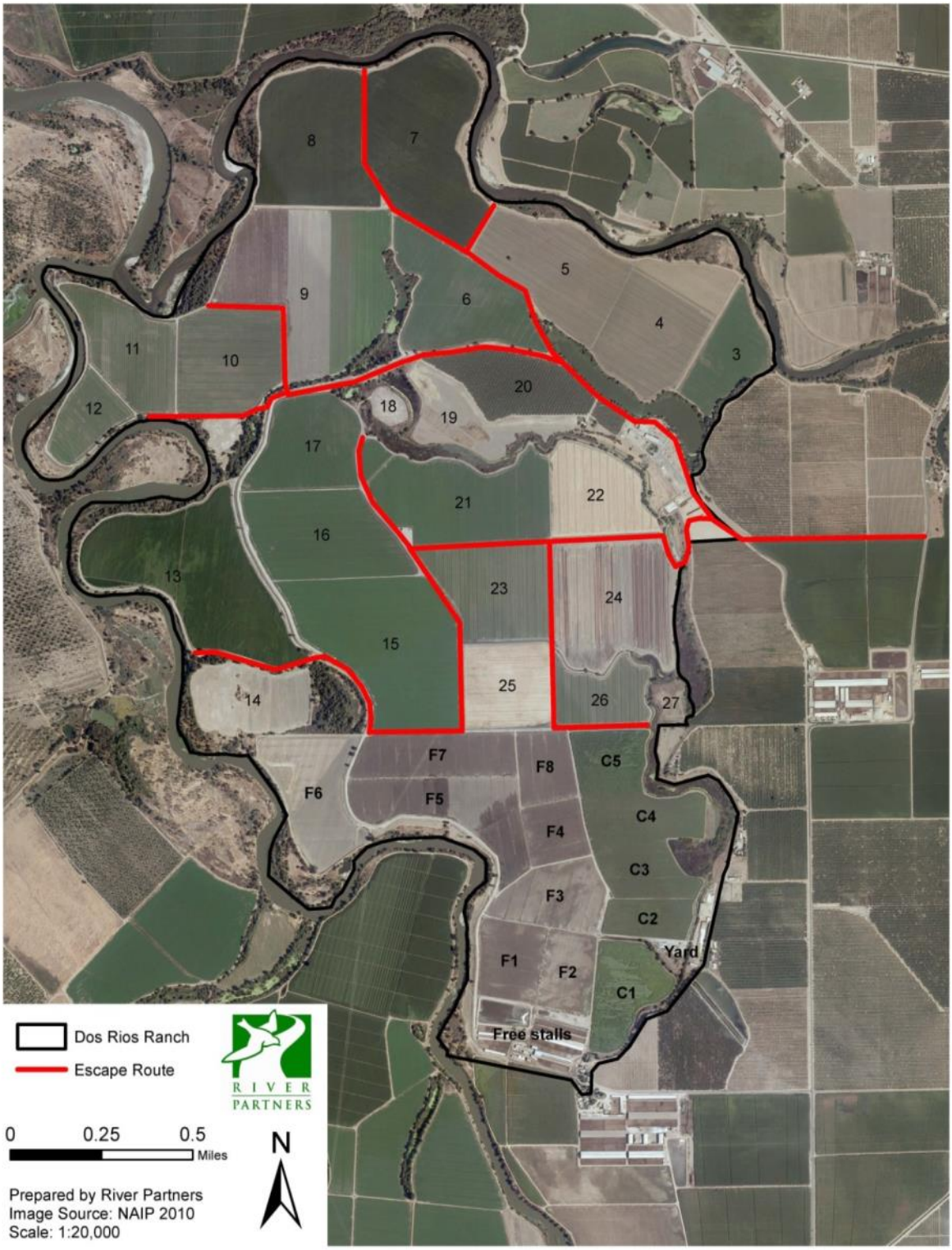

Figure 15. Access roads that will serve as primary escape routes in the event of fire on the Project site, Dos Rios Ranch, Stanislaus County, CA.

