Final

Botanical Resources and Wetlands Technical Report

Shasta Lake Water Resources Investigation, California

Prepared by:

United States Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

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Attachments

Abbreviations and Acronyms

Bay-Delta	San Francisco Bay/Sacramento–San Joaquin River Delta
BLM	U.S. Department of the Interior, Bureau of Land Management
CALFED	CALFED Bay-Delta Program
Cal-IPC	California Invasive Plant Council
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRPR	California Rare Plant Rank
CVP	Central Valley Project
CWA	Clean Water Act
Delta	Sacramento–San Joaquin River Delta
ESA	Federal Endangered Species Act
FAC	facultative plants
FACU	facultative upland plants
FACW	facultative wetland plants
Final EIS	final environmental impact statement
GIS	geographic information system
I-5	Interstate 5
LRMP	land and resource management plan
MCV	A Manual of California Vegetation
MSCS	Multi-Species Conservation Strategy
msl	mean sea level
NCCP	Natural Community Conservation Plan
NI	no indicator
NL	not listed
NRA	National Recreation Area
NSO	northern spotted owl
NWFP	Northwest Forest Plan

OBL	obligate wetland plants
OHWM	ordinary high-water mark
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
Resources Agency	California Natural Resources Agency (formerly known as the California Resources Agency or State Resources Agency)
RBPP	Red Bluff Pumping Plant
RCD	resource conservation district
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RHJV	Riparian Habitat Joint Venture
ROD	Record of Decision
RWQCB	regional water quality control board
S&M	Survey and Manage
SB	Senate Bill
SLWRI	Shasta Lake Water Resources Investigation
SRCA	Sacramento River Conservation Area
SRNWR	Sacramento River National Wildlife Refuge
STNF	Shasta-Trinity National Forest
SWAG	Sacramento Watersheds Action Group
SWP	State Water Project
TES	Threatened and Endangered Species
TNC	The Nature Conservancy
UPL	obligate upland plants
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

Chapter 1
Affected Environment

This chapter describes the affected environment related to botanical resources and wetlands for the dam and reservoir modifications that are proposed under the Shasta Lake Water Resources Investigation (SLWRI).

The botanical resources and wetlands setting for the Shasta Lake and vicinity portion of the primary study area consists of the impoundment area (five arms and the Main Body of Shasta Lake, as described below) and the relocation areas (Figure 1-1).

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) established project boundaries for focused surveys in the areas that would be subject to inundation under the various enlargement scenarios. The lower boundary corresponds to the current full pool elevation defined by Reclamation (1,070-foot-mean-sea-level (msl) contour line). The upper boundary was established using the 1,090-foot-msl contour line around the entire lake. This area is referred to as the "impoundment area" (Figure 1-1).

Areas subject to physical disturbance as an indirect result of the project (i.e., areas proposed as relocation sites for roadways, bridges, utilities, and campgrounds that would be inundated after the enlargement of Shasta Dam as well as proposed dike locations) were incorporated into the Shasta Lake and vicinity portion of the primary study area. These locations are hereafter referred to as "relocation areas" (Figure 1-1).

To examine the biological resources along riverine reaches that would be subject to inundation if Shasta Dam were enlarged, reaches of 11 streams and rivers that are tributary to Shasta Lake were also incorporated into the Shasta Lake and vicinity portion of the primary study area. These streams were selected by Reclamation in conjunction with the U.S. Forest Service (USFS) as an initial sampling of streams representative of riverine and riparian habitats. Subsequently, botany studies have been expanded into select areas of the impoundment area and within all of the relocation areas.

As a component of the SLWRI, Reclamation proposes to restore and/or enhance riparian and riverine habitats at six locations along the lower Sacramento River below Shasta Dam. These six locations occur generally between the city of Redding and Reading Island, Shasta County, California. The purpose of the restoration effort is to improve spawning and rearing habitat for anadromous fish occurring in the Sacramento River. These six locations are referred to as

the potential Sacramento River downstream habitat restoration areas (Figure 1-2).

For the purposes of this investigation, approximate acreages for vegetation types and waters of the United States are reported by arm of the lake. For a relocation area that falls between two arms, the area is included with the arm that has the most acreage of the vegetation type or water of the United States. Habitats and waters of the United States are also reported for the potential Sacramento River downstream habitat restoration areas.

Vegetation communities and special-status plant species in the extended study area are discussed in less detail. The extended study area includes the Sacramento River basin from Red Bluff Pumping Plant (RBPP) south to the Sacramento–San Joaquin River Delta (Delta). It also includes the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta) area and portions of the American River basin, San Joaquin River basin, and the water service areas of the Central Valley Project (CVP) and the State Water Project (SWP).

Descriptions of biological resources were derived primarily from the following sources:

- Shasta Lake Water Resources Investigation Mission Statement Milestone Report (Reclamation 2003)
- Shasta Lake Water Resources Investigation Initial Alternatives Information Report (Reclamation 2004)
- Chapter 3, "Biological Environment," in the Draft Shasta Lake Water Resources Investigation Plan Formulation Report (Reclamation 2007)
- U.S. Fish and Wildlife Service (USFWS) Endangered Species Lists
- The California Natural Diversity Database (CNDDB)
- The California Native Plant Society (CNPS) online inventory
- Numerous technical studies of botanical and wetland resources conducted by Reclamation in the Shasta Lake and vicinity portion of the primary study area since 2002

Several attachments provide detailed lists and descriptions of special-status species present in the primary and extended study areas:

- Attachment 1, "Lists of All Special-Status Plant Species Known from or Potentially Present in the Primary and Extended Study Areas"
- Attachment 2, "List of Plant Species Observed in the Shasta Lake and Vicinity Portion of the Primary Study Area"

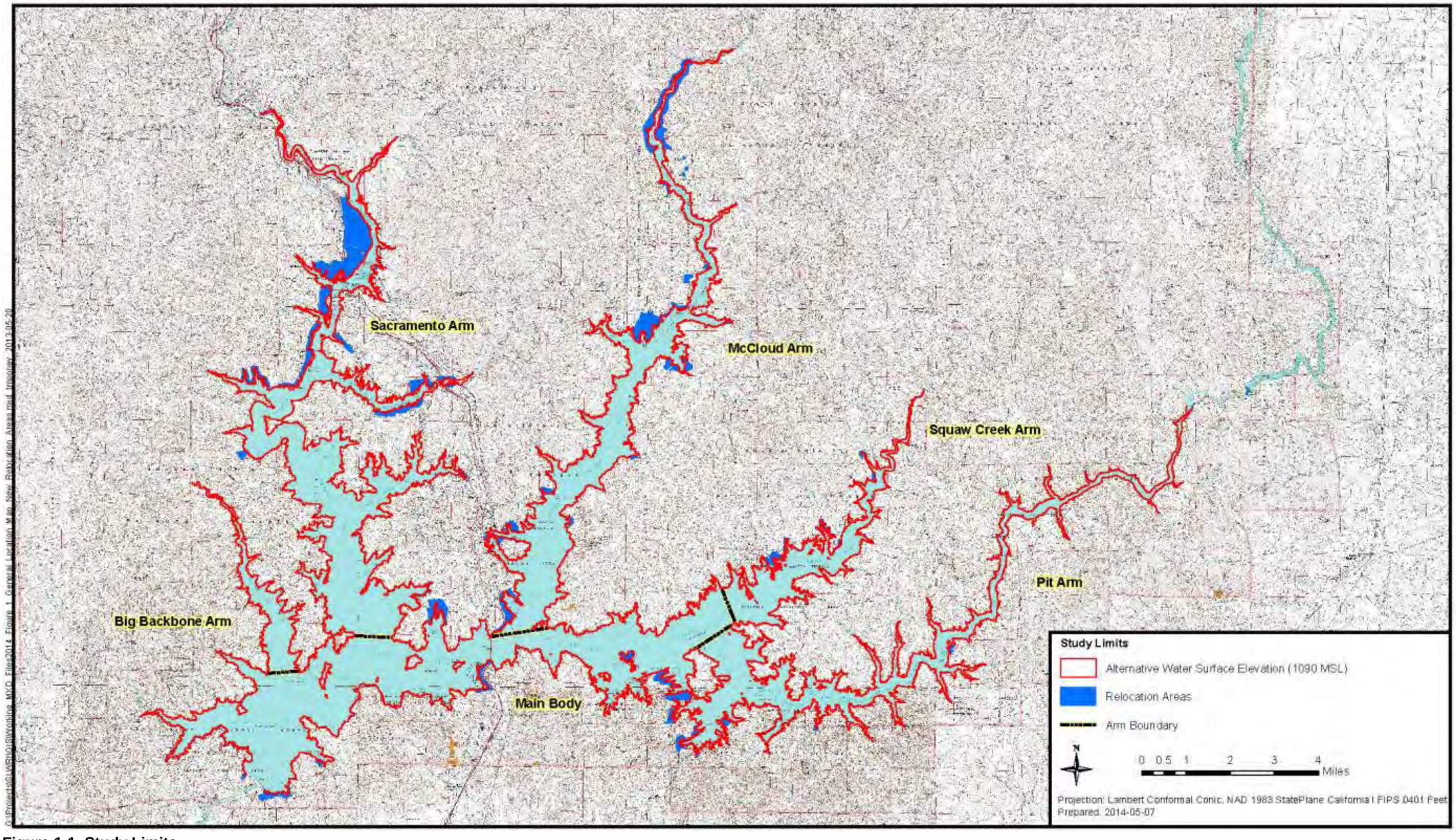

Figure 1-1. Study Limits

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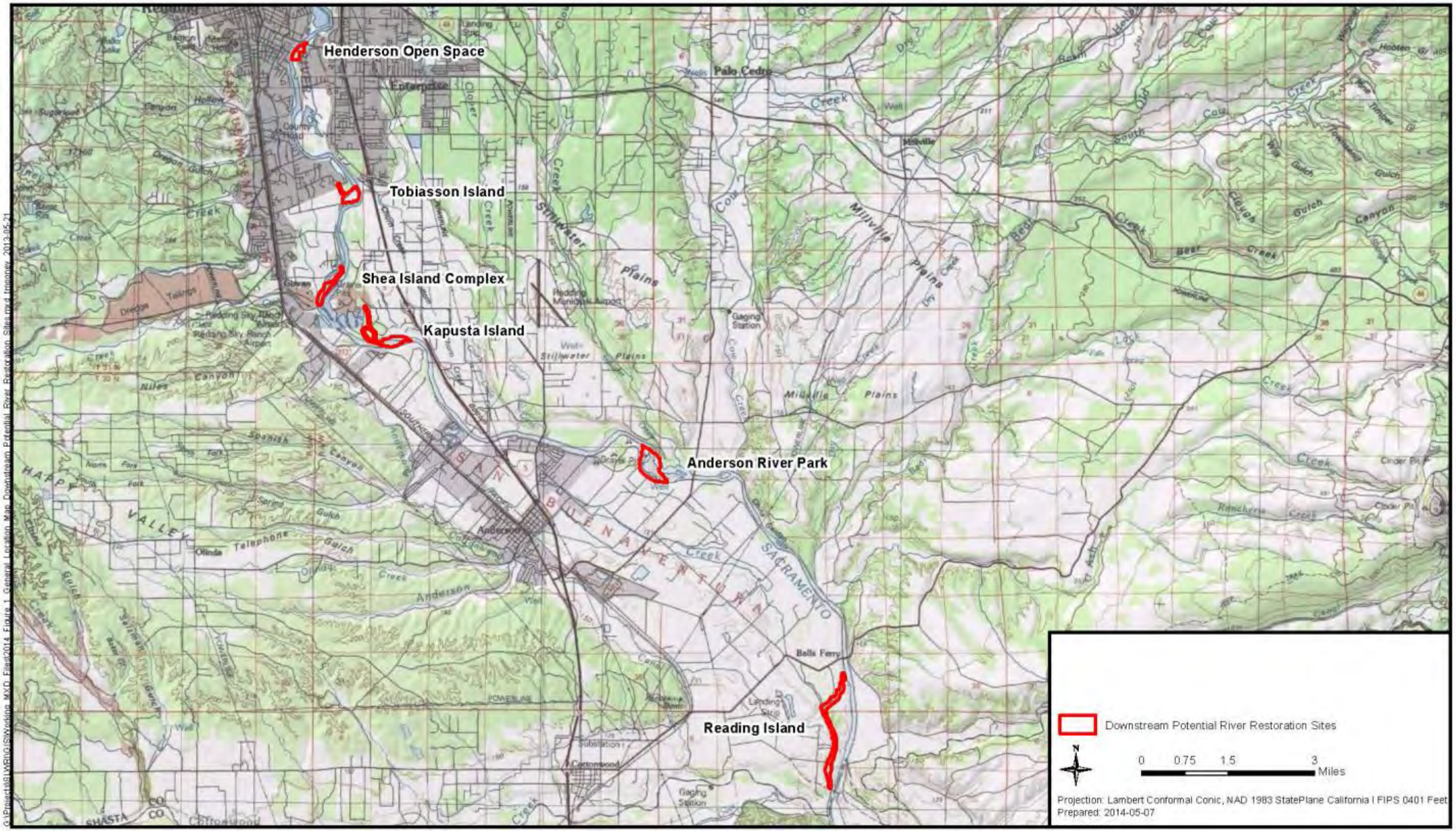

Figure 1-2. General Location Map Downstream Potential River Restoration Areas

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- Attachment 3, "Special-Status Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area"
- Attachment 4, "List of All Sensitive Plant Species in the Extended Study Area Reported to the CNDDB"
- Attachment 5, "Known Weed Source Locations, Potential Mode of Spread, and Risk of Spread"
- Attachment 6, "Botanical Survey Report 2002-2014"

Environmental Setting

Overview for Shasta Lake and Vicinity

Shasta Dam and Shasta Lake are located on the upper Sacramento River in Northern California. Shasta Dam is located about 9 miles northwest of Redding, and the dam and entire reservoir are located within Shasta County. Elevations in the Shasta Lake vicinity portion of the primary study area range between approximately 1,070 and 1,200 feet, and the terrain is moderate to steep.

Biological resources in the Shasta Lake and vicinity portion of the primary study area result from a wealth and diversity of climatic and vegetative associations within and adjacent to the study area. Influences from the Coast Ranges, southeastern Klamath Mountains, southern Cascades, northern Sierra Nevada, the Great Basin, and the Central Valley provide for a unique mix of biota. The entire Shasta Lake and vicinity portion of the primary study area lies within the Eastern Klamath Range subregion of the Klamath Ranges (Miles and Goudy 1997).

Vegetation Communities

Primary Study Area

Shasta Lake and Vicinity Reclamation conducted extensive mapping to characterize the plant communities in the Shasta Lake and vicinity portion of the primary study area. The study area for botanical resources and wetlands in the Shasta Lake and vicinity portion of the primary study area corresponds to the area that would be subject to inundation under all action alternatives and areas where infrastructure would be removed, modified, or relocated (Figure 1-1). The vegetation mapping followed the technical approach described in A Manual of California Vegetation (MCV) (Sawyer and Keeler-Wolf 1995), using the vegetation alliance classification system described in A Manual of California Vegetation, Second Edition (Sawyer et al. 2009).

The MCV classifies vegetation into a set of plant alliances, provisional alliances, special stands, or semi-natural stands. In this system, the plant species dominance or importance in the layer (i.e., tree, shrub, and ground) with the

greatest amount of cover determines the vegetation alliance classification. The same approach used to describe and classify MCV types was applied when other vegetation types not described in the current MCV were encountered and determined to be significant vegetative components.

Vegetation mapping was conducted using 1:2,400-scale rectified color aerial photography. All vegetation mapping was performed in the field by ground truthing the primary study area from boat, vehicle, and/or on foot. MCV plant alliances were identified and delineated onto the aerial photographs. The delineated boundaries were digitized and generated in ArcGIS/ArcInfo software for display and data query purposes.

The Shasta Lake and vicinity area is characterized by a variety of vegetation types typical of transitional mixed woodland and low-elevation forest habitats. MCV plant series types in this portion of the primary study area are birch-leaf mountain mahogany chaparral, black willow thicket, blue oak woodland, Brewer's oak scrub, buck brush chaparral, California annual grassland, California black oak forest, California ash chaparral, California buckeye groves, California yerba santa scrub, canyon live oak forest, deer brush chaparral, Fremont cottonwood forest, ghost pine woodland, Himalayan blackberry brambles, interior live oak chaparral, interior live oak woodland, knobcone pine forest, mixed willow, Oregon ash groves, Oregon white oak woodland, pale spike rush marshes, ponderosa pine–Douglas-fir forest, ponderosa pine forest, red osier thickets, sandbar willow thickets, spicebush thickets, valley oak woodland, white alder groves, and white leaf manzanita chaparral. Vegetation in each of these series varies, with dramatic changes often occurring in relation to aspect, slope, geologic substrate, or juxtaposition with other habitats.

Summaries of MCV types found in the impoundment area along the Main Body and the five arms of Shasta Lake is shown in Table 1-1, and the acreage of MCV types found in the relocation areas along the Main Body and the five arms of Shasta Lake is shown in Table 1-2. The locations of each type are depicted in Figures 1-3a through 1-3f. General descriptions of each type are provided below. Plant taxonomy follows Baldwin et al. (2012).

Table 1-1. Summary of Plant Communities in the Impoundment Area

Plant Series	Area (Acres)						Total
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm	
Arroyo willow thickets	0.15	0.00	0.00	0.00	0.00	0.00	0.15
Barren[1]	2.30	0.00	13.16	11.18	0.00	2.84	29.48
Birch-leaf mountain-mahogany chaparral	0.00	0.00	0.00	2.23	0.00	0.00	2.23
Black willow thicket	0.00	0.00	0.02	0.00	0.00	0.02	0.04
Blue oak woodland	1.27	0.00	0.00	0.70	0.00	4.08	6.05
Brewer oak scrub	9.78	0.17	51.62	4.99	4.51	7.78	78.85
Buck brush chaparral	0.90	2.42	2.11	1.59	0.67	0.19	7.88
California annual grassland	0.58	0.34	4.17	0.94	0.00	0.33	6.36
California black oak forest	71.45	14.14	160.32	47.44	1.72	5.06	300.13
California buckeye groves	0.00	0.00	0.20	0.001	0.00	0.00	0.20
California yerba santa scrub	0.75	0.00	0.00	0.00	0.00	11.58	12.33
Canyon live oak forest	9.80	18.41	53.80	48.31	26.78	110.51	267.61
Deer brush chaparral	0.18	0.00	0.00	0.08	0.00	2.34	2.60
Fremont cottonwood forest	0.00	0.00	0.07	0.00	0.00	0.05	0.12
Ghost pine woodland	54.05	0.00	51.29	13.50	22.03	30.54	171.41
Himalayan blackberry brambles	0.00	0.00	0.00	0.00	0.00	0.44	0.44
Interior live oak chaparral	1.24	0.00	10.05	0.01	0.00	24.22	35.52
Interior live oak woodland	2.00	0.00	0.14	0.09	0.00	2.28	4.51
Knobcone pine forest	32.96	0.40	16.38	20.72	47.87	79.83	198.16
Mixed willow	1.39	1.46	14.56	0.16	0.19	0.83	18.59
Oregon ash groves	0.00	0.00	0.00	0.17	0.00	0.00	0.17
Oregon white oak woodland	0.00	0.00	0.00	1.09	0.00	0.66	1.75
Ponderosa pine–Douglas fir forest	5.02	0.00	28.37	50.04	69.02	127.51	279.96
Ponderosa pine forest	225.95	36.67	212.79	208.77	59.33	101.17	808.01

Table 1-1. Summary of Plant Communities in the Impoundment Area (contd.)

Plant Series	Area (Acres)						Total
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm	
Red osier thickets	0.00	0.00	0.00	0.12	0.00	0.00	0.12
Riverine[1]	0.00	0.88	5.24	15.43	1.41	0.00	22.96
Sandbar willow thickets	0.00	0.00	0.00	0.28	0.07	0.00	0.35
Spicebush thickets	0.00	0.00	0.00	0.06	0.00	0.00	0.06
Urban[1]	22.04	0.00	0.00	0.00	0.00	1.92	23.96
White alder groves	1.34	4.47	9.70	12.40	1.18	2.85	31.94
White leaf manzanita chaparral	16.60	12.30	98.22	6.21	7.49	2.86	143.68
Total	459.76	91.67	732.20	446.49	242.28	519.90	2492.29

Note:
[1] California Wildlife Habitat Relationships Wildlife Habitat Type; no corresponding plant series type.

Table 1-2. Summary of Plant Communities in the Relocation Areas

Plant Series	Area (Acres)						Total
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm	
Barren[1]	22.32	0.00	74.17	29.66	11.53	12.77	150.46
Birch-leaf mountain-mahogany chaparral	0.00	0.00	0.00	0.41	0.00	0.00	0.41
Black willow thicket	0.00	0.00	0.03	0.00	0.00	0.00	0.03
Blue oak woodland	0.00	0.00	0.00	3.68	0.00	0.93	4.61
Brewer oak scrub	5.46	0.00	13.22	8.40	0.00	0.12	27.20
Buck brush chaparral	0.00	0.00	0.77	1.45	0.00	0.04	2.26
California annual grassland	4.76	0.00	20.31	9.75	0.84	0.23	35.89
California ash chaparral	0.00	0.00	0.00	0.68	0.00	0.00	0.68
California black oak forest	35.03	0.00	131.78	77.04	1.29	0.04	245.17
California buckeye groves	0.00	0.00	0.00	1.58	0.00	0.00	1.58
California yerba santa scrub	0.09	0.00	0.00	0.00	0.00	2.75	2.83
Canyon live oak forest	1.06	0.00	8.10	77.26	4.98	5.60	96.99
Deer brush chaparral	0.18	0.00	0.00	0.57	0.00	0.40	1.15

Table 1-2. Summary of Plant Communities in the Relocation Areas (contd.)