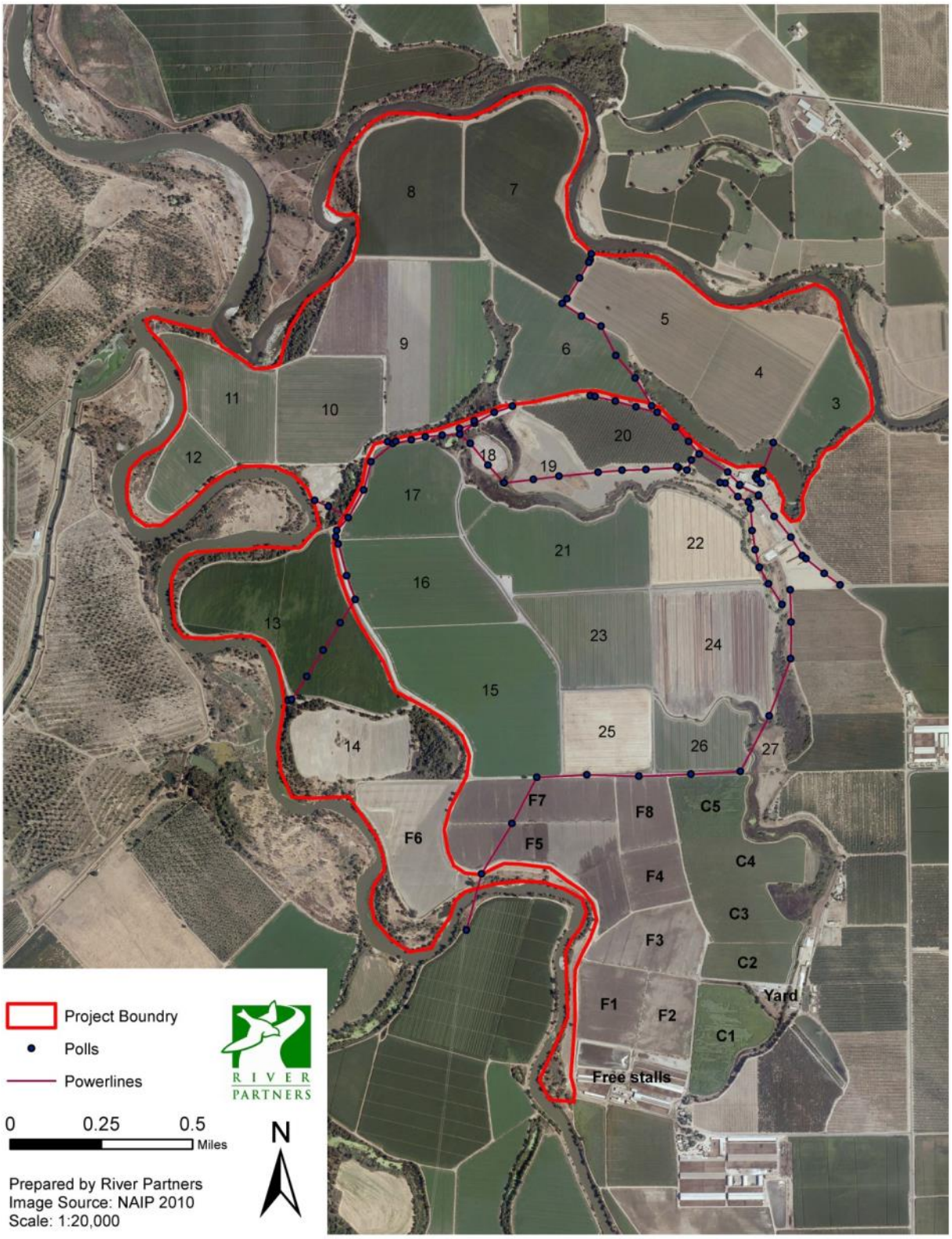

Figure 16. Utility lines on Dos Rios Ranch, Stanislaus County, CA.

D. Impacts to Adjacent Landowners

River Partners has always adhered to a good neighbor policy on its restoration projects. Restoration activities on Dos Rios Ranch could potentially negatively impact one neighboring property. Ott Farms grows walnuts, almonds, cherries and blueberries on lands east of Field 3 on Tuolumne River floodplain.

An existing berm constructed between Dos Rios Ranch and Ott Farms property east of Field 3 will be enhanced (Fig. 11) to reduce the potential for floodwater to backfill Ott Farms. Ott Farms has raised concerns that floodwater filling the main lake from the west (backfilling through a berm breach in Field 9) could compromise this berm and has suggested that the enhancement of a berm on the northwest portion of the main lake could reduce this possibility (Fig. 11). These actions could minimize the impacts to Otts Farms lands during the smaller 3-5 year flood events that are anticipated to reactivate the floodplain. Larger flood events, such as the 1997 flood, would inundate the entire floodplain irrespective of berm enhancement. Further consideration of Project impacts to adjacent landowners will be detailed in the *Plan to Minimize Impacts to Adjacent Landowners* report currently under development for submission to the California Department of Water Resources.

The Project will have positive impacts on adjacent landowners as well, including flood attenuation, enhanced pollination services, and eventual public access for education and recreation.

IX. REFERENCES

Barr, C.B. 1991. The distribution, habitat and status of the valley elderberry longhorn beetle *Desmocerus californicus dimorphus* Fisher (Insecta: Coleoptera: Cerambycidae). Report to U.S. Fish and Wildlife Service.

California Climate Change Center. 2012. Our changing climate 2012 vulnerability and adaptation to the increasing risks from climate change in California. Publication # CEC-500-2012-007. http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf

Chen, Z.Q.R., M.L. Kavvas, H. Bandeh, and E. Tan. 2009. Study of the roughness characteristics of native plant species in California floodplain wetlands. Report to Department of Water Resources.

Collinge S.K., M. Holyoak, C.B. Barr, and J.T. Marty. 2001. Riparian habitat fragmentation and population persistence of the threatened valley elderberry longhorn beetle. Biological Conservation 100:103-113.

Dettling, M.D., C.A. Howell, and N.E. Seavy. 2012. Least Bell's Vireo and other Songbird Monitoring and Threat Assessment at the San Joaquin River National Wildlife Refuge 2007- 2009. Report to US Bureau of Reclamation, Grant R10AP20573. PRBO Contribution #1854.

Dybala, K.E., N.E. Seavy, M. D. Dettling, M. Gilbert, R. Melcer, Jr., and T. Gardali. 2014. Does restored riparian habitat create ecological traps for riparian birds through increased Brown-headed Cowbird nest parasitism? Ecological Restoration 32:239-248.

Gardali, T., and A.L. Holmes. 2011. Maximizing benefits from riparian revegetation efforts: local-and landscape-level determinants of avian response. Environmental Management 48:28-37.

Geupel, G.R., N. Nur, A. King, and G. Ballard. 1997. Songbird monitoring on the San Luis National Refuge: Results from the 1996 field season. PRBO unpublished report to the US Fish and Wildlife Service. Stinson Beach, CA.

Gruber, J.J., Z.J. Jackson, and J.P. Van Eenennaam. 2012. 2011 San Joaquin River sturgeon spawning survey. Lodi Fish and Wildlife Office, Anadromous Fish Restoration Program, U. S. Fish and Wildlife Service, Stockton, California.

Hammond, J., R. Chruchwell, and G.R. Geupel. 2002. Songbird monitoring on the San Joaquin River National Wildlife Refuge: Progress report for the 2001 field season. Point Reyes Bird Observatory. Publication Number 966.

Holl, K.D. and T.M. Aide. 2011. When and where to actively restore ecosystems? Forest Ecology and Management 261: 1558-1563.

Howell, C.A., J.K. Wood, M.D. Dettling, K. Griggs, C.C. Otte, L. Lina, and T. Gardali. 2010. Least Bell's Vireo breeding records in the Central Valley following decades of extirpation. Western North American Naturalist 70:105-113.