Plant Series	Area (Acres)						Total
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm	
Fremont cottonwood forest	0.00	0.00	0.56	0.00	0.00	0.05	
Ghost pine woodland	105.48	0.00	41.27	29.95	13.48	11.94	202.11
Himalayan blackberry brambles	0.15	0.00	0.00	0.06	0.00	0.00	0.21
Interior live oak chaparral	0.00	0.00	0.60	0.00	0.00	22.70	23.29
Interior live oak woodland	0.00	0.00	0.00	0.00	0.00	0.05	0.05
Knobcone pine forest	0.11	0.00	40.64	9.65	1.94	13.96	66.30
Lacustrine[1]	0.00	0.00	0.00	0.001	0.00	0.00	0.001
Mixed willow	0.08	0.00	0.73	0.00	0.06	0.01	0.87
Oregon ash groves	0.00	0.00	0.00	0.33	0.00	0.00	0.33
Oregon white oak woodland	0.00	0.00	0.00	5.72	0.07	0.00	5.72
Pale spike rush marshes	0.00	0.00	6.51	0.00	0.00	0.00	6.51
Ponderosa pine–Douglas fir forest	0.00	0.00	13.06	106.07	15.62	11.80	146.55
Ponderosa pine forest	156.56	0.00	458.50	347.64	43.08	35.97	1041.75
Riverine[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sandbar willow thickets	0.00	0.00	0.00	0.09	0.00	0.00	0.09
Spicebush thickets	0.00	0.00	0.00	0.64	0.00	0.00	0.64
Urban[1]	20.65	0.00	227.46	0.48	0.00	0.57	249.16
Valley oak woodland	0.00	0.00	1.06	0.00	0.00	0.00	1.06
White alder groves	0.00	0.00	0.23	1.90	0.17	0.00	2.31
White leaf manzanita chaparral	7.28	0.00	41.41	14.88	4.38	0.00	67.94
Total	359.20	0.00	1,079.84	727.92	97.44	119.83	2,387.23

Note:
[1] California Wildlife Habitat Relationships Wildlife Habitat Type; no corresponding plant series type included in *A Manual of California Vegetation* (Sawyer et al. 2009).

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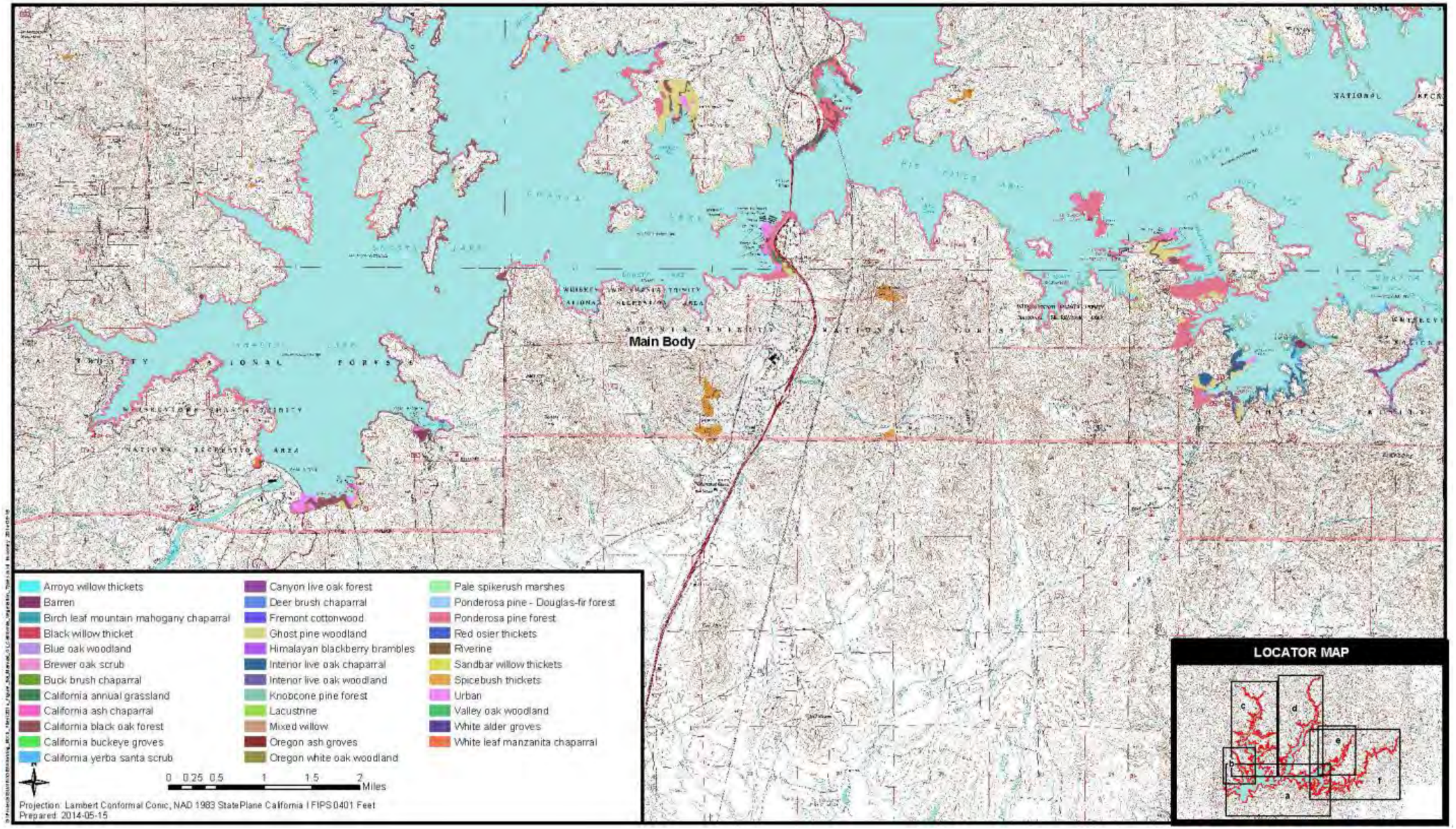

Figure 1-3a. Manual of California Vegetation Types

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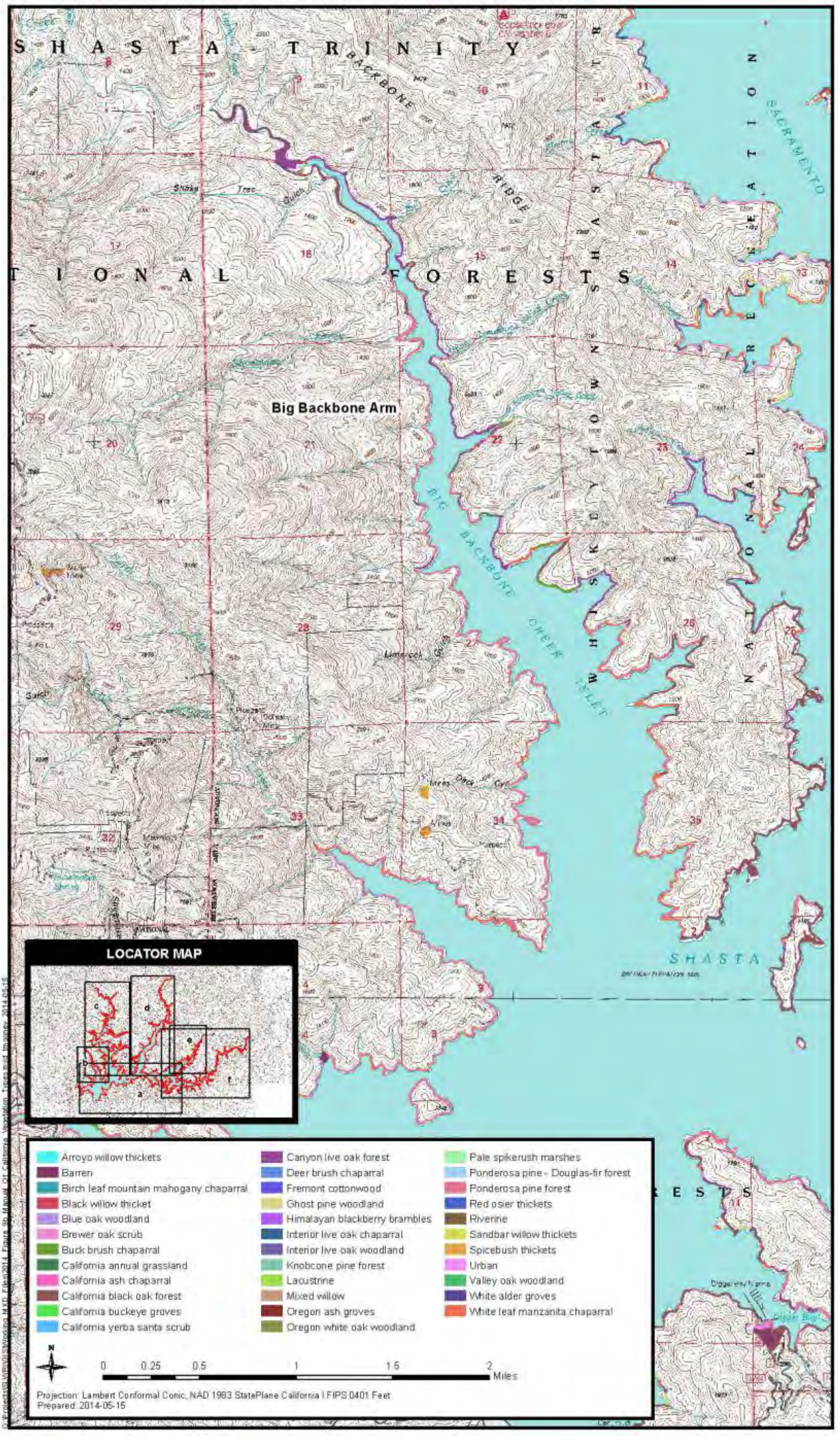

Figure 1-3b. Manual of California Vegetation Types

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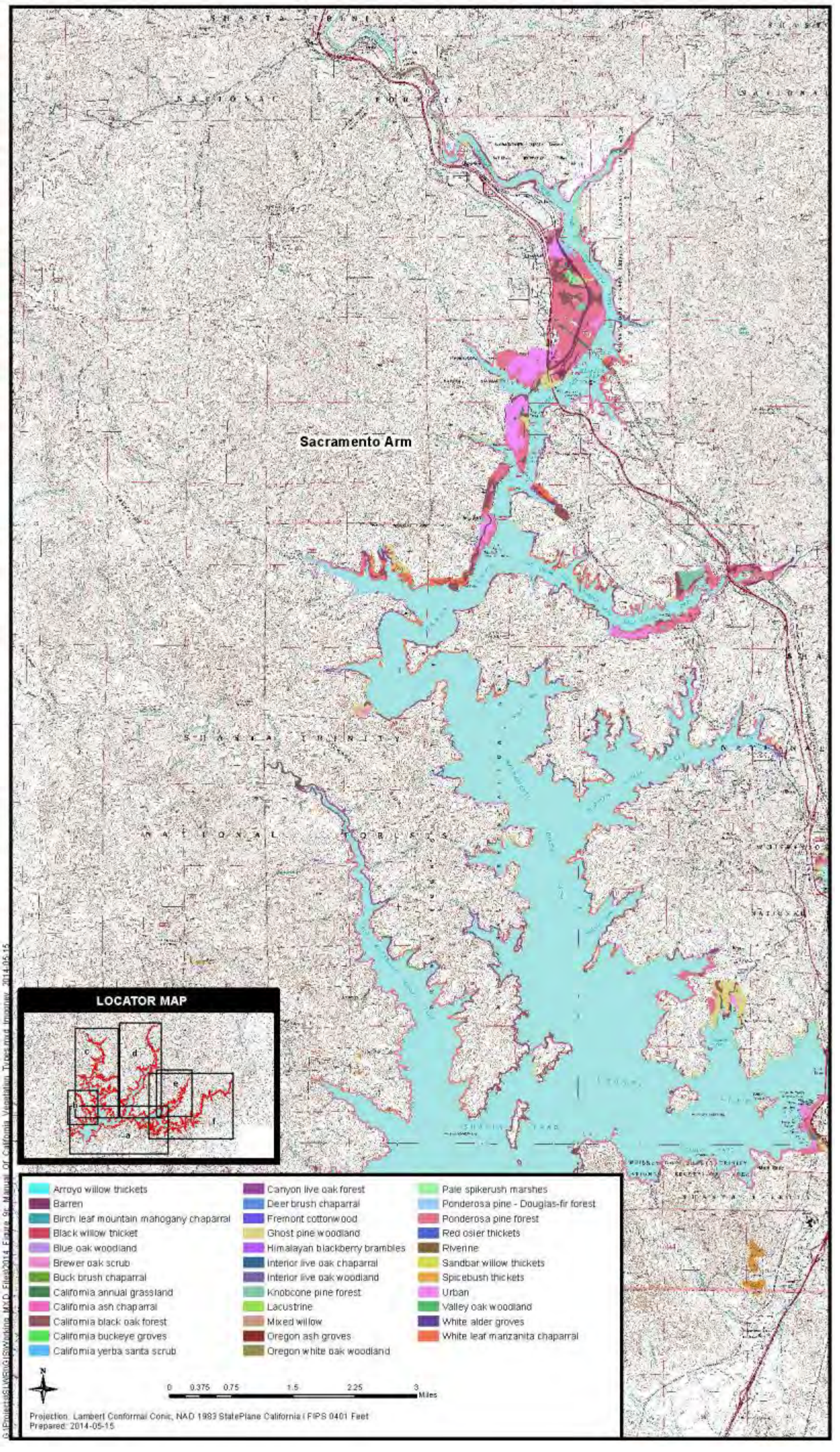

Figure 1-3c. Manual of California Vegetation Types

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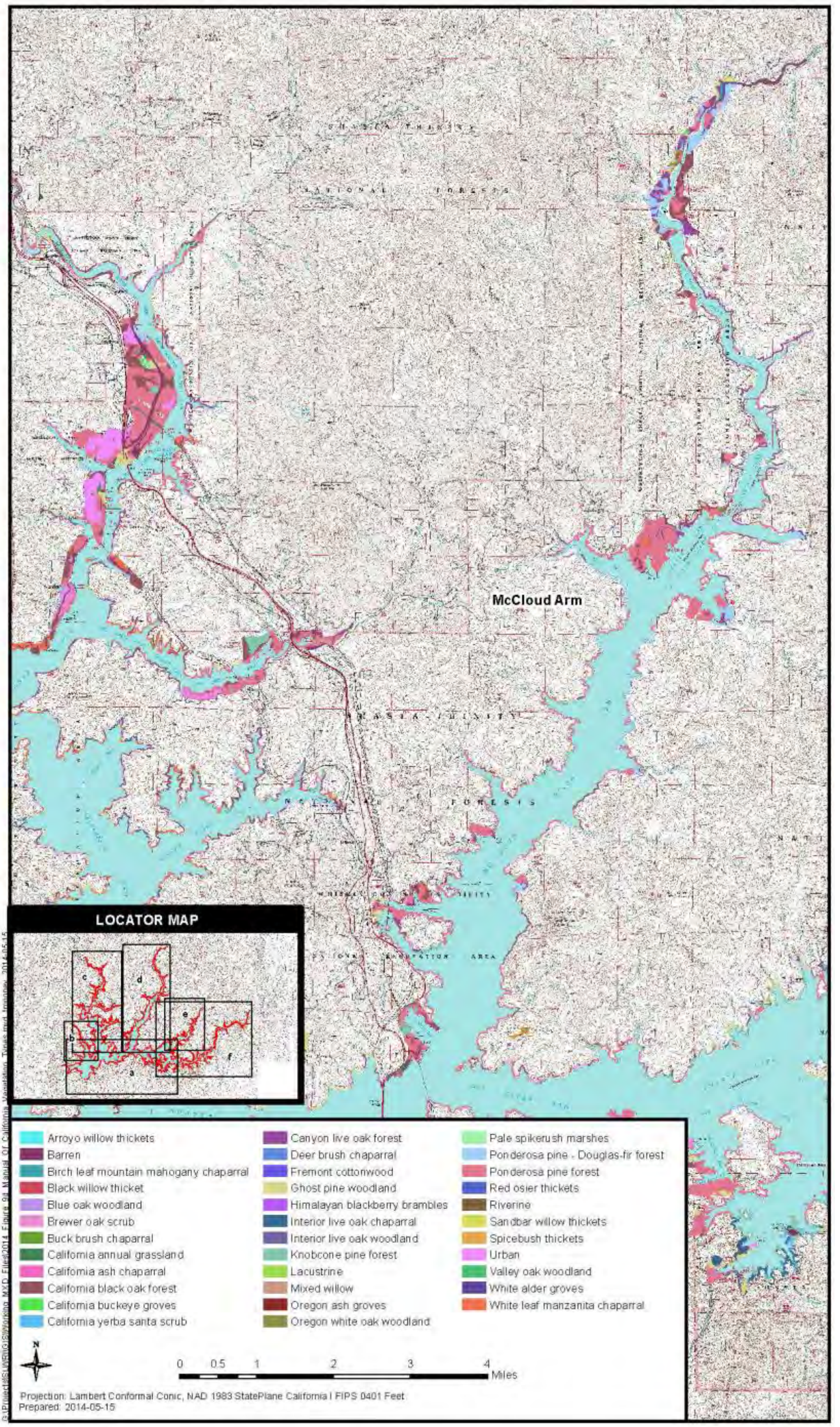

Figure 1-3d. Manual of California Vegetation Types

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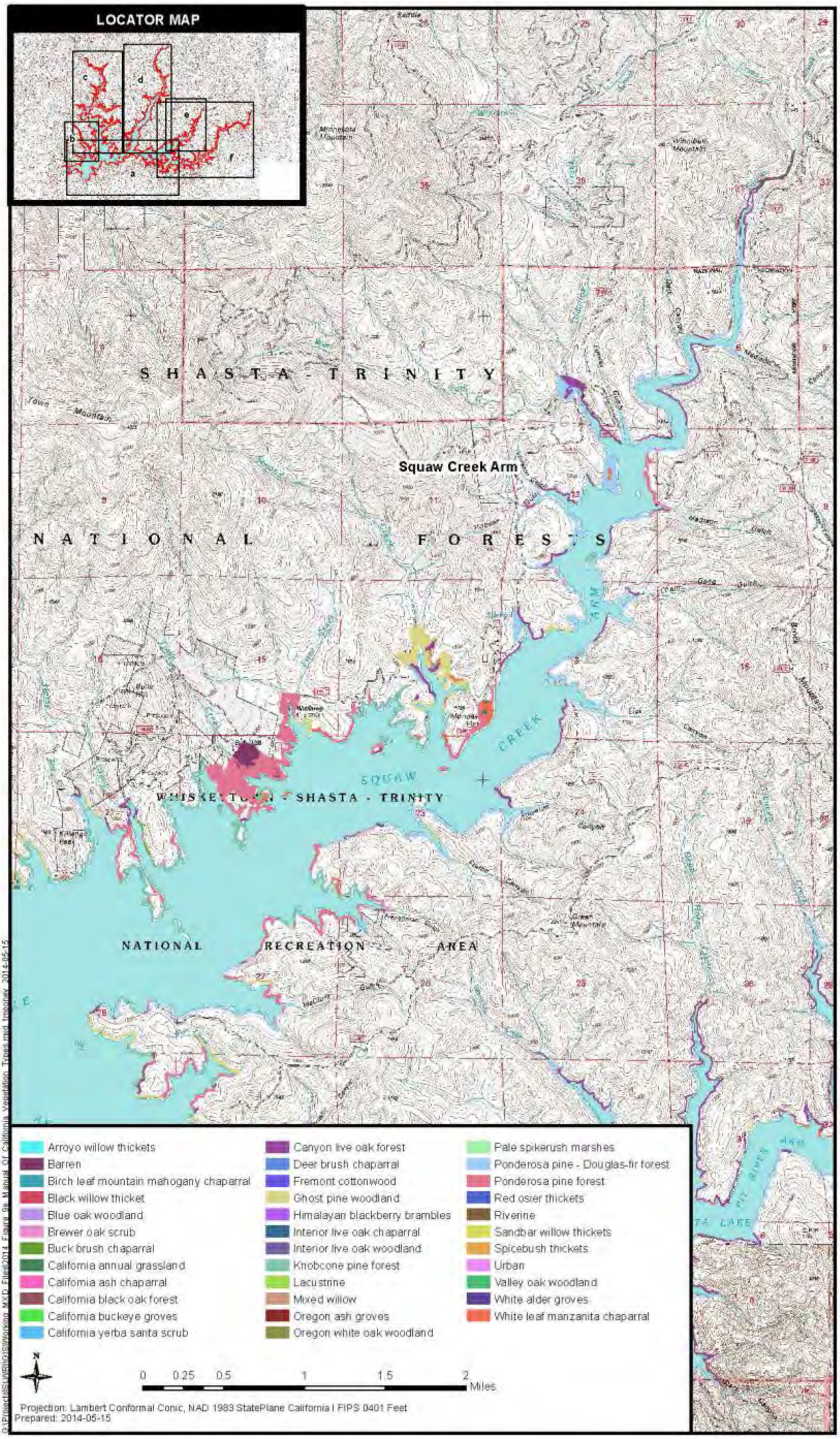

Figure 1-3e. Manual of California Vegetation Types

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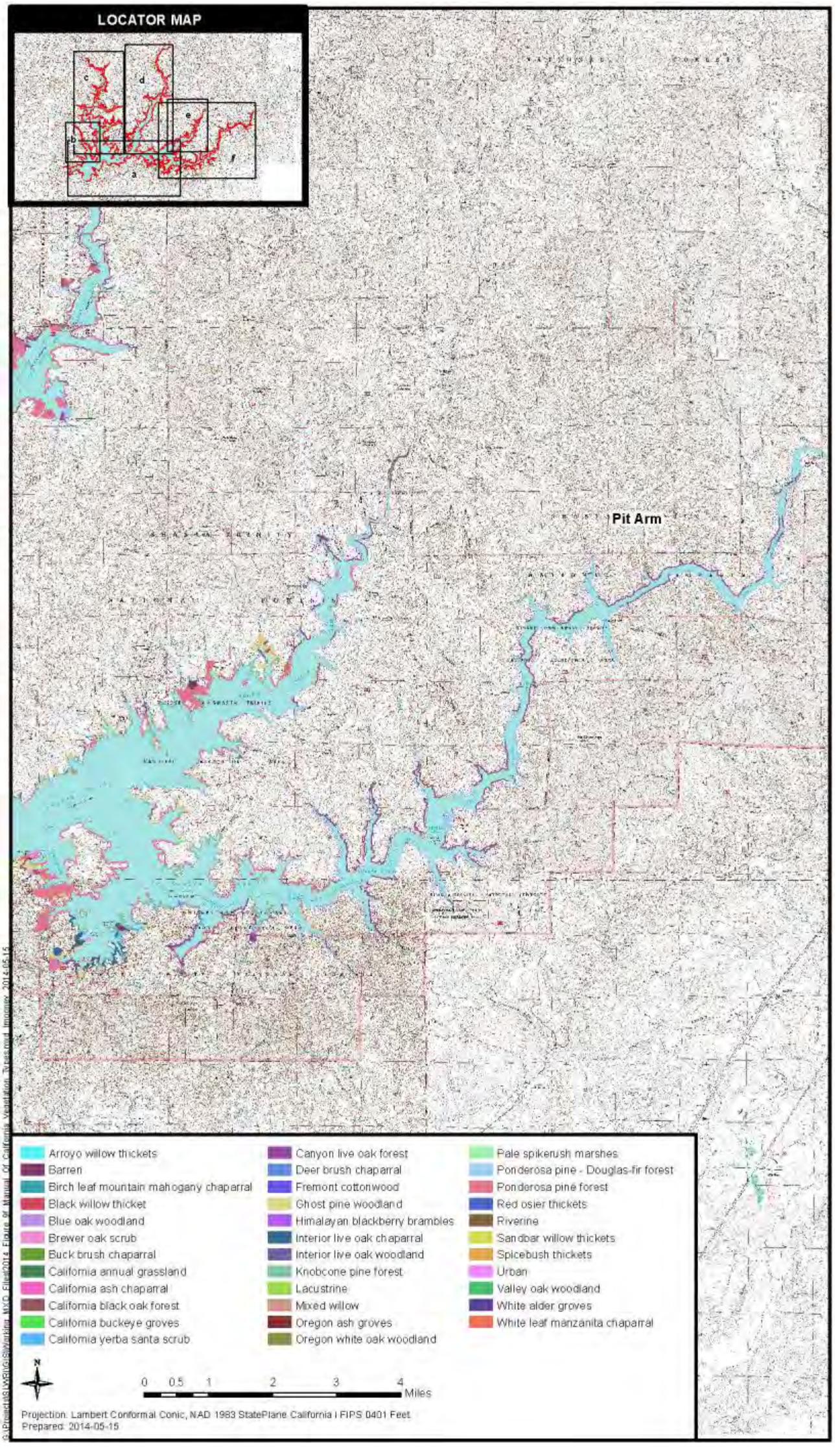

Figure 1-3f. Manual of California Vegetation Types

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Barren Barren habitat consists mainly of nonvegetated man-made features. Barren habitat is scattered throughout the Shasta Lake and vicinity portion of the primary study area, including boat ramps, parking lots, and roads. Other barren habitats are a large gravel plain feature at the confluence of Butcher Creek and Shasta Lake (Main Body) and a sealed riprap feature adjacent to Interstate 5 (I-5) near the upper Sacramento Arm and Shasta Lake confluence. Vegetation is usually not present, although sparse opportunistic grasses/forbs or weedy species may occur.

Birch Leaf Mountain-Mahogany Chaparral Birch-leaf mountain-mahogany chaparral is a relatively common associate species in many chaparral and woodland plant series types. As a plant series, birch-leaf mountain-mahogany occurs in the Shasta Lake and vicinity portion of the primary study area along the upper McCloud and Sacramento arms. These sites are located on floodplain terraces and are characterized as moderate to dense chaparral stands dominated by birch-leaf mountain-mahogany (*Cercocarpus betuloides*), with occasional buck brush (*Ceanothus cuneatus*), poison oak (*Toxicodendron diversilobum*), western redbud (*Cercis occidentalis*), yerba santa (*Eriodictyon californicum*), and Brewer oak (*Q. garryana* var. b*reweri*).

Black Willow Thicket Although commonly associated with willow and other riparian plant series types, black willow thicket is uncommon in the Shasta Lake and vicinity portion of the primary study area. This plant series is dominated by black willow (*Salix gooddingii*), with spicebush (*Calycanthus occidentalis*), rushes (*Juncus* spp.), and California grape (*Vitis californica*). It occurs at only two locations in the Shasta Lake and vicinity portion of the primary study area, one along the Sacramento Arm and the other in the Jones Valley area (Pit Arm).

Blue Oak Woodland The blue oak plant series occurs mainly as small inclusions within other more prevalent plant series types; however, moderate-sized stands also occur. This plant series occurs at scattered locations along the Main Body, McCloud Arm, and Pit Arm and is characterized by open to moderate woodlands dominated by blue oak (*Quercus douglasii*). Associated tree species include occasional interior live oak (*Q. wislizenii* var. *wislizenii*) and gray pine (*Pinus sabiniana*). The shrub layer is open or absent, and a moderate to dense forb layer dominates the understory.

Brewer Oak Scrub The Brewer oak plant series consists of moderate to very dense stands of Brewer oak, the shrub form of Oregon white oak (*Q. garryana* var. *garryana*). This plant series type is widespread throughout the Shasta Lake and vicinity portion of the primary study area. Brewer oak stands are often nearly pure; occasionally, however, shrub species such as poison oak, white leaf manzanita, yerba santa, buck brush, bush poppy (*Dendromecon rigida*), Fremont's silktassel (*Garrya fremontii*), deer brush (*Ceanothus integerrimus*), skunkbrush (*Rhus trilobata*), and snowdrop bush (*Styrax officinalis*) occur in association with Brewer oak.

Buck Brush Chaparral Buck brush chaparral occurs at scattered locations throughout the Shasta Lake and vicinity portion of the primary study area. This plant series is dominated by moderate to dense stands of buck brush. Associated species include white leaf manzanita, poison oak, western redbud, yerba santa, Brewer oak, birch-leaf mountain-mahogany, and coffeeberry (*Frangula* sp.).

California Annual Grassland California annual grassland is uncommon in the Shasta Lake and vicinity portion of the primary study area, occurring only as small inclusions in other more prevalent plant series types or in areas subjected to previous disturbance. Dominant species include wild oat (*Avena fatua*), downy brome (*Bromus tectorum*), ripgut (*B. diandrus*), yellow star-thistle (*Centaurea solstitialis*), squirreltail (*Elymus elymoides*), and European hairgrass (*Aira caryophyllea*).

California Ash Chaparral California ash (*Fraxinus dipetala*) is a relatively common associate species in many chaparral and woodland plant series types. As a plant series, California ash chaparral occurs in the Shasta Lake and vicinity portion of the primary study area at several locations along the McCloud Arm. This plant series is characterized as a moderate to dense chaparral stand dominated by California ash, with occasional birch-leaf mountain-mahogany, buck brush, poison oak, western redbud, yerba santa, and Brewer oak.

California Black Oak The black oak series is characterized by moderate to dense stands of California black oak (*Quercus kelloggii*). This plant series is relatively common throughout the Shasta Lake and vicinity portion of the primary study area. Understory associates include white leaf manzanita (*Arctostaphylos viscida*), poison oak, snowdrop bush (*Styrax officinalis*), and buck brush. The ground layer is open to dense and is dominated by various grasses and forbs.

California Buckeye Groves Although a common associate in many plant series types in the Shasta Lake and vicinity portion of the primary study area, California buckeye groves are uncommon as a plant series type. This plant series is dominated by California buckeye (*Aesculus californica*). Associated species include poison oak, Brewer oak, buck brush, and various grasses and forbs. It occurs at only several scattered locations in the Sacramento Arm, McCloud Arm, and Pit Arm.

California Yerba Santa Scrub California yerba santa scrub is a relatively common associate species in many chaparral and woodland plant series types. California yerba santa is a pioneer species that readily responds to various disturbances and wildfire. As a plant series, California yerba santa scrub occurs in the Shasta Lake and vicinity portion of the primary study area at two general locations subject to wildfires in 2004 and 2008: the Jones Valley area (Pit Arm), and the Dry Creek area (Main Body). This plant series is characterized as moderate to dense chaparral stands dominated by California yerba santa, with

occasional shrub interior live oak, shrub canyon live oak, buck brush, poison oak, western redbud, and Brewer oak.

Canyon Live Oak Forest The canyon live oak plant series is characterized by moderate to dense stands of canyon live oak (*Quercus chrysolepis*). This plant series is relatively common throughout the Shasta Lake and vicinity portion of the primary study area. Associated tree species include occasional California black oak. Understory associates include white leaf manzanita and poison oak. The ground layer is open to moderate and is dominated by various grasses and forbs.

Deer Brush Chaparral Deer brush chaparral is a relatively common associate in chaparral and forest plant series types in the Shasta Lake and vicinity portion of the primary study area; however, deer brush is uncommon in the study area as a plant series type. This plant series is dominated by deer brush. It occurs at several scattered locations along the Main Body, McCloud Arm, and Pit Arm.

Fremont Cottonwood Forest In the Shasta Lake and vicinity portion of the primary study area, Fremont cottonwood forest is an uncommon plant series type that occurs as single stands of trees along small portions of the upper Sacramento Arm and the Pit Arm. The dominant species is Fremont cottonwood (*Populus fremontii*).

Ghost (Gray) Pine The ghost pine plant series occurs in all parts of the Shasta Lake and vicinity portion of the primary study area except along the Big Backbone Arm. This plant series type is characterized by open to moderate stands of gray pine. Associated species include blue oak, canyon live oak, interior live oak, and California black oak. Shrub species are moderate to dense and include white leaf manzanita, western redbud, buck brush, Brewer oak, poison oak, and yerba santa.

Himalayan Blackberry Brambles Himalayan blackberry (*Rubus armeniacus*) is a common associate in many riparian plant series and in various other plant series with mesic microhabitats and/or previous disturbance. As a plant series, Himalayan blackberry brambles occur in portions of the Dry Creek (Main Body) and Jones Valley (Pit Arm) areas disturbed by wildfire. This plant series occurs in and along drainage and stream features and is characterized as dense thickets of Himalayan blackberry. Associated species include spicebush, willow, and rushes.

Interior Live Oak Chaparral In the Shasta Lake and vicinity portion of the primary study area, the interior live oak chaparral plant series is relatively uncommon, occurring mainly along the Sacramento Arm. However, this plant series also occurs at scattered locations along the Main Body, the McCloud Arm, and the Pit Arm. This plant series is dominated by moderate to dense stands of the shrub form of interior live oak. Associated species include Brewer oak, white leaf manzanita, poison oak, and buck brush.

Interior Live Oak Woodland The interior live oak woodland plant series is uncommon in the Shasta Lake and vicinity portion of the primary study area. It occurs in several small areas along the Sacramento Arm, the Pit Arm, the McCloud Arm, and the Main Body.

Knobcone Pine Forest The knobcone pine forest plant series consists of open to dense knobcone pine (*Pinus contorta*) stands. This plant series is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area. Knobcone pine forest often occurs at locations characterized by disturbances, including historic mining activities and wildfires. Dominant species include knobcone pine, with occasional canyon live oak, California black oak, ponderosa pine (*Pinus ponderosa*), and gray pine. The shrub layer is moderate to dense and is dominated by white leaf manzanita and poison oak. The ground layer varies and is dominated by various grasses and forbs.

Lacustrine Lacustrine habitat consists of the area regularly inundated by Shasta Lake (i.e., areas at and below the 1,070-foot elevation). Most of this area is barren of vegetation and is characterized as exposed soil and/or rock. Portions of the lacustrine habitat do support vegetation, including woody riparian species such as black willow, button willow (*Cephalanthus occidentalis*), Fremont cottonwood, and various grasses and forbs, during draw-down periods.

Mixed Willow Mixed willow is the most common willow plant series type in the Shasta Lake and vicinity portion of the primary study area and occurs throughout the entire area. Dominant species include red willow (*Salix laevigata*), black willow, shining willow (*S. lasiandra*), arroyo willow (*S. lasiolepis*), and narrowleaf willow (*S. exigua*).

Oregon Ash Groves Oregon ash groves are an uncommon plant series type in the Shasta Lake and vicinity portion of the primary study area. This type occurs along the upper McCloud Arm and is dominated by open to moderate stands of Oregon ash (*Fraxinus latifolia*) with willow, California grape, mock orange, brickelbush (*Brickellia* sp.), and poison oak.

Oregon White Oak Woodland The Oregon white oak woodland plant series is uncommon in the Shasta Lake and vicinity portion of the primary study area and occurs as small inclusions in other more prevalent plant series types. This plant series is characterized by open to moderate woodlands dominated by Oregon white oak. Associated tree species include occasional canyon live oak, blue oak, and California black oak. The shrub layer is open or absent, and a moderate to dense forb layer dominates the understory.

Pale Spike Rush Marshes Pale spike rush is an uncommon plant series in the Shasta Lake and vicinity portion of the primary study area; it is known to occur only in a portion of one relocation area near Lakehead (Sacramento Arm). This plant series is characterized as a seasonal wetland dominated by a complex of annual and perennial upland and wetland plant species. Dominant species

include pale spike rush (*Eleocharis macrostachya*), jointed coyote-thistle (*Eryngium articulatum*), pennyroyal (*Mentha pulegium*), panic grass (*Panicum acuminatum*), iris-leaf rush (*Juncus xiphioides*), sedges (*Carex* spp.), rushes, poison oak, white leaf manzanita, western choke-cherry (*Prunus virginiana*), interior rose (*Rosa woodsii*), and Himalayan blackberry.

Ponderosa Pine–Douglas-Fir Ponderosa pine–Douglas-fir is the second-most-common conifer plant series type in the Shasta Lake and vicinity portion of the primary study area, occurring everywhere except along the Big Backbone Arm. This plant series is characterized by open to dense conifer stands dominated by Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine. Associated species include occasional sugar pine (*P. lambertiana*), incense cedar (*Calocedrus decurrens*), canyon live oak, and California black oak. Associated understory species vary and include Pacific dogwood (*Cornus nuttallii*), mock orange (*Philadelphus lewisii*), poison oak, snowdrop bush, and white leaf manzanita. The ground layer is open to moderate and is dominated by various grasses and forbs.

Ponderosa Pine Ponderosa pine is the most common conifer plant series type in the Shasta Lake and vicinity portion of the primary study area and is scattered throughout all portions of the area. This plant series is characterized by open to dense conifer stands dominated by ponderosa pine. Associated species include occasional Douglas-fir, sugar pine, incense cedar, canyon live oak, and California black oak. Associated understory species vary and include redbud, buck brush, mock orange, poison oak, snowdrop bush, and white leaf manzanita. The ground layer is open to moderate and is dominated by various grasses and forbs.

Red Osier Thickets Red osier is a common associate in many riparian plant series types in the Shasta Lake and vicinity portion of the primary study area. As a plant series, red osier thickets are an uncommon plant series type. In the vicinity of Shasta Lake, red osier thickets are found along the upper McCloud Arm. Dominant species include red osier (*Cornus stolonifera*), brown dogwood (*C. glabrata*), mock orange, spicebush, and California grape.

Riverine Riverine habitat includes the free-flowing portions of the larger Shasta Lake tributaries occurring in the Shasta Lake and vicinity portion of the primary study area. The riverine habitat is highly variable and ranges from moderate, low-gradient to steep, well-confined stream reaches.

Sandbar Willow Thickets Sandbar willow thicket is an uncommon plant series that occurs at one location each along the McCloud Arm and the Squaw Creek Arm. Dominant species include narrowleaf willow, with occasional red willow, black willow, shining willow, and arroyo willow.

Spicebush Thickets Spicebush is a common associate in many riparian plant series types in the Shasta Lake and vicinity portion of the primary study area.

As a plant series, spicebush thickets are an uncommon plant series type. This plant series occurs at several locations along the McCloud Arm. Dominant species include spicebush, red osier, mock orange, and California grape.

Urban Urban habitat consists of various man-made features scattered throughout the Shasta Lake and vicinity portion of the primary study area, including resorts and a portion of the visitor center complex at Shasta Dam. These features are typically a combination of various buildings, pavement areas with manicured landscaping, and lawns.

Valley Oak Woodland Valley oak woodland is an uncommon plant series and occurs at two small locations in the Lakehead area (Sacramento Arm). Dominant species include valley oak (*Quercus lobata*) with white leaf manzanita, redbud, poison oak, and various grasses and forbs.

White Alder Groves The white alder plant series occurs in the riparian vegetation found in drainages throughout the Shasta Lake and vicinity portion of the primary study area. This plant series is characterized as narrow bands of vegetation occurring in and along the margins of rivers, streams, or other drainages. Dominant species include white alder (*Alnus rhombifolia*) with occasional Oregon ash, red osier, big-leaf maple (*Acer macrophyllum*), narrowleaf willow, red willow, shining willow, and arroyo willow. Associated shrubs include spicebush, mock orange, California blackberry (*Rubus ursinus*), mugwort (*Artemisia douglasiana*), ninebark (*Physocarpus capitatus*), and western azalea (*Rhododendron occidentale*). Common lianas include California grape, pipevine (*Aristolochia californica*), greenbriar (*Smilax californica*), and virgin's bower (*Clematis ligusticifolia*). The ground layer is open to dense and is dominated by sedges with various grasses and forbs.

White Leaf Manzanita Chaparral White leaf manzanita is the most common chaparral plant series type in the Shasta Lake and vicinity portion of the primary study area and is scattered throughout all portions of the area. The dominant species is white leaf manzanita. Associated species include occasional common manzanita (*A. manzanita*), western redbud, buck brush, deer brush, poison oak, birch-leaf mountain-mahogany, interior live oak (shrub form), Fremont's silktassel, bush poppy, yerba santa, and Brewer's oak.

Upper Sacramento River (Shasta Dam to Red Bluff) The following section provides a description of the habitat that exist along the Sacramento River throughout the primary study area, and a detailed discussion of potential Sacramento River downstream habitat restorations areas. as well as the plant habitat that exist along the Sacramento River throughout the rest of the primary study area.

Plant Communities in the Primary Study Area (Shasta Dam to RBPP)
Vegetation within the Sacramento River Valley includes a variety of both upland and lowland plant communities, including a number of communities that

are considered sensitive. Plant community names and descriptions used in this report are based primarily on the Preliminary Descriptions of the Terrestrial Natural Communities of California (Holland 1986). Additional plant community information was obtained from *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995), *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988), and the Shasta Lake Water Resources Investigation Initial Alternatives Report (Reclamation 2004). Also, for each plant community, the corresponding Natural Community Conservation Plan (NCCP) habitat type of the Multi-Species Conservation Strategy (MSCS) for the CALFED Bay-Delta Program (CALFED) (2000a) is noted. The plant communities present in the primary study area between Shasta Dam and RBPP are grouped into common and sensitive communities, and the relevant aspects of their ecology are discussed. These descriptions are generally applicable to the extended study area as well.

Common Plant Communities Common plant communities present within the primary study area include annual grassland, chaparral, and agricultural lands. The upper banks along steep-sided, bedrock constrained segments of the Sacramento River and its tributaries are characterized primarily by upland communities including blue oak woodland, foothill pine–oak woodland, and chaparral. These segments occur primarily between Shasta Dam and Redding.