Imhoff, D. 2003. Farming with the Wild. Sierra Club Books.

Kelt, D. A., P. A. Kelly, S. E. Phillips, and D. F. Williams. 2014. Home range size and habitat selection of reintroduced *Sylvilagus bachmani riparius*. Journal of Mammalogy.

Kus, B. E. 1998. Use of restored riparian habitat by the endangered Least Bell's Vireo (*Vireo bellii pusillus*). Restoration Ecology 6:1.

Mailliard, J. 1914. Notes on a colony of tri-colored blackbirds. Condor 16: 204-207.

Matocq, M. D., P. A. Kelly, S. E. Phillips, and J. E. Maldonado. 2012. Reconstructing the evolutionary history of an endangered subspecies across the changing landscape of the Great Central Valley of California. Molecular Ecology 21:5918-5933.

McBain and Trush. 2000. Habitat restoration plan for the lower Tuolumne River corridor. Final Report.

Meese, R. J. 2014. Results of the 2014Tricolored Blackbird Statewide Survey. Department of Environmental Science and Policy. University of California, Davis.

National Marine Fisheries Service. 2014. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. California Central Valley Area Office. July 2014.

Natural Resources Conservation Service. 2006. Soil Survey, Eastern Stanislaus Area, California.

Point Blue Conservation Science. 2011. Projected effects of climate change in California: ecoregional summaries emphasizing consequences for wildlife. Version 1.0. http://data.prbo.org/apps/bssc/uploads/Ecoregional021011.pdf.

PWA. 2001. San Joaquin River National Wildlife Refuge Phase 1: Analysis of proposed levee breaches. Prepared for Ducks Unlimited, Inc. and US Fish and Wildlife Service.

PWA. 2004. San Joaquin River National Wildlife Refuge Phase 2: Habitat implications of levee breaching alternatives. Prepared for US Fish and Wildlife Service.

RHJV (Riparian Habitat Joint Venture). 2004. Version 2.0. The Riparian Bird Conservation Plan: A strategy for reversing the decline of riparian associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/pdfs/riparian.v-2.pdf.

River Partners. 2006. Dos Rios Conceptual Restoration Plan. Stanislaus County, California. Modesto, California.

River Partners. 2013a. Habitat Restoration at Dos Rios Ranch Phase 1, Stanislaus County, California. Modesto, California.

River Partners. 2013b. Riparian Habitat Restoration at Dos Rios Ranch Phase 1B, Stanislaus County, California. Modesto, California.

Sawyer, J.O. and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society, Sacramento, CA.

Seavy, N.E., T. Gardali, G.H. Golet, F.T. Griggs, C.A. Howell, R. Kelsey, S.L. Small, J.H. Viers, and J.F. Weigand. 2009. Why climate change makes riparian restoration more important than ever: recommendations for practice and research. Ecological Restoration 27:330-338.

Seavy, N.E., T. Gardali, G.H. Golet, D. Jongsomjit, R. Kelsey, S. Matsumoto, S. Paine, and D. Stralberg. 2012. Integrating avian habitat distribution models into a conservation planning framework for the San Joaquin River, California. Natural Areas Journal 32:420-426.

Small, S.L., J. DeStaebler, G.R. Geupel, and A. King. 1999. Landbird response to riparian restoration on the Sacramento River system: Preliminary results from the 1997 and 1998 field seasons. PRBO report to The Nature Conservancy and US Fish and Wildlife Service. Stinson Beach, CA.

The Nature Conservancy (TNC). 2000. Species management abstract: Bell's Vireo (*Vireo bellii*). http://conserveonline.org/docs/2001/08/bevi.doc.

Williams, D., E. Cypher, P. Kelly, K. Miller, N. Norvell, S. Phillips, C. Johnson, and G. Colliver. 1998. Recovery plan for upland species of the San Joaquin Valley, California.

Appendix A: Dos Rios Conceptual Restoration Plan