Annual Grassland Annual grassland is an herbaceous plant community characterized by a dense cover of nonnative annual grasses with numerous species of nonnative annual forbs, as well as native wildflowers. Typical grass species include bromes (*Bromus diandrus*, *B. hordeaceus*, and *B. madritensis* ssp. *rubens*), wild oat (*Avena fatua*), foxtail barley (*Hordeum murinum* ssp. *leporinum*), medusahead (*Elymus caput-medusae*), and Italian ryegrass (*Festuca perennis*). Common nonnative forbs include vetches (*Vicia* spp.), filarees (*Erodium* spp.), and clovers (*Trifolium* spp.). Native wildflowers such as California poppy (*Eschscholzia californica*), frying pans (*Eschscholzia lobbii*), California goldfields (*Lasthenia californica*), Fremont's tidy-tips (*Layia fremontii*), rusty popcorn flower (*Plagiobothrys nothofulvus*), and Fitch's tarweed (*Centromadia fitchii*) are also a common component of the annual grassland community. This plant community occurs in openings and disturbed areas and also characterizes the understory of the woodland plant communities. Annual grassland corresponds to the MSCS NCCP habitat "grassland."

Although the annual grasslands of the Central Valley and surrounding foothills are dominated by a small number of nonnative annual grasses, this natural community includes a large number of species, particularly species with an annual life history, both natives and nonnatives. These species differ substantially in the timing and duration of germination, growth, and reproduction. As a consequence, grassland structure and species composition vary substantially both throughout the growing season and from year to year. In response to annual patterns of temperature and rainfall, grassland structure and species composition also varies from one year to the next.

Chaparral Chaparral communities are characterized by dense cover of drought-tolerant shrubs, generally 6–12 feet tall. This plant community typically occurs on dry, rocky, thin-soiled slopes that are often steep and have southern aspects. Chaparral communities in the primary study area are typically dominated by common manzanita or buckbrush and have only a sparse herbaceous layer. Chaparral communities in the extended study area may be dominated by any one of several species of manzanita or ceanothus, or may be dominated by other species such as chamise (*Adenostoma fasciculatum*), scrub oak (*Quercus dumosa*), or interior live oak. Chaparral communities are within the MSCS habitat type "upland scrub."

The dynamics of chaparral are closely related to fire. Because the crowns of chaparral shrubs are at or within several feet of the ground surface, they are killed by fire. However, many chaparral shrubs produce new stems from their stem bases. These "sprouters" and a number of nonsprouting species (of both shrubs and herbaceous species) also have a soil seedbank of dormant seed that are stimulated to germinate following fire. Following fire, sprouts and seedlings rapidly restore the shrub layer, which after reforming changes in structure and species composition much more slowly than during the first decade following a fire.

Agricultural Lands Much of the land within the Sacramento River Valley has been converted to agricultural uses. A variety of crops are cultivated in the fertile floodplain soils between Redding and Red Bluff, including irrigated row and field crops (e.g., rice, beans, melons, and alfalfa) and orchards and vineyards (e.g., grapes, walnuts, almonds, and grapes). Vegetation on the edges of agricultural fields is typically dominated by invasive annual grasses and forbs such as ripgut brome (*Bromus diandrus*), wild oats, Italian ryegrass, wild radish (*Raphanus sativus*), and field bindweed (*Convolvulus arvensis*). MSCS habitats include a "seasonally flooded agricultural land" category that includes any agricultural land that requires at least 1 week of flooding as a management practice. The MSCS does not include any habitat types for other agricultural lands.

These lands go through frequent, often seasonal cycles of tillage, seedbed preparation, seeding, crop growth, and harvesting, with applications of irrigation water, fertilizers, pesticides, and herbicides. Consequently, they progress from exposed soil to formation of a uniform, low, layer of herbaceous plants (dominated by a single species), to disturbance of the herbaceous layer and the underlying soil. The vegetation is low (1 foot to several feet high), uniform in structure, and except for irrigated pastures, generally of a single crop species and associated weeds.

Sensitive Plant Communities Sensitive plant communities include those that are of special concern to resource agencies or are afforded specific consideration through the California Environmental Quality Act (CEQA), Section 1602 of the California Fish and Game Code, Section 404 of the Federal

Clean Water Act (CWA), and the State's Porter-Cologne Water Quality Control Act (Porter-Cologne Act), as discussed under "Regulatory Framework" below. Sensitive natural communities may be of special concern to these agencies and conservation organizations for a variety of reasons, including their locally or regionally declining status, or because they provide important habitat to common and special-status species. Many of these communities are tracked in the California Department of Fish and Wildlife's (CDFW, formerly known as California Department of Fish and Game [CDFG]) CNDDB, a statewide inventory of the locations and conditions of the state's rarest plant and animal taxa and vegetation types. Many riparian and wetland plant communities occurring in the primary study area are considered sensitive by regulatory agencies. In addition, valley oak woodland is identified as a sensitive natural community by CDFW, and CEQA requires counties to consider treat all oak woodlands as sensitive communities. (Oak trees present in the study area also may be eligible for protection under local ordinances.) In the primary study area, in addition to the oak woodland, riparian, and wetland communities described above, sensitive natural communities include waters of the United States, including wetlands and navigable waters, which are subject to U.S. Army Corps of Engineers (USACE) jurisdiction. Potential waters of the United States in the primary study area include wetland communities and several named sloughs, canals, and irrigation ditches.

Oak Woodlands Oak woodlands present in the primary study area include blue oak woodland, blue oak savanna, foothill pine–oak woodland, and valley oak woodland.

Blue Oak Woodland Blue oak woodland is a broadleaved deciduous woodland plant community. The understory varies from grassy to shrubby. This plant community is dominated by blue oak (*Quercus douglasii*), but other oaks, including canyon live oak (*Q. chrysolepis*) and interior live oak (*Q. wislizeni*), are also typically present, as well as foothill pine (*Pinus sabiniana*). Common understory shrubs include common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), buckbrush (*Ceanothus cuneatus*), toyon (*Heteromeles arbutifolia*), redberry buckthorn (*Rhamnus crocea*), and poison oak (*Toxicodendron diversilobum*). Blue oak woodland occurs in valley uplands and on gentle to steep slopes with shallow, rocky, infertile soils that are moderately to excessively drained. Blue oak woodland is a community within the MSCS habitat type "valley/foothill woodland and forest."

Blue Oak Savanna Blue oak savanna is a broadleaved deciduous plant community characterized by an open tree canopy (typically less than 10 percent cover) and an understory of nonnative annual grasses and forbs interspersed with native wildflowers. The tree canopy is dominated by blue oak. Individual foothill pine trees occur occasionally in this community and patches of shrubs such as buckbrush, common manzanita, or toyon may also be present. Blue oak savanna typically occurs on south-facing slopes with thinner soils. Blue oak

savanna is a community in the MSCS habitat type "valley/foothill woodland and forest."

Foothill Pine–Oak Woodland Foothill pine-oak woodland is an evergreen plant community characterized by a foothill pine–dominated tree canopy with oaks including blue oak and interior live oak as subdominants. This is a moderately open woodland community with an annual grassland understory. Shrub species including toyon, buckbrush, mountain mahogany (*Cercocarpus betuloides*), and common manzanita are often present. Foothill pine-oak woodland is widespread on east and northeast aspects. Foothill pine-oak woodland is a community in the MSCS habitat type "valley/foothill woodland and forest."

Valley Oak Woodland This habitat type consists of an open savanna of valley oak (*Quercus lobata*) trees and an annual grassland understory. Valley oak is typically the only tree species present and shrubs are generally absent except for occasional poison oak. Canopy cover rarely exceeds 30–40 percent in valley oak woodland. This community occupies the highest portions of the floodplain terrace where flooding is infrequent and shallow. Valley oak woodland is a community in the MSCS habitat type "valley/foothill woodland and forest."

The oaks that dominate the tree layer of oak savannas and woodlands are long-lived trees that are resilient to damage; their stems often survive fire, and when their stems are killed by fire or are cut down, basal sprouts often grow into new stems. (Valley oak also tolerates inundation during winter before it has leafed out.)

Nonetheless, there are concerns regarding the status and ongoing trends of tree canopies of blue oak- and valley oak-dominated savannas and woodlands (Tyler, Kuhn, and Davis 2006). When canopy oaks die, their replacement through the growth of saplings or the remaining canopy trees is necessary to maintain the tree canopy. Currently, saplings are absent or at low densities on many sites; thus, their recruitment into the canopy is very infrequent. The infrequent recruitment of saplings appears to be a consequence of climate, interactions with herbivores, competition for resources with herbaceous plants, and the reproductive biology of the oaks themselves.

Riparian Communities Riparian communities in the primary study area are subject to regulation by CDFW under Section 1602 of the California Fish and Game Code because they are associated with streambanks. They are identified as sensitive natural communities by CDFW because of their declining status statewide and because of the important habitat values they provide to both common and special-status plant and animal species. These habitat types are tracked in the CNDDB. In addition, areas containing riparian habitat may be subject to USACE jurisdiction under Section 404 of the CWA, if they meet the three wetland criteria described below under "Regulatory Framework."

California's riparian and wetland communities have experienced the most extensive reductions in their acreage, and in the Sacramento Valley approximately 90 percent of riparian vegetation has been converted to agriculture or development, and the remainder substantially altered by dams, diversions, gravel mining, grazing practices, and invasive species (Hunter et al. 1999; CALFED 2000b). Consequently, riparian and wetland communities are considered sensitive.

Much of the vast riparian habitat that once existed along the Sacramento River has been eliminated by agricultural clearing, flood control projects, and urbanization. Historically, belts of riparian forest more than 5 miles wide occurred along the Sacramento River (Jepson 1893; Thompson 1961, cited in Hunter et al. 1999). Only narrow remnants of these riparian forests remain in the Sacramento River Valley. In the primary study area, much of the Sacramento River from Shasta Dam to Redding is deeply entrenched in bedrock, which precludes development of extensive areas of riparian vegetation. The river corridor between Redding and Red Bluff, however, still maintains extensive areas of riparian vegetation.

Riparian communities present within the floodplain of the Sacramento River, within the primary study area, include blackberry scrub, Great Valley willow scrub, Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, and Great Valley valley oak riparian forest. Willow and blackberry scrub and cottonwood- and willow-dominated riparian communities are present along active channels and on the lower flood terraces whereas valley oak–dominated communities occur on higher flood terraces. These communities are all in the MSCS habitat type "valley/foothill riparian," and are described below.

Blackberry Scrub Blackberry scrub is dominated by Himalayan blackberry (*Rubus discolor*), a species that is listed as invasive by the California Invasive Plant Council (Cal-IPC). Cover of Himalayan blackberry is extremely dense in this community, leaving little opportunity for the establishment of native tree seedlings or shrubs beneath its canopy. Herbaceous cover is also very sparse. Scattered individual trees and shrubs may be interspersed through the blackberry scrub community. Himalayan blackberry generally establishes in gaps created by natural or human disturbances. Although Himalayan blackberry is an invasive species, this community does provide nesting habitat for some bird species and may be regulated under Section 1602 of the California Fish and Game Code when located within the bed, channel, or bank of a stream and may be subject to USACE jurisdiction under Section 404 of the CWA.

Great Valley Willow Scrub Great Valley willow scrub is a deciduous broadleaved community with open to dense cover of shrubby willows. This community type may be dominated by a single species of willow or by a mixture of willow species. Dense stands have very little understory while more open stands have herbaceous understories, usually dominated by grasses characteristic of the annual grassland community. Characteristic plant species

include sandbar willow (*Salix exigua*), arroyo willow (*S. lasiolepis*), shining willow (*S. lucida*), and California wild rose (*Rosa californica*). This community occupies point bars and narrow corridors along the active river channel that are repeatedly disturbed by high flows.

Great Valley Cottonwood Riparian Forest Great Valley cottonwood riparian forest is a deciduous broadleaved forest community with a dense tree canopy dominated by Fremont cottonwood (*Populus fremontii*) and often including a high abundance of black willow (*Salix gooddingii*). This community also has a dense understory of seedlings, saplings, and sprouts of the canopy dominants and shade-tolerant species including California box elder (*Acer negundo*) and Oregon ash (*Fraxinus latifolia*). Characteristic shrub species include California buttonbush (*Cephalanthus occidentalis* var. *californicus*) and willows (*Salix* spp.). Lianas such as California grape (*Vitis californica*) are typically present as well. This community occupies lower floodplain terraces that are flooded annually.

Great Valley Mixed Riparian Forest Great Valley mixed riparian forest is a deciduous broadleaved forest community with a moderately dense to dense tree canopy that typically includes several species as codominates. Shrubs and lianas are also typically present. Mixed riparian forest is typically dominated by sycamore (*Platanus racemosa*) and valley oak (*Quercus lobata*) with Fremont cottonwood, white alder (*Alnus rhombifolia*), willow, and Oregon ash also occurring frequently. Common shrub species in this community type include blue elderberry (*Sambucus nigra* ssp. *canadensi*), California buttonbush, spicebush (*Calycanthus occidentalis*), and Himalayan blackberry. The herbaceous understory consists primarily of annual grasses and forbs similar to those found in the annual grassland communities but with a higher proportion of shade-tolerant species such as miner's lettuce (*Claytonia parviflora*), common bedstraw (*Galium aparine*), bur-chervil (*Anthriscus caucalis*), and meadow nemophila (*Nemophila pedunculata*). At stream edges, the herbaceous understory of this community is characterized by species that grow entirely or partially in water, such as tall flatsedge (*Cyperus eragrostis*), common tule (*Schoenoplectus acutus*), cattail (*Typha* spp.), sedges (*Carex* spp.), deergrass (*Muhlenbergia rigens*), and seep monkeyflower (*Mimulus guttatus*). This community occupies intermediate flood terraces that are subject to occasional high-flow disturbance.

Great Valley Valley Oak Riparian Forest Great Valley valley oak riparian forest is a deciduous broadleaved forest community with a closed canopy. This community type is similar to the Great Valley mixed riparian forest community described above but is clearly dominated by valley oak. Characteristic species include many of the same associates found in the Great Valley mixed riparian forest community type, but tree and shrub associates are more widely scattered. This community occupies upper floodplain terraces where flooding is infrequent but soil moisture is high.

More than 15 native species of deciduous trees and shrubs occur in the riparian forests, woodlands, and scrubs of the Central Valley and the Delta (Conard, MacDonald, and Holland 1977; Sawyer and Keeler-Wolf 1995; Vaghti and Greco 2007). Flow regime, disturbance, and species attributes determine the species composition and physical structure of this woody vegetation. Although flow regime influences the dispersal, establishment, growth, and survival of all the woody riparian species, Fremont's cottonwood (*Populus fremontii*) and the willow species (*Salix* sp.) particularly depend on specific hydrologic events for their recruitment. During seed release, flows must be high enough to disperse seed to surfaces where scouring by subsequent flows does not occur, yet not so high that seedlings desiccate after flows recede, and flows must recede gradually to enable germination and seedling establishment while the substrate is still moist (Mahoney and Rood 1998).

Fremont's cottonwood and willow species are rapidly growing, shade intolerant and relatively short-lived (Burns and Honkala 1990, Vaghti and Greco 2007). Within 10–20 years, initially shrubby thickets have reached 10–40 feet in height. Other species, such as Oregon ash (*Fraxinus latifolia*) and valley oak (*Quercus lobata*), establish concurrently or subsequent to the willows and cottonwood, grow more slowly but are more tolerant of shade, and are longer-lived (Burns and Honkala 1990, Tu 2000). In the absence of frequent disturbance, these species enter the canopy, particularly after 50 years, as mortality of willows and cottonwood frees space. Conversely, frequent disturbance prevents the transition to mature mixed riparian or valley oak forests.

Riparian trees and shrubs are readily top-killed by fire (valley oak is somewhat more resistant to fire); however, most species will produce new shoots from the base of their previous trunks or from their roots. Important consequences of frequent fire can include shifts in species composition, more open vegetation, and an absence of larger trees (which are important habitat components for some species of wildlife).

None of the native woody species of the Central Valley's riparian areas germinate and establish seedlings underwater, and all tolerate inundation during the dormant season (i.e., late fall to early spring). Tolerance of inundation during the growing season varies among species. Most species can withstand a prolonged period of inundation if at least a portion of their foliage is above the water surface.

Wetland Communities Similar to riparian communities, much of the wetland habitat that once occurred in the Sacramento River Valley has been eliminated as a consequence of land use conversion to agriculture and urbanization. It is estimated that nearly 1.5 million acres of wetlands once occurred in the Central Valley. Today, approximately 123,000 acres remain. Wetland communities that are likely to occur in the primary study area between Shasta Dam and RBPP include freshwater marsh, freshwater seep, northern hardpan vernal pools,

northern volcanic mudflow vernal pools, and other seasonal wetlands. Riparian communities in the primary study area are subject to regulation by CDFW under Section 1602 of the California Fish and Game Code because they are associated with streambanks. They are identified as sensitive natural communities by CDFW because of their declining status statewide and because of the important habitat values they provide to both common and special-status plant and animal species. These habitat types are tracked in the CNDDB. In addition, areas containing riparian habitat may be subject to USACE jurisdiction under Section 404 of the CWA, if they meet the three wetland criteria described below under "Regulatory Framework."

Freshwater Marsh Freshwater marshes are herbaceous wetland plant communities that occur along rivers and lakes and are characterized by dense cover of perennial, emergent plant species. Marshes are typically perennial wetlands, but may dry out for short periods of time. Characteristic freshwater marsh species include common tule (*Schoenoplectus acutus*), narrowleaf cattail (*Typha angustifolia*), broadleaf cattail (*Typha latifolia*), common reed (*Phragmites australis*), tall flatsedge, common spikerush (*Eleocharis macrostachya*), and sedges (*Carex* spp.). Freshwater marshes in the primary study area are communities in the MSCS habitat type "nontidal freshwater permanent emergent."

In marsh vegetation, vegetation structure and species richness are strongly influenced by disturbance, changes in water levels, and the range of elevations present at a site (Keddy 2000). Disturbances, and water level drawdowns that expose previously submerged surfaces, provide opportunities for annuals, short-lived perennials, and other species to establish, which creates diversity in species composition and vegetation structure.

Although seedling establishment takes place on exposed surfaces, clonal growth allows many plants to subsequently occupy sites at lower elevations (i.e., in deeper water). The growth of emergent macrophytes is reduced, however, by submergence and by damage to their culms from wave action; thus vegetation dominated by emergent macrophytes is restricted to shallow water, typically less than 2 feet in depth (Coops, Boeters, and Smith. 1991; Coops, Van Der Brink, and Van Der Velde 1996).

At upper and lower elevations, wetlands frequently intergrade with adjacent vegetation. At upper elevations, emergent wetlands often intergrade with the woody vegetation of adjacent riparian areas; at lower elevations, wetlands often intergrade with aquatic vegetation, and a characteristic feature of this transitional zone is floating mats of plants such as water primrose (*Ludwigia* spp.) and knotgrass (*Paspalum distichum*).

Freshwater Seep Freshwater seep is a wetland plant community characterized by dense cover of perennial herb species usually dominated by rushes, sedges, and grasses. Freshwater seep communities occur on sites with

permanently moist or wet soils resulting from daylighting groundwater. Species commonly observed in freshwater seeps in the area include rushes (*Juncus* spp.), sedges, flatsedges (*Cyperus* spp.), deergrass, cattail, bull thistle (*Cirsium vulgare*), blue-eyed grass (*Sisyrinchium bellum*), and willow (*Salix* spp.). The MSCS does not designate a habitat type that includes freshwater seeps.

Vernal Pools Vernal pools are seasonal wetlands that fill during winter rains and dry up in spring. They occur in undulating or mima mound (i.e., mound-intermound) topography where the soil or underlying rock has layers that are relatively impermeable to water. Vernal pools may be isolated from one another, but more often they are interconnected by swales or ephemeral drainages in vernal pool complexes that may extend for hundreds of acres. Vernal pool complexes generally include water features.

Vernal pools are considered sensitive because they provide potential habitat for Federally listed species, including slender Orcutt grass (*Orcuttia tenuis*) and vernal pool crustaceans; provide important ecological values and functions; and are likely considered waters of the State subject to jurisdiction of the Central Valley Regional Water Quality Control Board under the Porter-Cologne Act.

Vernal pool communities are included in the MSCS habitat type "natural seasonal wetland." The two predominant types of vernal pool communities in the primary study area, northern hardpan vernal pools and northern volcanic mudflow vernal pools, are described below.

Northern Hardpan Vernal Pool This is an herbaceous plant community characterized by low-growing annual grasses and forbs adapted to live both on land and in water. In this type of vernal pool, the restrictive layer is composed of cemented hardpan soils that are very acidic. This type of vernal pool occurs on alluvial terraces with hummocky (i.e., mound and depression) topography. The pools form in depressions between mounds. Northern hardpan vernal pool communities are dominated by native plant species; characteristic species include Fremont's goldfields (*Lasthenia fremontii*), toothed downingia (*Downingia cuspidata*), Sacramento Valley pogogyne (*Pogogyne zizyphoroides*), stalked popcornflower (*Plagiobothrys stipitatus*), common blennosperma (*Blennosperma nanum*), pigmy-weed (*Crassula aquatica*), and water starwort (*Callitriche marginata*).

Northern Volcanic Mudflow Vernal Pool This is an herbaceous plant community characterized by an open mixture of very low-growing annual grasses and forbs adapted to live both on land and in water. This type of vernal pool is restricted to small, irregular depressions in tertiary pyroclastic flows. In this case, the restrictive layer is composed of volcanic mudflow material. Typical plant species encountered in these vernal pool communities include smooth goldfields (*Lasthenia glaberrima*), bristled downingia (*Downingia bicornuta*), Douglas' meadowfoam (*Limnanthes douglasii*), stalked popcornflower, white-headed navarretia (*Navarretia leucocephala*), pigmy-

weed, and woolly marbles (*Psilocarphus brevissimus*). Northern volcanic mudflow vernal pool is a community in the MSCS habitat type "natural seasonal wetland."

Pool size and the depth, duration, and seasonal timing of ponding are important factors that influence the composition and diversity of plant and animal species in vernal pools (Solomeshch, Barbour, and Holland 2007). Consequently, the vegetation of vernal pools can vary substantially from year to year in response to interannual fluctuations in climate.

Management activities such as grazing and burning also influence species composition and diversity. In fact, research indicates that the abundance of nonnative grasses, grazing practices, and hydrology are strongly interrelated and can substantially affect the plant communities of vernal pools (Robins and Vollmar 2002, Pyke 2004, Marty 2005).

Seasonal Wetlands Seasonal wetlands are ephemeral wetlands that pond or remain flooded for long periods during a portion of the year, generally the rainy winter season, then dry up, typically in spring. They often occur in shallow depressions on flood terraces that are occasionally to infrequently flooded. Seasonal wetlands are herbaceous communities typically characterized by species adapted for growth in both wet and dry conditions, and may contain considerable cover of upland species as well. Species commonly present in seasonal wetlands include tall flatsedge, dallisgrass (*Paspalum dilatatum*), Bermudagrass (*Cynodon dactylon*), Italian ryegrass, Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), and curly dock (*Rumex crispus*).

Seasonal wetlands differ from vernal pools in that they do not have a restrictive hardpan layer and are usually dominated by nonnative plant species, especially nonnative grasses. Vernal pools are typically distinguished by a unique host of native and endemic plant species adapted to the extreme conditions created by the cycles of inundation and drying. Seasonal wetlands differ from freshwater marshes and seeps in that they are not permanently flooded or saturated. The seasonal wetland community type is not included in the Holland or Sawyer and Keeler-Wolf classification systems, but it is recognized by USACE and may be subject to USACE jurisdiction under Section 404 of the CWA. Seasonal wetland communities are in both the MSCS "natural seasonal wetland" and "managed seasonal wetland" habitat types.

Potential Sacramento River Downstream Habitat Restoration Areas The potential Sacramento River downstream habitat restoration areas are characterized by habitats typical of riparian and riverine areas found in Sacramento River below Shasta Dam. These habitats were also mapped and classified using the MCV. Habitats present in the potential Sacramento River downstream habitat restoration areas are summarized in Table 1-3, and depicted in Figures 1-4a through 1-4f. General habitat descriptions for these locations are also described below.

Table 1-3. Summary of Plant Communities in the Potential Sacramento River Downstream Restoration Areas

Habitat	Potential Sacramento River Downstream Restoration Area (acres*)						
	Henderson	Tobiasson Island	Shea Island Complex	Kapusta Island	Anderson River Park	Reading Island	Total
Broom patches	0.00	2.62	13.03	0.92	4.55	0.00	21.13
Black locust groves	0.00	0.00	0.35	0.00	0.00	0.00	0.35
California annual grassland	2.50	13.50	2.61	17.56	7.83	0.00	44.01
California yerba santa scrub	0.00	0.22	0.00	0.00	1.30	0.00	1.53
Cattail marshes	0.37	0.28	0.29	0.11	1.14	0.00	2.18
Foothill pine	0.00	13.26	0.70	1.86	0.00	0.00	15.82
Fremont cottonwood forest	7.05	1.04	0.00	4.79	44.26	0.00	57.14
Hind's walnut stands	0.42	0.00	0.00	0.00	0.00	0.00	0.42
Orchard	0.00	0.00	0.00	0.00	0.00	0.55	0.55
Oregon ash groves	0.00	0.00	0.00	0.00	2.57	0.00	2.57
Sandbar willow thickets	2.77	0.69	6.68	12.84	5.92	0.38	29.28
Shining willow groves	0.00	2.34	4.05	0.00	0.00	0.00	6.39
Silver wattle thickets	0.00	0.34	0.00	0.00	0.59	0.00	0.93
Soft rush marshes	0.00	0.00	0.26	0.00	0.00	0.00	0.26
Valley oak woodland	2.88	2.03	3.50	14.46	26.85	50.48	100.19
Wright's buckwheat patches	0.00	0.00	0.00	0.00	1.49	0.00	1.49
Water primrose wetlands	3.36	0.00	0.00	0.00	5.81	15.33	24.50
White alder groves	0.00	0.00	0.22	4.16	0.00	0.00	4.38
White-root beds	0.00	0.00	0.00	0.18	0.00	0.00	0.18
Mixed riparian forest	0.00	0.00	0.00	0.00	0.00	24.40	24.40
Parrot's feather mats	0.00	0.00	0.00	0.00	2.92	0.00	2.92
Reed canarygrass swards	0.00	0.00	0.44	0.32	1.18	0.00	1.95
Barren[1]	0.31	1.10	0.00	0.00	0.55	0.00	1.96
Riverine[1]	0.66	1.33	3.45	8.13	0.00	0.47	14.04
Total	20.32	38.76	35.57	65.33	106.96	91.61	358.56

Notes:

[1] California Wildlife Habitat Relationships Wildlife Habitat Type; no corresponding plant series type included in A Manual of California Vegetation (Sawyer et al. 2009).

*Acreage values are approximate.

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Figure 1-4a. Manual of California Vegetation Types – Henderson Open Space

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Figure 1-4b. Manual of California Vegetation Types – Tobiasson Island

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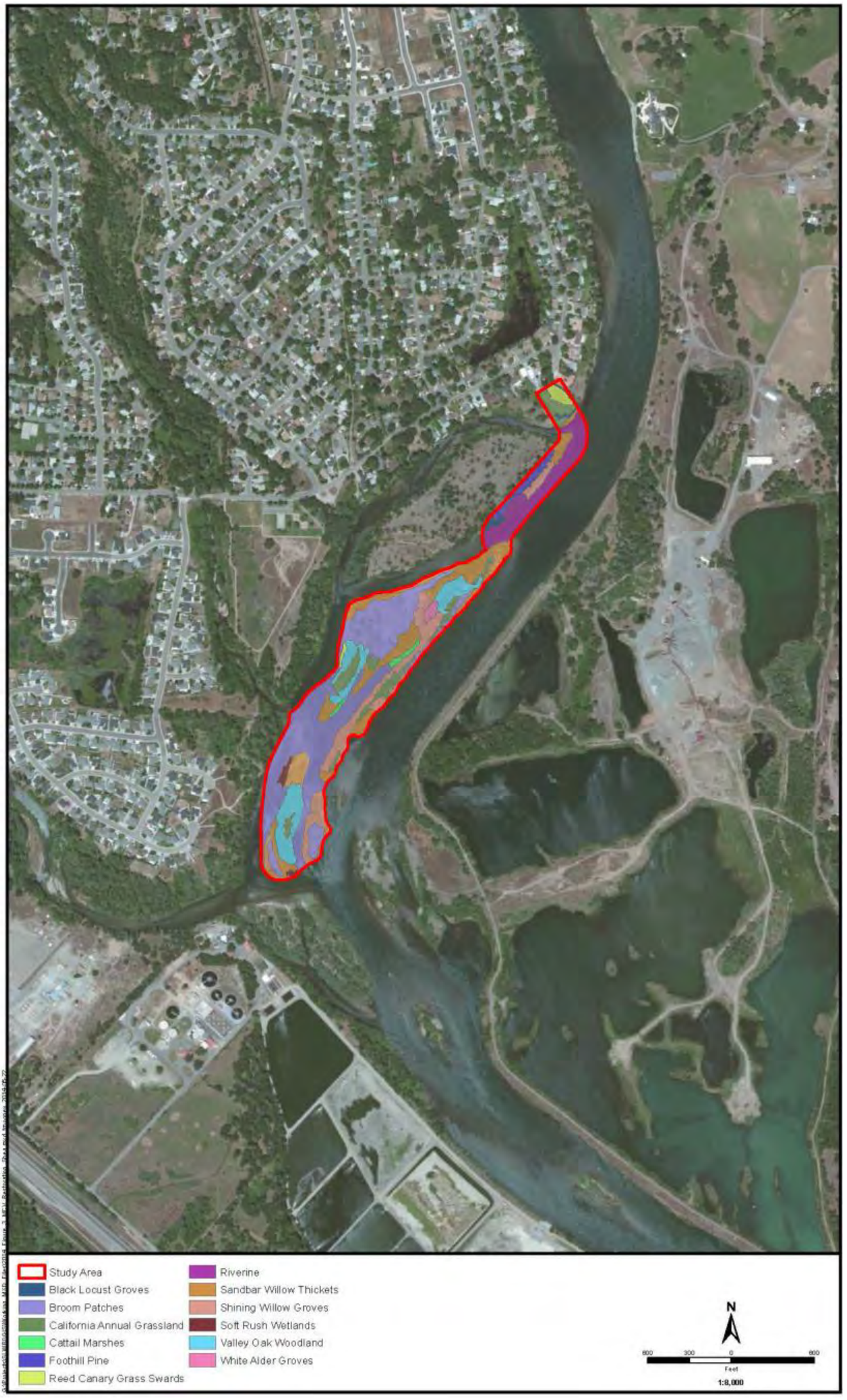

Figure 1-4c. Manual of California Vegetation Types – Shea Island Complex

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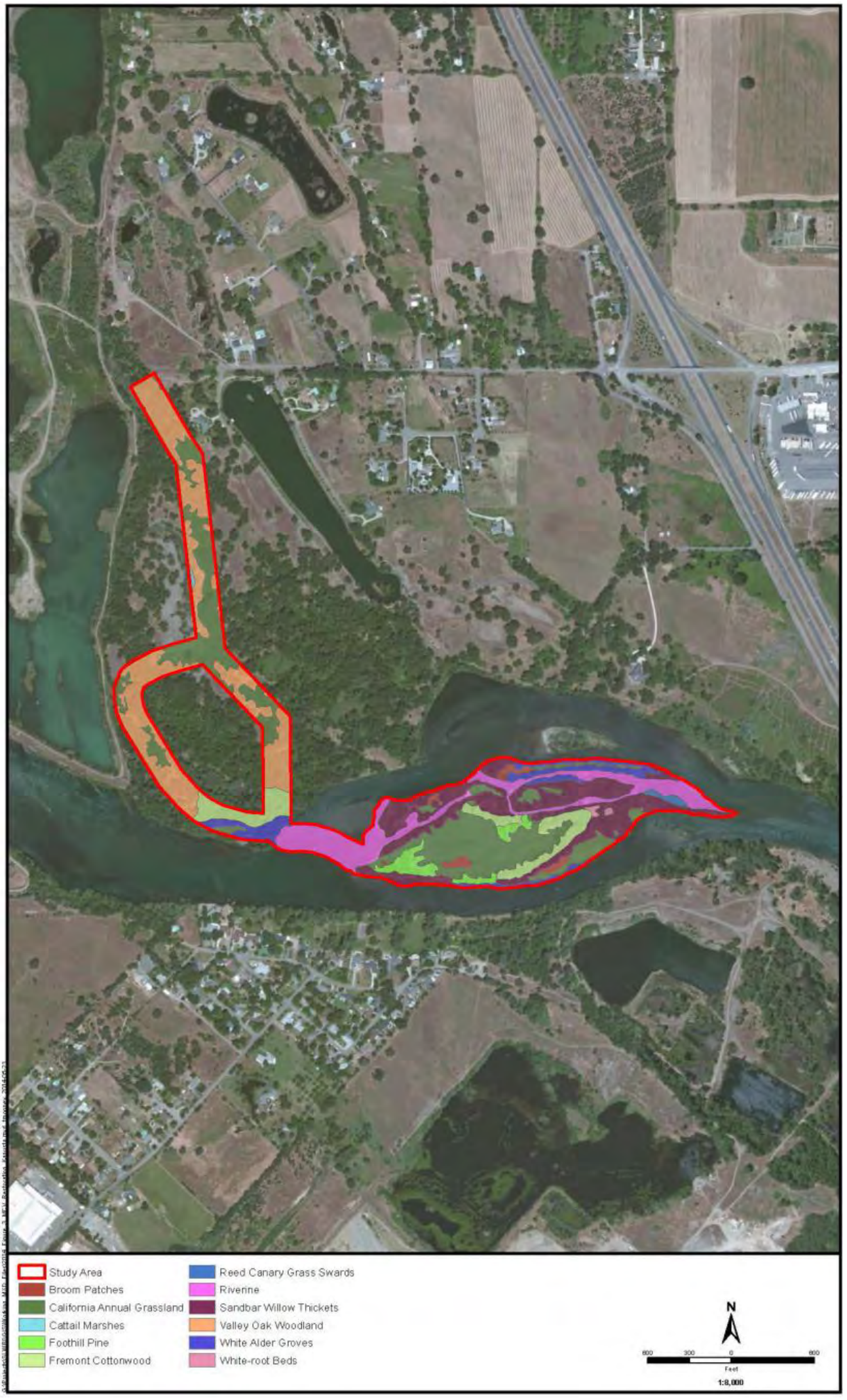

Figure 1-4d. Manual of California Vegetation Types – Kapusta Island

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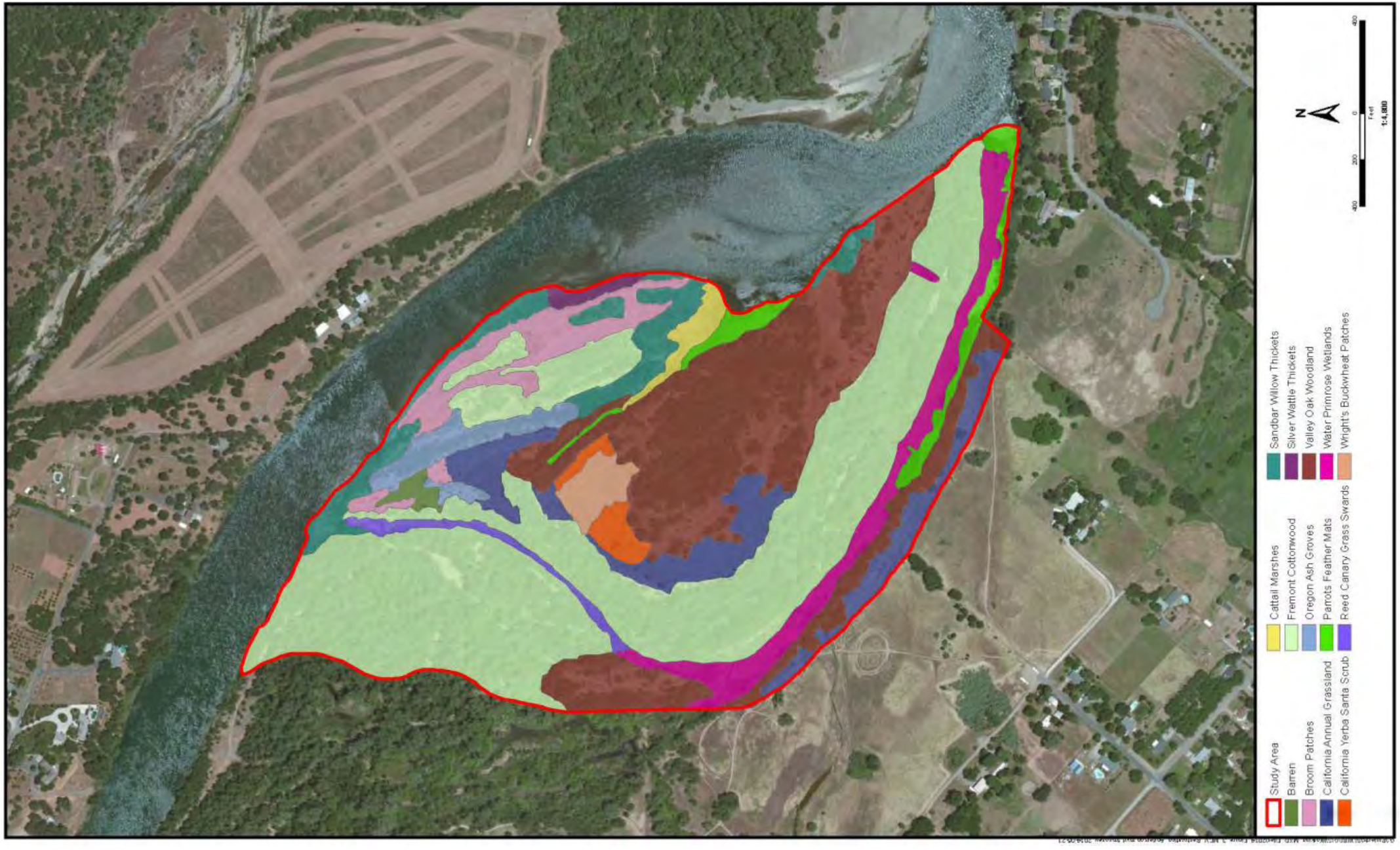

Figure 1-4e. Manual of California Vegetation Types – Anderson River Park

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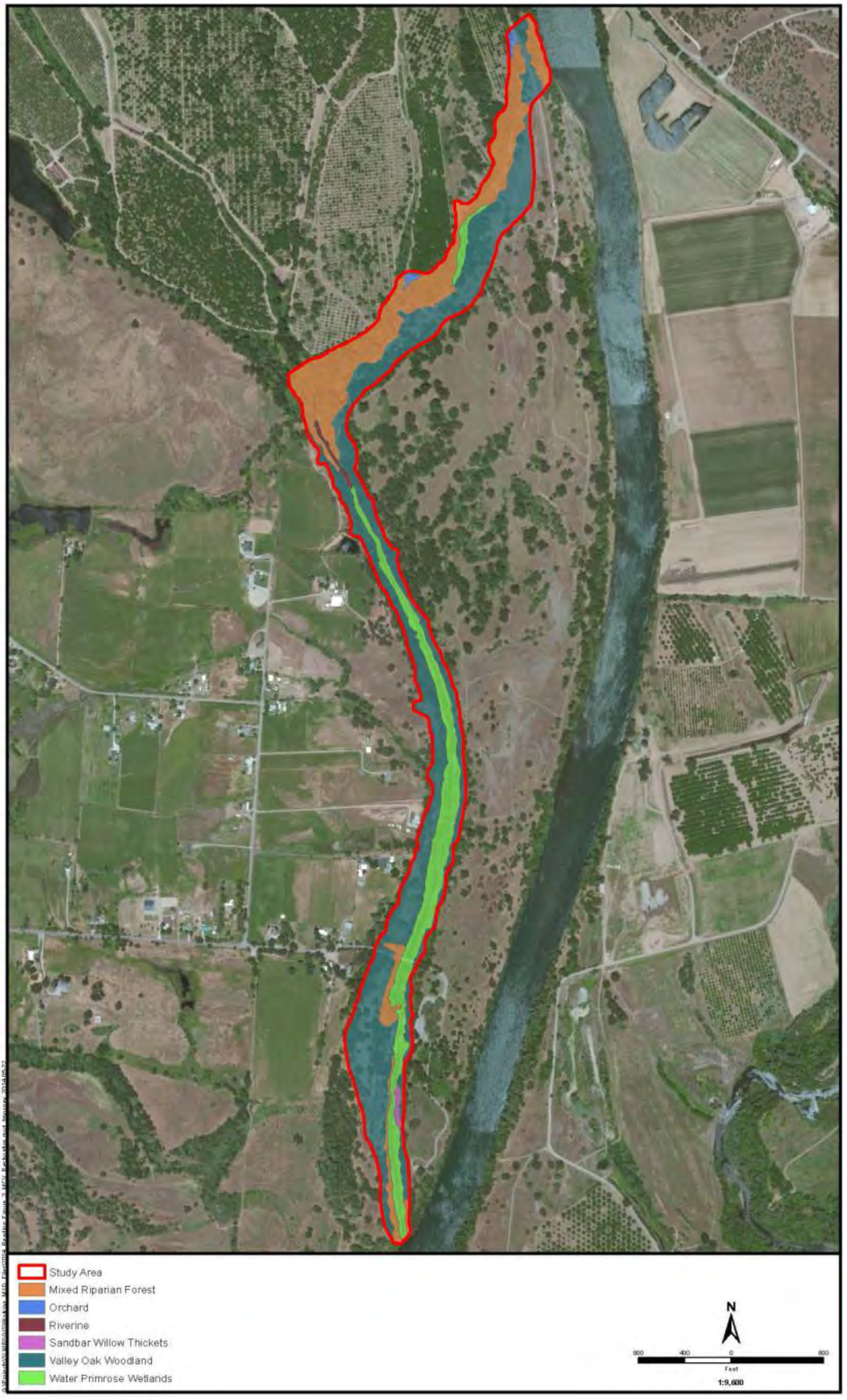

Figure 1-4f. Manual of California Vegetation Types – Reading Island

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Potential Sacramento River Downstream Habitat Restoration Areas Many of the same plant community classifications found in the Shasta Lake and vicinity portion of the primary study area also occur in the potential Sacramento River habitat restoration areas. However, the species composition, structure, and overall function of these areas are significantly different, as these areas are situated in a separate geographic setting and region. Plant communities occurring in the potential Sacramento River habitat restoration areas include broom patches, black locust groves, California yerba santa scrub, cattail marshes, Fremont cottonwood forest, ghost pine woodlands, Hind's walnut stands, Oregon ash groves, sandbar willow thickets, shining willow groves, soft rush marshes, valley oak woodland, Wright's buckwheat patches, water primrose wetlands, white alder groves, and white-root beds. Other plant or habitat communities include California annual grassland, mixed riparian forest, parrot's feather mats, reed canarygrass swards, silver wattle thickets, barren, orchard, and riverine.

Broom Patches Broom patches mainly occur on open gravel bars and are characterized by sparse to dense patches of Spanish broom (*Spartium junceum*). Associated species include Bermuda grass (*Cynodon dactylon*), Oregon golden aster (Heterotheca oregona), gumweed (*Grindelia* sp.), and common ragweed (*Ambrosia artemisiifolia*).

Black Locust Groves Black locust groves is an uncommon plant community in the potential restoration sites and occurs as small stands at the Shea Island Complex site. This community is characterized by a moderate to dense canopy of black locust with occasional valley oak. The dominant understory vegetation is Himalayan blackberry.

California Yerba Santa Scrub California yerba santa scrub occurs on open rocky areas and is characterized by sparse to moderate cover of California yerba santa. Sparse annual grasses and forb cover also occurs in these areas including Oregon golden aster, wright's buckwheat (*Eriogonum wrightii*), naked buckwheat (*Eriogonum nudum*), slender wild oat (*Avena barbata*), mousetail (*Myosurus* sp.), ripgut grass (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), and red brome (*Bromus madritensis* ssp. *rubens*).

Cattail Marshes Cattail marshes occur along the margins of backwater sloughs, pond margins, and as small inclusions in riparian forests. This alliance is characterized by dense stands of broadleaf cattail (*Typha latifolia*). Within the shallow fringes of these cattail marshes are small patches of reed canarygrass (*Phalaris arundinacea*), horsetail (*Equisetum* sp.), rush (*Juncus* sp.), and dallisgrass (*Paspalum dilatatum*). Parrot's feather (*Myriophyllum aquaticum*), smartweed (*Persicaria* sp.) and water primrose (*Ludwigia peploides*) grow in the deep water areas of the marshes.

Fremont Cottonwood Forest Fremont cottonwood forest occurs as multi-layered riparian forest stands characterized by a moderate to dense canopy of

predominantly Fremont cottonwood. Associated species include valley oak, Oregon ash, white alder, narrowleaf willow, shining willow, Goodding's black willow, black locust (*Robinia pseudoacacia*), and silver wattle (*Acacia dealbata*) are also present in the canopy layer. Dominant understory vegetation includes Himalayan blackberry, California grape, Santa Barbara sedge (*Carex barbarae*), giant reed (*Arundo donax*), mugwort (*Artemisia douglasiana*), horsetail, Bermuda grass (*Cynodon dactylon*), and Johnson grass (*Sorghum halepense*).

Ghost Pine Woodland Ghost pine woodlands occur in upland areas above the active floodplain and are characterized by a moderately dense canopy of foothill pine with occasional valley oak and Fremont cottonwood. Dominant understory species include Himalayan blackberry and Spanish broom.

Hind's Walnut Stands Hind's walnut and related stands occur as a small stand of riparian trees in the southeast portion of the Henderson Open Space potential restoration site. This semi-natural stand is dominated by an overstory of black walnut (*Juglans nigra*) with occasional valley oak and narrowleaf willow. Understory vegetation is moderately dense and includes Himalayan blackberry, California grape, Johnson grass, and Bermuda grass.

Oregon Ash Groves Oregon ash groves are an uncommon plant community in the potential restoration sites and are characterized by a moderately dense canopy of Oregon ash. Associated tree species include Fremont cottonwood, shining willow, and narrowleaf willow. Dominant shrub species include French broom (*Genista monspessulana*), giant reed, and Himalayan blackberry. The herbaceous layer is dominated by Bermuda grass.

Sandbar Willow Thickets Sandbar willow thickets occur in riparian habitats throughout the study area. This alliance is characterized by a moderate to dense canopy of narrowleaf willow. Associated trees and shrubs include shining willow, Fremont cottonwood, Goodding's black willow, Oregon ash, black walnut, black locust, and Himalayan blackberry. The herbaceous layer consists of primarily broomsedge bluestem (*Andropogon virginicus*), horsetail, rushes, nut sedges (*Cyperus* spp.), dallisgrass, and Johnson grass.

Shining Willow Groves Shining willow groves are an uncommon plant community in the potential restoration sites and are characterized by dense stands of shining willow with occasional narrowleaf willow, Himalayan blackberry, and California grape.

Soft Rush Marshes Soft rush marshes are an uncommon wetland plant community in the potential restoration sites and occur in patches along the shallow margins of the Sacramento River. This alliance is characterized by dense cover of soft rush (Juncus effusus) with occasional Santa Barbara sedge, reed canarygrass, nut sedge (*Cyperus eragrostis*), and spikerush (*Eleocharis* sp.).

Valley Oak Woodland Valley oak woodland occurs in portions of the potential restoration sites above the active flood plain of the Sacramento River. This alliance is characterized by a moderately dense canopy of valley oak with some interior live oak, foothill pine, narrowleaf willow, shining willow, black locust, Fremont cottonwood, black willow, Oregon ash, and tree of heaven (*Ailanthus altissima*) scattered throughout. Dominant understory vegetation includes western redbud, California coffee berry (*Frangula californica*), mugwort, winter vetch (*Vicia villosa*), Santa Barbara sedge, ripgut grass, common ragweed, California grape, California pipevine, and Bermuda grass.

Wright's Buckwheat Patches Wright's buckwheat patches occur in open rocky areas and are characterized by sparse to moderate cover of Wright's buckwheat. Sparse cover of annual grasses and forbs also occur in these areas including Oregon golden aster, naked buckwheat, slender wild oat, mousetail, ripgut grass, soft chess, and red brome.

Water Primrose Wetlands Water primrose wetlands occur in sloughs, backwater marshes, and along pond margins. These wetlands are characterized by dense mats of water primrose (*Ludwigia peploides*) with parrot's feather, smartweed (*Persicaria* sp.), and broadleaf cattail.

White Alder Groves White alder groves occur as multi-layered stands along the river margins characterized by a moderate to dense canopy of white alder. Associated species include Fremont cottonwood, shining willow, narrowleaf willow, black locust, valley oak, Oregon ash, and box elder. Dominant understory vegetation includes Himalayan blackberry, Santa Barbara sedge, mugwort, horsetail, verbena, water iris, and rush.

White-root Beds White-root beds occur as small inclusions in riparian forest habitats. This alliance is characterized by dense patches of Santa Barbara sedge with occasional Himalayan blackberry, verbena, horsetail, and goose grass (*Galium aparine*).

California Annual Grasslands California annual grasslands are uncommon in the study area and occur as open ruderal areas and vegetated gravel bars. This plant community is characterized by moderate to dense cover of annual grasses and forbs including black mustard (*Brassica nigra*), California poppy (*Eschscholzia californica*), ripgut grass, soft chess, wild oat, rose clover (*Trifolium hirtum*), long beaked storks bill (*Erodium botrys*), turkey mullein (*Croton setigeris*), Oregon golden aster, and tall sock-destroyer (*Torilis arvensis*).

Mixed Riparian Forest Mixed riparian forest occurs at the Reading Island potential restoration site and consists of moderate to dense stands of riparian trees and shrubs. A diverse assemblage of tree species occur including valley oak, narrowleaf willow, Goodding's black willow, shining willow, white alder, black walnut, tree of heaven, box elder, black locust, California buckeye, and

blue elderberry (*Sambucus nigra* ssp. *caerulea*). Dominant understory species include buttonbush, Himalayan blackberry, California grape, California pipevine, mugwort, Santa Barbara sedge, and California man-root (*Marah fabacea*).

Parrot's Feather Mats Parrot's feather mats occur in sloughs and backwater marshes. This vegetation type is characterized by dense patches of parrot's feather with small inclusions of water primrose, smartweed, and broadleaf cattail.

Reed Canarygrass Swards Reed canarygrass swards occur in sloughs and backwater areas in the study area. This semi-natural stand is characterized by moderate to dense cover of reed canarygrass. Associated species include narrowleaf willow, broadleaf cattail, smartweed, sedges, and rushes.

Silver Wattle Thickets Silver wattle thickets are an uncommon plant community in the potential restoration sites and occurs a small riparian stands in the northern portion of Tobiasson Island. This alliance is characterized by a moderate to dense canopy of silver wattle. Associated species include Oregon ash, Fremont cottonwood, black locust, giant reed, horsetail, and Bermuda grass.

Barren Barren habitat occurs on gravel bars and is characterized by open areas of gravel and cobble substrates. Vegetation is typically absent, although in some barren areas sparse opportunistic grasses/forbs or weedy species may occur.

Orchard Orchard habitat is uncommon in the potential Sacramento River habitat restoration areas and only occurs at the Reading Island site. This habitat consists of a small portion of a walnut orchard extending into a portion of the northern site boundary. The walnut orchard is mature and well maintained. Vegetation includes an overstory of walnut trees and ground cover of various grasses and forbs.

Riverine Riverine habitat occurs at each potential Sacramento River habitat restoration area and consists of portions of active Sacramento River channel within and/or around each site. The riverbed is dominated by primarily gravel, cobble, and boulder substrates.Extended Study Area

The extended study area extends from RBPP south to the Delta and includes the lower Sacramento River, as well as the lower Feather and American Rivers downstream from SWP and CVP reservoirs. It also includes the Bay-Delta area and portions of the American River basin, San Joaquin River basin, and the water service areas of the CVP and SWP. (See Figure 1-5.)

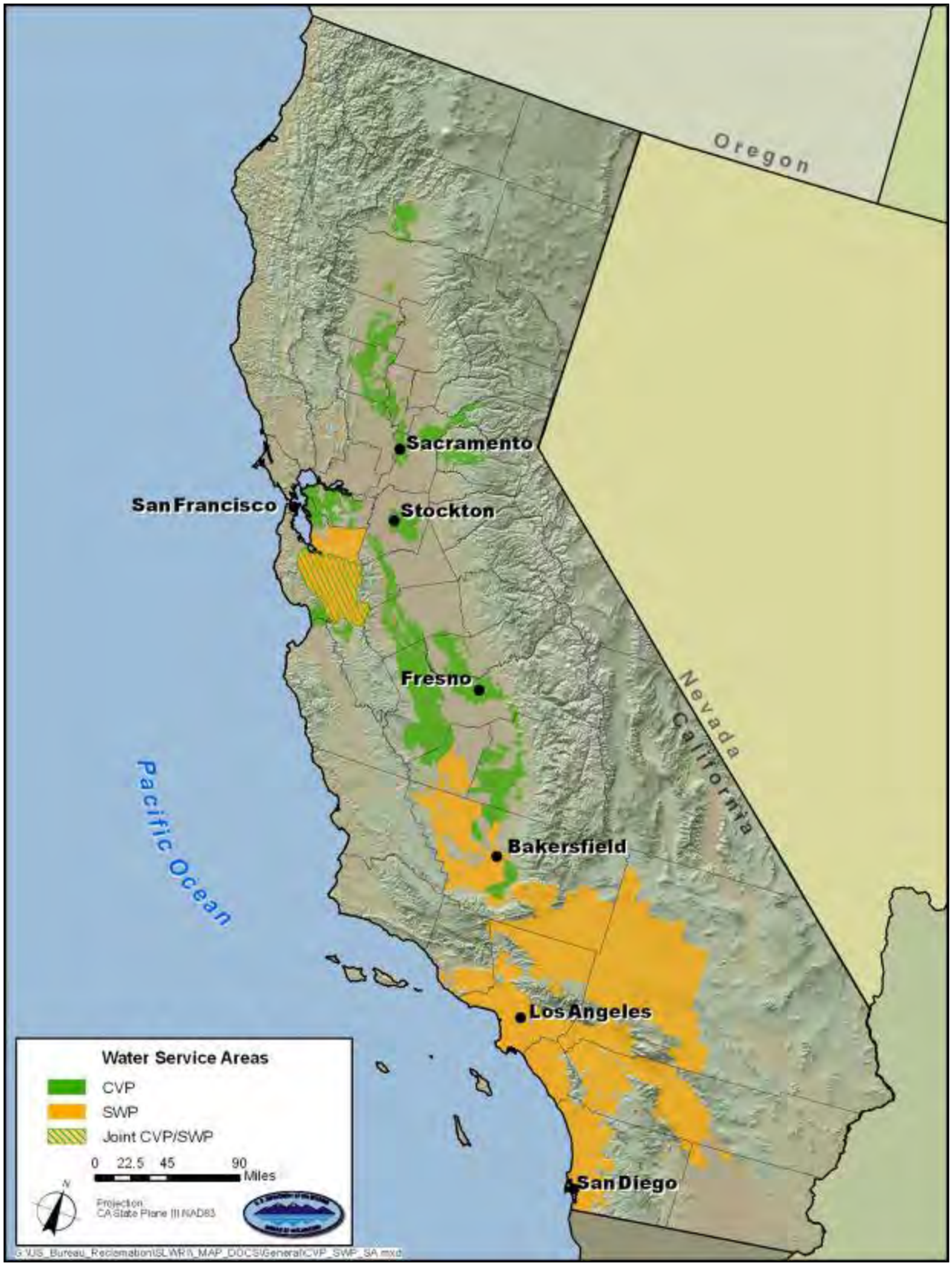

Figure 1-5. Central Valley Project and State Water Project Service Areas

This vast area includes a large number of plant communities. The types of plant communities include the following:

- Submerged aquatic vegetation
- Permanent wetlands (fresh, brackish, and saline; tidal and nontidal)
- Riparian scrubs, woodlands, and forests
- Vernal pools and other seasonal wetlands
- Grasslands
- Oak woodlands
- Montane hardwood and conifer forests
- Coastal and desert scrubs
- Chaparrals

A number of these natural plant communities occur in the primary study area and are described above. The other natural plant communities are described in the following sections, and in Mayer and Laudenslayer (1988), Sawyer and Keeler-Wolf (1995), and CALFED (2000b).

In addition to natural plant communities, plant communities of agricultural and urban areas occupy extensive areas in the extended study area. Agricultural plant communities include alfalfa and other irrigated pastures, field and row crops, orchards and vineyards, and rice. Plant communities in developed areas, as described in Mayer and Laudenslayer (1988), include those of golf courses and parks, ruderal (disturbed) areas, landscaped development, and small areas of natural plant communities. Currently, agricultural and urban vegetation occupies nearly 70 percent of the Central Valley, and more than 70 percent of terrestrial habitats in the Delta. This extensive conversion of natural vegetation to agricultural and urban vegetation has reduced the extent of some natural plant communities more than others.

Lower Sacramento River and Delta The roughly 300 miles of the Sacramento River can be subdivided into distinct reaches. These reaches are discussed separately below because the differences among them in topography, hydrology, and geomorphology strongly affect riparian vegetation and associated habitat functions. This section focuses on the reaches of the main stem Sacramento River from RBPP to Colusa, from Colusa to the Delta, and in the Delta. Each of these reaches is discussed individually along with the main tributaries and floodplain bypasses to the Sacramento River. (See the Fisheries and Aquatic Ecosystem technical report for more information.)

Sacramento River from RBPP to the Delta The Sacramento River from RBPP to the Delta is described below by reach from RBPP to Colusa, and Colusa to the Delta. Primary tributaries to the lower Sacramento River and floodplain bypasses are also described.

Red Bluff Pumping Plant to Colusa In this approximately 54-mile reach, the Sacramento River is classified as a meandering river, where relatively stable, straight sections alternate with more sinuous, dynamic sections (Resources Agency 2003). The active channel is fairly wide in some stretches and the river splits into multiple forks at many different locations, creating gravel islands often with riparian vegetation. Historic bends in the river are visible throughout this reach and appear as scars of the historic channel locations with the riparian corridor and oxbow lakes still present in many locations. Well-developed riparian woodland occurs in many locations. The channel remains active and has the potential to migrate in times of high water. Point bars, islands, high and low terraces, instream woody cover, early-successional riparian plant growth, and other evidence of river meander and erosion are common in this reach.

As is characteristic of this section of the lower Sacramento River, major physiographic features include floodplains, basins, terraces, active and remnant channels, and oxbow sloughs. These features, together with the historic and current hydrology and dynamic meander pattern of the Sacramento River, sustain a diverse array of riparian plant communities along the river channel, intermixed in a broad arable floodplain. Although most of the mature valley oak woodland and savanna and other mature riparian forest community types farther from the river's edge are now absent from much of the lower Sacramento River corridor, this meandering section of the Sacramento River nonetheless supports a variety of habitat types: annual grassland, blackberry scrub, Great Valley willow scrub, Great Valley cottonwood forest, Great Valley mixed riparian forest, Great Valley valley oak woodland, and freshwater marsh. All of these habitat types are described above under the "Upper Sacramento River (Shasta Dam to Red Bluff)."

Colusa to the Delta The general character of the Sacramento River changes quite drastically downstream from Colusa from a dynamic and active meandering channel to a confined, narrow channel restricted from migration. Surrounding agricultural lands encroach directly adjacent to the levees, which have cut the river off from most of its riparian corridor, especially on the eastern side of the river. Most of the levees in this reach are lined with riprap, allowing the river no erodible substrate and limiting the extent of riparian vegetation.

Urban and agricultural encroachment, development, dams, levees, and demand for fuel resulted in the removal and fragmentation of most riparian areas along the lower Sacramento River. Native perennial grasslands once covered vast areas in the region but have since been farmed or invaded by nonnative annuals. Low-lying areas in the region once were routinely flooded, replenishing

nutrients and providing water to many portions of the region not situated along waterways. However, diking and construction of levees to protect agricultural lands and residential areas have changed this, and the extent of many vegetation communities that depend on regular floods has been greatly reduced. Vernal pools, important wetland resources that were historically abundant, have decreased dramatically with agriculture and development in the last two centuries.

Primary Tributaries to the Lower Sacramento River The primary tributaries to the lower Sacramento River are the American and Feather Rivers; each is described separately below.

Lower Feather River The aquatic ecosystem in the lower Feather River, down to the confluence with the Sacramento River at Verona, is influenced by the California Department of Water Resources' Oroville Facilities. The upper extent is fairly confined by levees as the river flows through the city of Oroville. Downstream from Oroville, the Feather River is fairly active and meanders its way south to Marysville. However, this stretch is bordered by active farmland, which confines the river into an incised channel in certain stretches and limits the width of riparian woodland. Some of this adjacent farmland is in the process of being restored to floodplain habitat with the relocation of levees to become setback levees.

Lower American River The lower American River (below Folsom and Nimbus Dams) is fairly low gradient. Most of the lower American River is surrounded by the American River Parkway, which preserves the surrounding riparian zone. The river channel does not migrate to a large degree because it has become deeply incised, leaving tall cliffs and bluffs adjacent to the river.

Sacramento River Floodplain Bypasses Multiple water diversion structures in the lower Sacramento River move floodwaters into floodplain bypass areas during high-flow events. These floodplain bypass areas – the Butte basin, Sutter Bypass, and Yolo Bypass – provide broad, inundated floodplain habitat during wet years. Unlike other Sacramento River and Delta habitats, floodplains and floodplain bypasses are seasonally dewatered (as high flows recede).

Sacramento–San Joaquin River Delta The Delta comprises an area of approximately 750,000 acres divided into a number of islands by hundreds of miles of waterways. Surface-water resources in the Delta are influenced by the interaction of tributary inflows, tides, Delta hydrodynamics, and diversions and transfers. The Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras Rivers all discharge directly into the Delta.

Before reclamation, the Delta was inundated each year by winter and spring runoff, which changed channel geometry in response to flood conditions and

tidal influence. Consequently, there were extensive areas of marsh in the Delta, and large areas of peat soils (Histosols) formed.

Nearly all of the Delta's marshland has since been reclaimed by agriculture, peat production, and urban and industrial uses. More than 1,000 miles of levees protect this reclaimed land (CALFED 2000c). Reclaiming the land exposed the previously submerged peat soils to the atmosphere, and they began to oxidize and diminish. As a result, reclaimed Delta islands have been subsiding, and some are now as much as 25 feet below sea level.

Agriculture dominates the Delta area, with agricultural lands occupying approximately 72 percent of the region's total land area (CALFED 2000c). Agricultural vegetation includes agricultural lands that are seasonally flooded and those that are not. Major crops and cover types in agricultural production include small grains (such as wheat and barley), field crops (such as corn, sorghum, and safflower), truck crops (such as tomatoes and sugar beets), forage crops (such as hay and alfalfa), pastures, orchards, and vineyards. The distribution of seasonal crops varies annually, depending on crop-rotation patterns and market forces. Recent agricultural trends in the Delta include an increase in the acreage of orchards and vineyards. General cropping practices result in monotypic stands of vegetation for the growing season and bare ground in fall and winter. In areas not intensively cultivated, such as fallow fields, roads, ditches, and levee slopes, regular maintenance precludes the establishment of ruderal vegetation or native vegetation communities.

Grassland and ruderal (i.e., disturbed upland) communities are present throughout the Delta region. Historically, native grasslands and seasonal wetlands occurred in the Delta region, but vernal pools were not common. However, vernal pools that occur in grasslands along the margins of the Delta region, such as the Jepson Prairie Preserve, support a wide diversity of native plants. The grassland, ruderal, and seasonal wetland communities of the Delta are similar to those of the upper and lower Sacramento River portions of the combined primary and extended study areas.

Although about one-half of the Delta's historical wetland areas have been diked and drained, some small islands remain in a quasinatural state, as do some other areas with aquatic and wetland communities (e.g., "flooded islands" that were once reclaimed land, but have been abandoned after levee failures). The species composition and ecology of these riparian, marsh, and aquatic plant communities differ from the composition and ecology of communities in the upper and lower Sacramento River portions of the study area. These are all sensitive communities and are described below.

Riparian Communities Along the lower Sacramento River and in the Delta, riparian vegetation is characterized by narrow linear strips of trees and shrubs, in single- to multiple-story canopies. Tree canopies may be continuous or discontinuous, or absent altogether (as in riparian scrubs). These patches of

riparian vegetation may be on or at the toe of levees (particularly in the Delta). Riparian communities in this region include cottonwood-willow woodland, Valley oak riparian woodland, riparian scrub, and willow scrub. These communities are described below.

Cottonwood-willow Woodland Cottonwood-willow woodland typically can be found on channel islands, on levees, and along unmaintained channel banks of Delta sloughs and rivers. The riparian zone along leveed islands is usually very narrow, but more extensive riparian areas occur on in-channel islands or in other unleveed areas. Dominant understory species include black willow, sandbar willow, and shining willow. Other understory species include Himalayan blackberry, California blackberry, California button-willow, Indian hemp, California rose, coyote brush, and California black walnut. Herbaceous cover occurs where shrubs are sparse or absent and includes Santa Barbara sedge, hoary nettle, creeping wildrye, and numerous nonnative species. Cottonwood-willow woodland is a community in the MSCS NCCP habitat "valley/foothill riparian."

Valley Oak Riparian Woodland Valley oak riparian woodland includes areas where the dominant overstory is valley oak. Associated species are similar to those described for the cottonwood-willow woodland vegetation. Valley oak riparian woodland is a community in the MSCS NCCP habitat "valley/foothill riparian."

Riparian Scrub Riparian scrub is typically found on channel islands on levees and along narrow channel banks of creeks, waterways, and major tributaries in the Delta region. It is dominated by dense stands of shrubs, such as California button-willow, wild rose, Himalayan blackberry, and white alder. Where shrub cover is absent, herbaceous cover is often abundant and includes Indian hemp, yellow iris, centaury, vervain, umbrella sedge, creeping bent grass, bugleweed, and hedge-nettle. Riparian scrub also includes blackberry thickets, which intergrade with other riparian habitats. These thickets are characteristically monotypic stands of Himalayan blackberry, with scattered and isolated trees and shrubs, including coyote brush, sandbar willow, shining willow, and white alder. Blackberry thickets occur in association with ruderal habitats; however, an herbaceous understory is not evident within these thickets. Elderberry shrubs may also be associated with this community type. Riparian scrub is a community in the MSCS NCCP habitat "valley/foothill riparian."

Willow Scrub Willow scrub is a type of riparian scrub habitat dominated by willow species, particularly sandbar willow and young trees of other willow species, such as shining willow and black willow. In disturbed areas, willow scrub intergrades with blackberry vegetation. Willow scrub is a community in the MSCS NCCP habitat "valley/foothill riparian."

In the Delta, riparian areas are frequently dominated by nonnative invasive species, particularly along levees and berms. The most abundant of these are

giant reed (*Arundo donax*), blue gum eucalyptus (*Eucalyptus globulus*), fennel (*Foeniculum vulgare*), perennial pepperweed, black locust (*Robinia pseudoacacia*), and Himalayan blackberry. However, a number of other species, such as fig (*Ficus carica*) and tree-of-heaven (*Ailanthus altissima*), are locally problematic.

The dynamics of riparian communities along the lower Sacramento River and in the Delta are similar to those described for riparian communities along the upper Sacramento River. However, along the Sacramento River south of Colusa, in the flood bypasses, and in the Delta, the disturbances that remove riparian vegetation, or create newly exposed surfaces where riparian vegetation can establish, differ somewhat from those along the upper Sacramento River. In these downstream areas, disturbances related to meander migration are more limited, and anthropogenic (human-caused) disturbances, such as levee maintenance and trampling, are greater than those upstream. This is because of the close proximity to levees, extensive placement of bank protection, and greater human population.

Marsh Communities Tidal freshwater and brackish-water emergent marsh is dominated by clonal perennial plants, particularly bulrushes (tules, *Scirpus* sp.), and to a lesser extent cattails (*Typha* sp.), common reed (*Phragmites australis*), and waterpepper (*Persicaria hydropiperoides*). Tules, cattails, and giant reed are emergent macrophytes, large (up to 10 feet in height) rhizomatous plants rooted in the substrate with stems (culms) above the water surface. This community occurs on instream islands and along tidally influenced waterways. Tidal freshwater and brackish-water emergent marsh corresponds to the MSCS NCCP habitat “tidal freshwater emergent.”

In tidal marsh vegetation, vegetation structure and species richness are strongly influenced by disturbance (e.g., wave action, fire), the range of elevations present at a site, and salinity. Disturbance provides opportunities for annuals and short-lived perennials to regenerate and for additional species (also primarily clonal perennials) to colonize the site, and it creates structural diversity. Disturbances in Delta marshes result from erosion, human uses, and fires. Erosion of channel banks creates eroded “scallops” and slumped sections of bank that are colonized by a number of species (Hart and Hunter 2004). Human uses include the clearing of trails, construction and use of blinds, and maintenance of ponds and clearing of vegetation to create open water. The diversity of native plant species in such disturbed areas can be noticeably greater than in relatively undisturbed areas nearby. Fires occur in the marshes of some Delta islands (e.g., Lower Sherman Island). Overall, these fires reduce thatch and aboveground biomass, and increase the availability of nutrients; this benefits annual and short-lived perennial species and increases the diversity of marsh vegetation.

In the Delta’s tidal wetlands, the cover of woody species and the richness (i.e., number) of species increase with elevation, and dominance frequently shifts

from California bulrush (*Schoenoplectus californicus*) to softstem bulrush. (Softstem bulrush is deciduous and California bulrush is evergreen; thus, these two species probably differ in their hydraulic roughness during the winter, and in the habitat they provide during winter and spring.)

The species composition of tidal marshes changes at upper elevations from that found at middle elevations. In brackish marshes, upper elevations may support halophytes such as saltgrass (*Distichlis spicata*) and pickleweed (*Salicornia* species). A number of species typical of freshwater and saline marshes may grow together in these high marsh areas. Areas with higher soil salinities support pickleweed, saltgrass, fat-hen, and gumplant (*Grindelia hirsutula*). If salinity levels are lower in the high marsh areas, brass buttons (*Cotula coronopifolia*) and Baltic rush (*Juncus balticus*) may be more prevalent. Alternatively, emergent wetlands may intergrade with the woody vegetation of adjacent riparian areas. Most woody plants in this transitional zone are shrubs and vines, including red osier dogwood, buttonbush, and willows. In the northern and central Delta, a transition from mid-level marsh to woody vegetation occurs (e.g., at Delta Meadows State Park), and in the western Delta mid-level marsh may transition to either woody vegetation or to an upper elevation marsh dominated by halophytes.

At lower elevations, there is also a transitional zone between marsh and aquatic vegetation. In this zone there are fewer species of emergent plants, tule stems are at a lower density, and occasionally clumps of submerged aquatics exist. A characteristic feature of this transition zone is floating mats of plants that are rooted in the substrate but have creeping stems that are prostrate on the water. Native plants on the fringes of the marsh with this form of growth include creeping water primrose (both the native *Ludwigia peploides* ssp. *peploides* and the nonnative *L. p.* ssp. *montevidensis*), which has both native and nonnative subspecies, and floating pennywort (*Hydrocotyle ranunculoides*). This floating fringe may be absent, or discontinuous and narrow (less than 3 feet), or it may extend out across the water surface for 3–12 feet with plants rooted in the substrate at the marsh's edge, and floating as a mat over deeper water. Other, smaller species of pennywort (*Hydrocotyle umbellata, H. verticillata*) also grow at the marsh's edge, but tend to be on exposed muddy banks and flats.

Regional salinity gradients also affect the species composition of the Delta's tidal marshes. Delta waters generally have minimal salt concentrations, but the water is brackish in areas of the lower Delta (like Lower Sherman Island) that are close to Suisun Bay. Salinity levels in the soil are driven primarily by the interaction between the salinity concentration of tidal waters, local weather conditions, and the marsh vegetation itself (Atwater and Hedel 1976). The presence of a certain plant species within different marsh vegetation types is the result of individual physiological tolerances and competition between species. In general, larger monocots inhabit the lowest marsh surfaces, which are inundated by most high tides, and surfaces at or above high-tide levels are dominated by broadleaf species and a few species of smaller monocots. Marshes

flooded by fresh or brackish water support a more diverse assemblage of species that generally tolerate low to moderate salinity concentrations (Atwater and Hedel 1976).

There is currently little cover of nonnative invasive species in Delta marshes. However, perennial pepperweed (*Lepidium latifolium*) has become abundant in the upper elevations of many marshes; it is extremely difficult to eradicate. Purple loosestrife (*Lythrum salicaria*) may be a problematic invader in the future; elsewhere in the Delta it has established patches in the tidal zone. Other species create localized problems: water hyacinth will root in tidal marsh, and black locust, giant reed, and Himalayan blackberry shade or encroach on the tidal zone at the base of levees and berms. Also, several nonnative species not generally considered invasive, such as dallisgrass (*Paspalum dilatatum*), are abundant within the tidal zone and may be reducing available habitat for native species.

Aquatic Communities Aquatic vegetation consists of submerged plants generally rooted in the substrate, whose stems may partially extend above the water surface (e.g., during flowering) and floating plants that are generally not rooted in the substrate. This section focuses on vascular plants because of their dominance of aquatic vegetation in much of the Delta.

Submerged plants generally die back to their stem bases, rhizomes, and/or other overwintering vegetative structures (e.g., turions) as water temperatures drop in the late fall. Throughout spring and summer, active growth increases stem biomass (i.e., standing crop) to a peak in early fall. Although these plants flower and produce seed, reproduction via vegetative propagules (e.g., turions, specialized buds, and stem fragments) is their primary means of reproduction. The availability of light (which decreases with depth), turbidity, and shade cast by overtopping vegetation can restrict submerged plants to relatively shallow areas. In the Delta (which has turbid waters), most submerged vegetation appears to be restricted to areas less than 5–10 feet deep. The velocity of flows may contribute to this depth restriction. Native species of submerged plants include coontail (*Ceratophyllum demersum*), common elodea (*Elodea canadensis*), waterbuttercup (*Ranunculus aquatilis*), and pondweeds (*Potamogeton* sp.). Nonnative species include curlyleaf pondweed (*Potamogeton crispus*), egeria (*Egeria densa*), parrotfeather (*Myriophyllum aquaticum*), and Eurasian milfoil (*Myriophyllum spicatum*).

Most floating plants also depend primarily on vegetative reproduction. The growth rate of most species, and consequently their abundance, increases in late spring and summer, and then diminishes in late fall to early spring. Species also produce overwintering buds, spores, and seeds. Native species of floating plants in the Delta include duckweeds (*Lemna* sp., *Spirodela* sp.) and mosquito ferns (*Azolla* sp.). In addition, the nonnative water hyacinth (*Eichhornia crassipes*) is widespread and abundant.

Aquatic plant communities are in the MSCS NCCP habitat "tidal perennial aquatic."

San Joaquin River Basin to the Delta The San Joaquin River basin includes the Central Valley south of the Delta. It is drier than the Sacramento Valley, and flows into the Delta from the San Joaquin River are considerably lower than those from the Sacramento River. Inflows from the Merced, Tuolumne, and Stanislaus Rivers historically contribute more than 60 percent of the flows in the San Joaquin River. Flows in these river systems are highly altered and are managed for flood control and water supply purposes. Numerous dams, reservoirs, and diversions are located on these rivers and others in the San Joaquin system. Historically, approximately 70 percent of the river's runoff has been diverted to the Friant-Kern and Madera Canals, primarily for agricultural uses.

The San Joaquin River region has many similarities to the Sacramento River region; however, the San Joaquin River region's riparian regions are not and have never been as extensive as those found in the Sacramento River region, and a larger portion of the land in the San Joaquin River region is devoted to agriculture (CALFED 2000c). Riparian communities and wetlands have been reduced by water diversions, reclamation activities, and conversion to agricultural land uses (CALFED 2000c). Wetlands are situated in the northern and western reaches in the region but are less abundant in other parts of the region. Almost 70 percent of the lowlands have been converted to irrigated agriculture, and remaining natural vegetation has been fragmented.

CVP/SWP Service Areas The Delta region provides water to most of California's agriculture and to urban and industrial communities across the state. Within the Delta, CVP and SWP pumping plants move water from the Delta to a system of canals and reservoirs for agriculture, municipal, industrial, and environmental uses in the Central Valley, the Bay Area, along the central coast, and portions of Southern California.

Agricultural and urban areas dominate much of these service areas. Agricultural plant communities include alfalfa and other irrigated pastures, field and row crops, orchards and vineyards, and rice. Plant communities in developed areas, as described in Mayer and Laudenslayer (1988), include those of golf courses and parks, ruderal (disturbed) areas, landscaped development, and small areas of natural plant communities.

Although agricultural and urban land uses have substantially reduced the area and connectivity of natural vegetation, the service areas still contain a large diversity of both lowland and upland plant communities, including many sensitive plant communities (CALFED 2000c, Attachment 1). The most dramatic difference between historical and existing conditions is the fragmentation of what were once large contiguous blocks of habitat, such as chamise-redshank chaparral, coastal sage scrub, grassland, oak woodland, oak

savanna, southern oak woodland-forest, riparian woodland-forest, succulent scrub, sand dune habitat, alkali desert scrub, desert riparian habitat, desert wash, freshwater/saltwater marsh, and coastal strand (CALFED 2000c). Significant changes to the natural landscape in the region occurred in the late 1800s and early 1900s with land conversions to agriculture, a pattern similar to that in the Central Valley. However, that pattern shifted dramatically compared to the pattern in the Central Valley, as urban growth in the region that started in the 1900s began to convert large areas of agricultural lands and of remaining natural vegetation to developed land uses.

Special-Status Species

Special-status species addressed in this section include plants that are legally protected or are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations. These include species that are State listed and/or Federally listed as rare, threatened, or endangered; those considered as candidates or proposed for listing as threatened or endangered; species identified by CDFW as Species of Special Concern or USFS as sensitive, endemic, or needing additional survey or management actions; and plants considered jointly by CDFW and CNPS to be rare, threatened, or endangered; and species afforded protection under local planning documents, including the CALFED MSCS.

Primary Study Area

Shasta Lake and Vicinity Within the Shasta Lake and vicinity portion of the primary study area are a wide variety of vegetative communities and habitat components that support a large diversity of plant species. To aid in determining the potential impacts of the project, a list of potential plant species of concern was developed.

For the purposes of this evaluation, botanical species of concern are plants, lichen, and fungi that fall into any of the following categories:

- Designated as rare or listed as threatened or endangered by the State or Federal government
- Proposed for designation as rare or listing as threatened or endangered by the State or Federal government
- Candidate species for State or Federal listing as threatened or endangered
- Ranked as California Rare Plant Rank (CRPR) 1A, 1B, 2, 3, or 4 (formerly CNPS List 1A, 1B, 2, 3, or 4)
- Considered sensitive or endemic by the USFS

- Considered a survey and manage species by the USFS or U.S. Department of the Interior, Bureau of Land Management (BLM)

- Designated as an MSCS covered species by CALFED

Potentially occurring plant species of concern were determined by performing several database searches, reviewing USFWS and CDFW special-status species lists for Shasta County, reviewing other appropriate literature, discussions with resource agency personnel, and professional experience in the region. Additionally, results from the various vegetation habitat mapping efforts, botanical surveys, and wildlife surveys conducted in the area by Reclamation since 2002 were used in developing the list of species of concern.

Table 1-4 summarizes special-status plant species identified as having a potential to occur in the Shasta Lake and vicinity portion of the primary study area. Potentially occurring special-status wildlife species at the potential Sacramento River downstream habitat restoration areas are described in Table 1-5.

Table 1-4. Plant Species of Concern with Potential to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area

Common Name	Scientific Name	Status[1]
Shasta ageratina	*Ageratina shastensis*	CRPR 1B.2, USFS E
Sanborn's onion	*Allium sanbornii* var. *sanbornii*	CRPR 4.2
Bent-flowered fiddleneck	*Amsinckia lunaris*	CRPR 1B.2, BLMS
Mallory's manzanita	*Arctostaphylos malloryi*	CRPR 4.3
Shasta County arnica	*Arnica venosa*	CRPR 4.2, USFS E
Marbled ginger	*Asarum marmoratum*	CRPR 2B.3
Depauperate milk-vetch	*Astragalus pauperculus*	CRPR 4.3
Yellow-twist horsehair	*Bryoria tortuosa*	BLMS
Yellow-twist horsehair	*Bryoria tortuosa*	BLMS
Green bug moss	*Buxbaumia viridis*	USFS S, BLMS, S&M
Callahan's mariposa lily	*Calochortus syntrophus*	CRPR 1B.1
Butte County morning-glory	*Calystegia atriplicifolia* ssp. *buttensis*	CRPR 4.2
Buxbaum's sedge	*Carex buxbaumii*	CRPR 4.2
Bristly sedge	*Carex comosa*	CRPR 2.1, MSCS r
Shasta clarkia	*Clarkia borealis* ssp. *arida*	CRPR 1B.1, MSCS m, BLMS
Northern clarkia	*Clarkia borealis* ssp. *borealis*	CRPR 1B.3, BLMS
Silky cryptantha	*Cryptantha crinita*	CRPR 1B.2, MSCS m, BLMS
California lady's-slipper	*Cypripedium californicum*	CRPR 4.2
Clustered lady's-slipper	*Cypripedium fasciculatum*	CRPR 4.2, USFS S, BLMS, S&M
Mountain lady's-slipper	*Cypripedium montanum*	CRPR 4.2, USFS S, BLMS, S&M
Four-angled spike rush	*Eleocharis quadrangulata*	MSCS m
Butte County fritillary	*Fritillaria eastwoodiae*	CRPR 3.2, USFS S
Dubious pea	*Lathyrus sulphureus* var. *argillaceus*	CRPR 3
Broad-lobed linanthus	*Leptosiphon latisectus*	CRPR 4.3
Cantelow's lewisia	*Lewisia cantelovii*	CRPR 1B.2, USFS S, BLMS

Table 1-4. Plant Species of Concern with Potential to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Status[1]
Howell's lewisia	*Lewisia cotyledon* var. *howellii*	CRPR 3.2
Bellinger's meadowfoam	*Limnanthes floccosa* ssp. *bellingeriana*	CRPR 1B.2, MSCS m, BLMS
Awl-leaved navarretia	*Navarretia subuligera*	CRPR 4.3
Shasta snow-wreath	*Neviusia cliftonii*	CRPR 1B.2, USFS S, MSCS m, BLMS
Shasta huckleberry	*Vaccinium* sp. nov.	Genetically and morphologically distinct from coastal and Sierra Nevada populations; taxonomic treatment in preparation. Considered a special-status species for the purposes of this evaluation.
Thread-leaved beardtongue	*Penstemon filiformis*	CRPR 1B.3, MSCS m, USFS S, BLMS
Narrow-petaled rein orchid	*Piperia leptopetala*	CRPR 4.3
Bidwell's knotweed	*Polygonum bidwelliae*	CRPR 4.3
Eel-grass pondweed	*Potamogeton zosteriformis*	CRPR 2.2, MSCS m
Pacific fuzzwort	*Ptilidium californicum*	USFS S, BLMS, S&M
Hoary gooseberry	*Ribes roezlii* var. *amictum*	CRPR 4.3
Bug on a stick	*Schistostega pennata*	S&M
Marsh skullcap	*Scutellaria galericulata*	CRPR 2.2, MSCS m
Canyon Creek stonecrop	*Sedum obtusatum* ssp. *paradisum*	CRPR 1B.3, USFS S, BLMS
English Peak greenbriar	*Smilax jamesii*	CRPR 1B.3, USFS S, MSCS m, BLMS
Long-fruit jewel-flower	*Streptanthus longisiliquus*	CRPR 4.3
Slender false lupine	*Thermopsis gracilis* var. *gracilis*	CRPR 4.3
Oval-leaved viburnum	Viburnum ellipticum	CRPR 2.3

Notes:

[1] Status Codes

CRPR 1B = Plants rare, threatened, or endangered in California and elsewhere (includes rare plant ranks 1B.1, 1B.2, and 1B.3)

CRPR 2 = Plants rare, threatened, or endangered in California but more common elsewhere (includes rare plant ranks 2B.1, 2B.2, and 2B.3)

CRPR 3 = Plants for which more information is need – a review list

CRPR 4 = Plants of limited distribution – a watch list

CRPR Threat Ranks

0.1 = Seriously threatened in California

0.2 = Fairly threatened in California

0.3 = Not very threatened in California

Multi Species Conservation Strategy (MSCS) covered species

R = Recovery. Recover species' populations within the MSCS focus area to levels that ensure the species' long-term survival in nature.

r = Contribute to recovery. Implement some of the actions deemed necessary to recover species' populations within the MSCS focus area.

m = Maintain. Ensure that any adverse effects on the species that could be associated with implementation of CALFED actions will be fully offset through implementation of actions beneficial to the species (CALFED 2000c).

Key:

BLMS = BLM sensitive

CRPR = California Rare Plant Rank

MSCS = Multi Species Conservation Strategy

S&M = Survey and Manage Species

USFS = U.S. Forest Service

USFS E = USFS Endemic Species

USFS S = USFS Sensitive Species

Table 1-5. Plant Species of Concern with Potential to Occur in the Potential Sacramento River Downstream Restoration Sites

Common Name	Scientific Name	Status[1]
Red-flowered bird's-foot trefoil	*Acmispon rubriflorus*	CRPR 1B.1, BLM S
Henderson's bent grass	*Agrostis hendersonii*	CRPR 3.2, MSCS m
Cleveland's milk-vetch	*Astragalus clevelandii*	CRPR 4.3
Jepson's milk-vetch	*Astragalus rattanii* var. *jepsonianus*	CRPR 4.3, BLM S
Big-scale balsamroot	*Balsamorhiza macrolepis*	CRPR 1B.2, BLM S
Sulphur Creek brodiaea	*Brodiaea matsonii*	CRPR 1B.1
Bristly sedge	*Carex comosa*	CRPR 2.1, MSCS r
Silky cryptantha	*Cryptantha crinita*	CRPR 1B.2, BLM S, MSCS m
Four-angled spikerush	*Eleocharis quadrangulata*	MSCS m
Boggs Lake hedge-hyssop	*Gratiola heterosepala*	CE, CRPR 1B.2, BLM S, MSCS m
California satintail	*Imperata brevifolia*	CRPR 2.1
Red Bluff dwarf rush	*Juncus leiospermus* var. *leiospermus*	CRPR 1B.1, BLM S, MSCS m
Bellinger's meadowfoam	*Limnanthes floccosa* ssp. *bellingeriana*	CRPR 1B.2, BLM S, MSCS m
Shield-bracted monkeyflower	*Mimulus glaucescens*	CRPR 4.3
Slender Orcutt grass	*Orcuttia tenuis*	FT, CE, CRPR 1B.1, MSCS m
Ahart's paronychia	*Paronychia ahartii*	CRPR 1B.1, BLM S, MSCS m
Sanford's arrowhead	*Sagittaria sanfordii*	CRPR 1B.2, BLM S, MSCS m
Greene's Tuctoria	*Tuctoria greenei*	FE, CR, CRPR 1B.1, MSCS m

Notes:
[1]Status Codes
CE = California endangered
CR = California rare
FE = Federally endangered
FT = Federally threatened
CRPR 1B = Plants rare, threatened, or endangered in California and elsewhere (includes rare plant ranks 1B.1, 1B.2, and 1B.3)
CRPR 2 = Plants rare, threatened, or endangered in California but more common elsewhere (includes rare plant ranks 2B.1, 2B.2, and 2B.3)
CRPR 3 = Plants for which more information is need – a review list
CRPR 4 = Plants of limited distribution – a watch list

CRPR Threat Ranks
0.1 = Seriously threatened in California
0.2 = Fairly threatened in California
0.3 = Not very threatened in California

BLM (Bureau of Land Management): S = Sensitive

Multi Species Conservation Strategy (MSCS) covered species
R = Recovery. Recover species' populations within the MSCS focus area to levels that ensure the species' long-term survival in nature.
r = Contribute to recovery. Implement some of the actions deemed necessary to recover species' populations within the MSCS focus area.
m = Maintain. Ensure that any adverse effects on the species that could be associated with implementation of CALFED actions will be fully offset through implementation of actions beneficial to the species (CALFED 2000c).

Key:
CRPR = California Rare Plant Rank
MSCS = Multi Species Conservation Strategy

The CNDDB was reviewed for records of special-status plant species in or near the Shasta Lake and vicinity portion of the primary study area. The CNDDB is a database consisting of historical observations of special-status plant species, wildlife species, and natural communities. The CNDDB is limited to reported sightings and is not a comprehensive list of special-status species that may occur in a particular area.

A search of the CNPS Electronic Inventory was also conducted. The Electronic Inventory allows users to query the database using a set of variable search criteria. The result of the search is a list of potentially occurring special-status plant species. The criteria used for the query included all CRPR 1A, 1B, 2, 3, and 4 plants occurring in Shasta County in closed-cone coniferous forest, chaparral, cismontane woodland, lower montane coniferous forest, marshes and swamps, pebble plain, valley and foothill grasslands, riparian forest, riparian woodland, and riparian scrub habitats between the elevations of approximately 900 feet and 2,500 feet.

Botanical Surveys Reclamation conducted several botanical surveys for special-status plant species in the Shasta Lake and vicinity portion of the primary study area. Botanical surveys were conducted between 2002 and 2014. A list of species observed during the surveys is provided as Attachment 2. Detailed survey information is provided as Attachment 6. Plant taxonomy follows Baldwin et al. (2012).

Botanical surveys were performed during 2002 along the Big Backbone and Squaw Creek arms. In 2003, botanical surveys were conducted along 11 selected riverine reaches: Little Backbone Creek, Sugarloaf Creek, upper Sacramento River, middle Salt Creek, Salt Creek, Nosoni Creek, Dekkas Creek, Campbell Creek, Flat Creek, Ripgut Creek, and Potem Creek. The surveys were conducted in general accordance with the technical methods prescribed in *California Department of Fish and Wildlife Protocols for Surveying and Evaluating Impacts to Special Status Plant Populations and Natural Plant Communities* (California Department of Fish and Game 2009).. In 2004, botanical surveys were conducted at a series of randomly and nonrandomly selected locations. Nonrandomly selected sites were located throughout the Shasta Lake and vicinity portion of the primary study area (not including relocation areas) based on 2002 and 2003 survey results. Sites were selected based on the presence of unique habitat and ecological attributes, such as recently burned areas, unique geologic substrates, late-seral forests, and uncommon plant series. Nonrandomly selected sites varied in size and often included several plant series types. Randomly selected sites were selected throughout the area using plant series polygons developed from previously completed vegetation mapping. Using geographic information systems (GIS), individual vegetation polygons were assigned a unique number, and 100 numbers (i.e., vegetation polygons) were then randomly selected.

Based on previous surveys resulting in discoveries of Shasta snow-wreath (*Neviusia cliftonii*) and Shasta huckleberry (*Vaccinium* sp. nov), specific surveys for these species have been conducted since 2009. These surveys were designed to identify potential habitat for and locate populations of these species outside of the project area. Pedestrian surveys were conducted to search the focus areas identified. Using methods described in Lindstrand and Nelson (2006), potential survey areas were identified using soil and geologic information at known sites and choosing areas with those same characteristics. In addition, survey sites were identified using intuitive techniques, such as selecting areas with vegetative cover types similar to those of known populations and areas near known populations (regardless of vegetative cover).

A genetic study of the Shasta snow-wreath was conducted in 2009 and 2010 to help determine potential project impacts on this species and to evaluate potential mitigation measures. The goal of the genetic study was to (1) determine whether all Shasta snow-wreath populations are genetically identical, (2) determine whether there are several homogeneous population clusters, or (3) whether some other pattern is present. Twenty-one of the 24 known Shasta snow-wreath sites were included in the study. The genetic study determined that the species is characterized by low genetic diversity and high levels of genetic differentiation (National Forest Genetics Laboratory 2010, DeWoody et al. 2012a). No strong patterns were found between the Shasta snow-wreath populations and several physical and geographic variables, including soil, geology, population size, and geographic location. Although high levels of genetic differentiation and no strong population patterns are present, the genetic study found three general population clusters, providing insight and basic species information for potential mitigation planning.

A separate study was conducted in 2009, 2010 and 2013 to describe the genetics of Shasta *Vaccinium* (huckleberry). The goal of the study was to determine whether the Shasta *Vaccinium* was different genetically from coastal and Sierra Nevada *Vaccinium* populations and, if so, to determine whether it warrants recognition as a new taxon (species). The genetic study determined that the species is genetically distinct from the other *Vaccinium* populations (National Forest Genetics Laboratory 2010, DeWoody et al. 2012b, National Forest Genetics Laboratory 2014). Based on the results of the genetic study, and distinct morphologic and ecologic characteristics, the Shasta huckleberry appears to be an uncommon and geographically restricted species, warranting recognition as a new species. The taxonomic treatment is in preparation.

Between 2010 and 2014, botanical surveys were conducted in all relocation areas including the dam footprint. The surveys were conducted in general accordance with the *California Department of Fish and Wildlife Protocols for Surveying and Evaluating Impacts to Special Status Plant Populations and Natural Plant Communities* (California Department of Fish and Game 2009).

Eight special-status plant species were found during the survey efforts and/or incidentally during other technical studies: Shasta County arnica (*Arnica venosa*), Northern clarkia (*Clarkia borealis* ssp. *borealis*), Cantelow's lewisia (*Lewisia cantelovii*), Shasta snow-wreath, slender false lupine (*Thermopsis gracilis* var. *gracilis*), Shasta huckleberry, oval-leaved viburnum (*Viburnum ellipticum*), and Shasta limestone monkeyflower (*Erythranthe taylorii*).

One Shasta County arnica population was found in ponderosa pine habitat south of Bridge Bay Resort along the Main Body and another near the privately owned cabins on USFS lands in the Salt Creek inlet on the Sacramento Arm (Figure 1-6c). Additionally, USFS has located a population along the Sacramento Arm north of Slaughterhouse Island during surveys conducted in 2010.

One northern clarkia population was found in hardwood-conifer/chaparral habitat near Bailey Cove on the McCloud Arm, and another population was found in hardwood-conifer/chaparral habitat in Sugarloaf Cove west of Beehive Point on the Sacramento Arm. The northern clarkia locations are shown in Figures 1-6c and 1-6d.

One Cantelow's lewisia population was discovered on a rock outcrop on the right bank of the upper Sacramento River near the Shasta Lake/upper Sacramento River transition zone. Additionally, three populations were found along the Sacramento Arm near Elmore Mountain during surveys conducted in 2010 (Figure 1-6c).

Shasta snow-wreath is currently known from 24 locations, most of which occur at or near the periphery of Shasta Lake. Ten Shasta snow-wreath populations occur in habitats associated with limestone formations, and 13 occur in other habitat types. Most populations are associated with stream drainages or the lower portions of upland slopes. Of these, 13 Shasta snow-wreath populations were discovered during the botanical surveys along the McCloud Arm (south of Shasta Caverns and Keluche Creek), Pit Arm (Brock Creek, Ripgut Creek, Flat Creek, Stein Creek, and west of Stein Creek), and the Main Body (Blue Ridge east, Blue Ridge west, Blue Ridge middle, Cove Creek, south of Cove Creek, and Jones Valley). Locations of Shasta snow-wreath found incidentally and during the surveys are shown in Figures 1-6a through 1-6f.

Slender false lupine populations were discovered in all portions of the primary study area, generally on low-gradient slopes. Locations of slender false lupine found during the surveys and incidentally are shown in Figures 1-6a through 1-6f.

Shasta huckleberry is currently known from 23 occurrences at 13 general locations. Shasta huckleberry occurs at four locations in the SLWRI project area; (little) Squaw Creek, Shoemaker Gulch, Little Backbone Creek, and Horse Creek near Bully Hill. The Shasta huckleberry populations at these locations

represent the lower portions of larger populations that extend further upstream in each stream. Other general locations include South Fork Mountain, Bohemotash Mountain, and the vicinity of Bully Hill. All locations occur in an area historically known as the Copper Belt of Shasta County and many occur in the immediate vicinity of historic copper mining activities. Locations of Shasta huckleberry found during the surveys are shown in Figures 1-6a through 1-6f.

Two oval-leaved viburnum populations were found during the surveys. One population was found in a forested upland slope west of Pine Point Campground along the McCloud Arm and a second in chaparral habitat at Jones Valley along the Pit Arm near the Clikapudi Trail. Locations of oval-leaved viburnum found during the surveys are shown in Figures 1-6d and 1-6f.

Three Shasta limestone monkeyflower occurrences were found in the impoundment area. These occurrences are in the McCloud Arm and include populations downslope of Samwell Cave, at Dekkas Rock, and in the Campbell Creek inlet. The Samwell Cave and Dekkas Rock populations extend upslope and above the impoundment areas, while the population at Campbell Creek occurs entirely within the impoundment area. Nineteen additional Shasta limestone monkeyflower occurrences were found in locations outside the SLWRI project area. Locations of Shasta limestone monkeyflower found during the surveys are shown in Figures 1-6d and 1-65f.

Reclamation conducted biological resource assessments of at each of the six potential Sacramento River downstream habitat restoration areas during 2013. The assessments include botanical surveys for special-status plants and noxious weeds. No special-status plants were found during these surveys. The biological resource assessment results are included as Attachments 12 and 13.

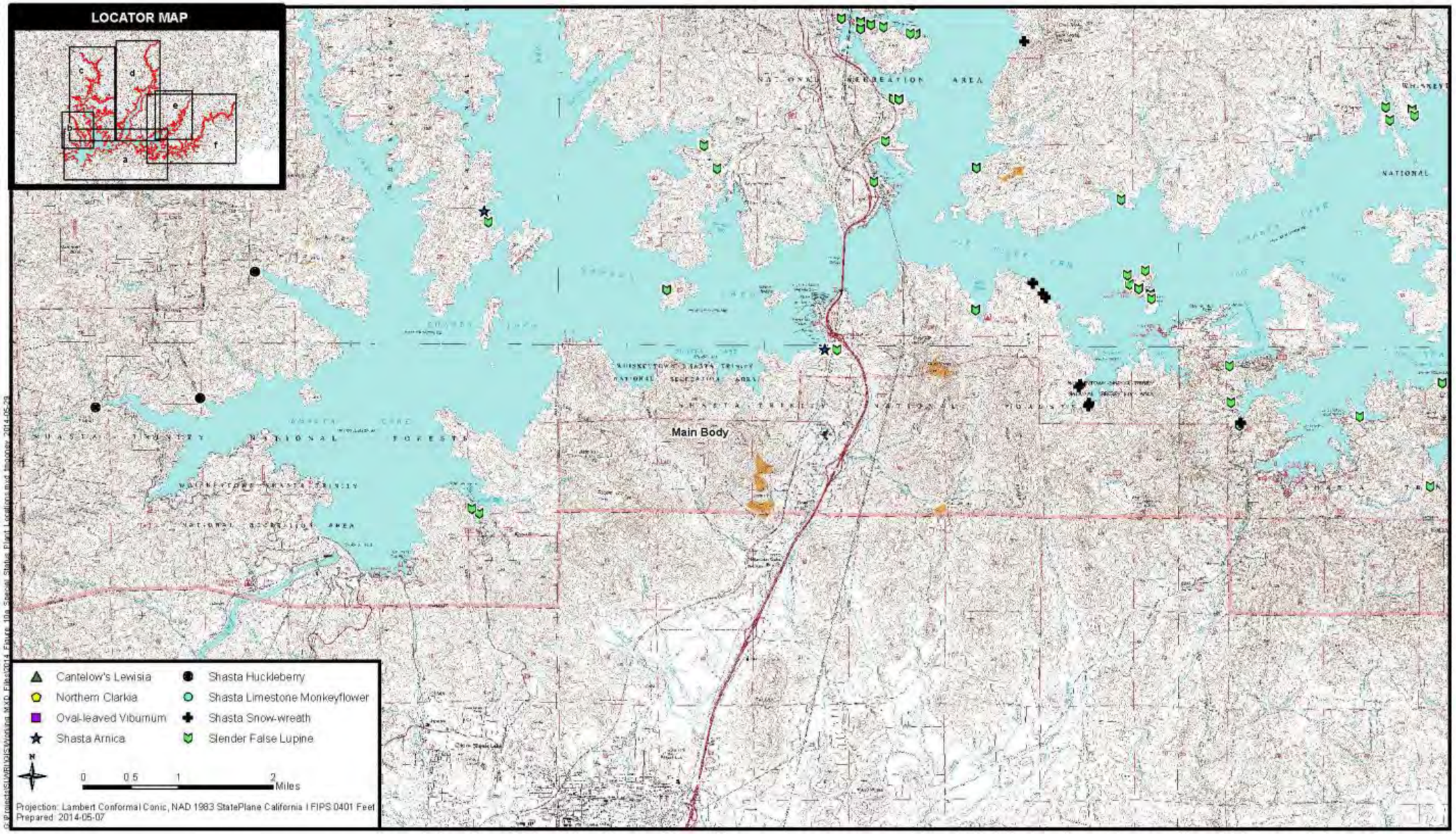

Figure 1-6a. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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Figure 1-6b. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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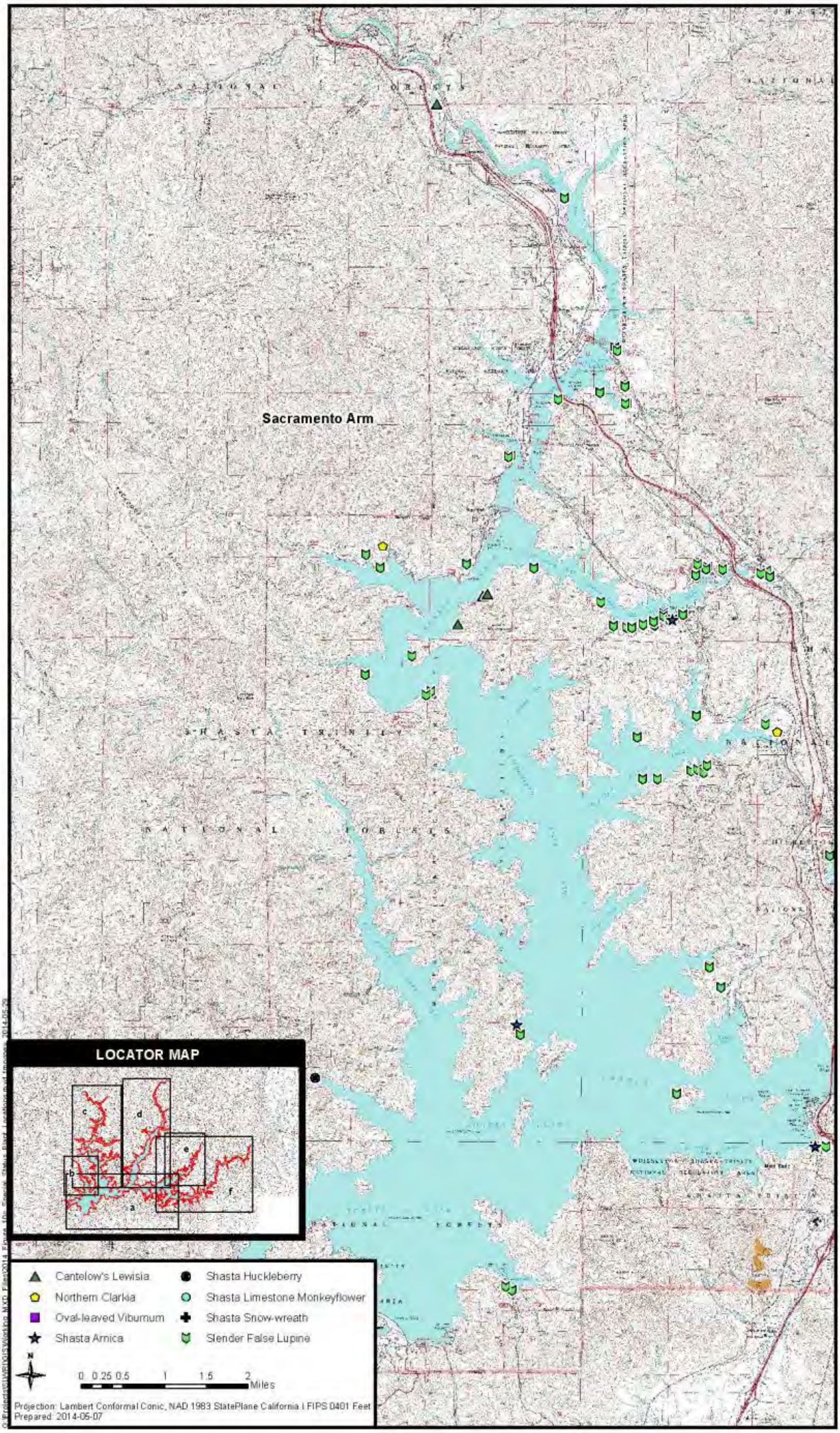

Figure 1-6c. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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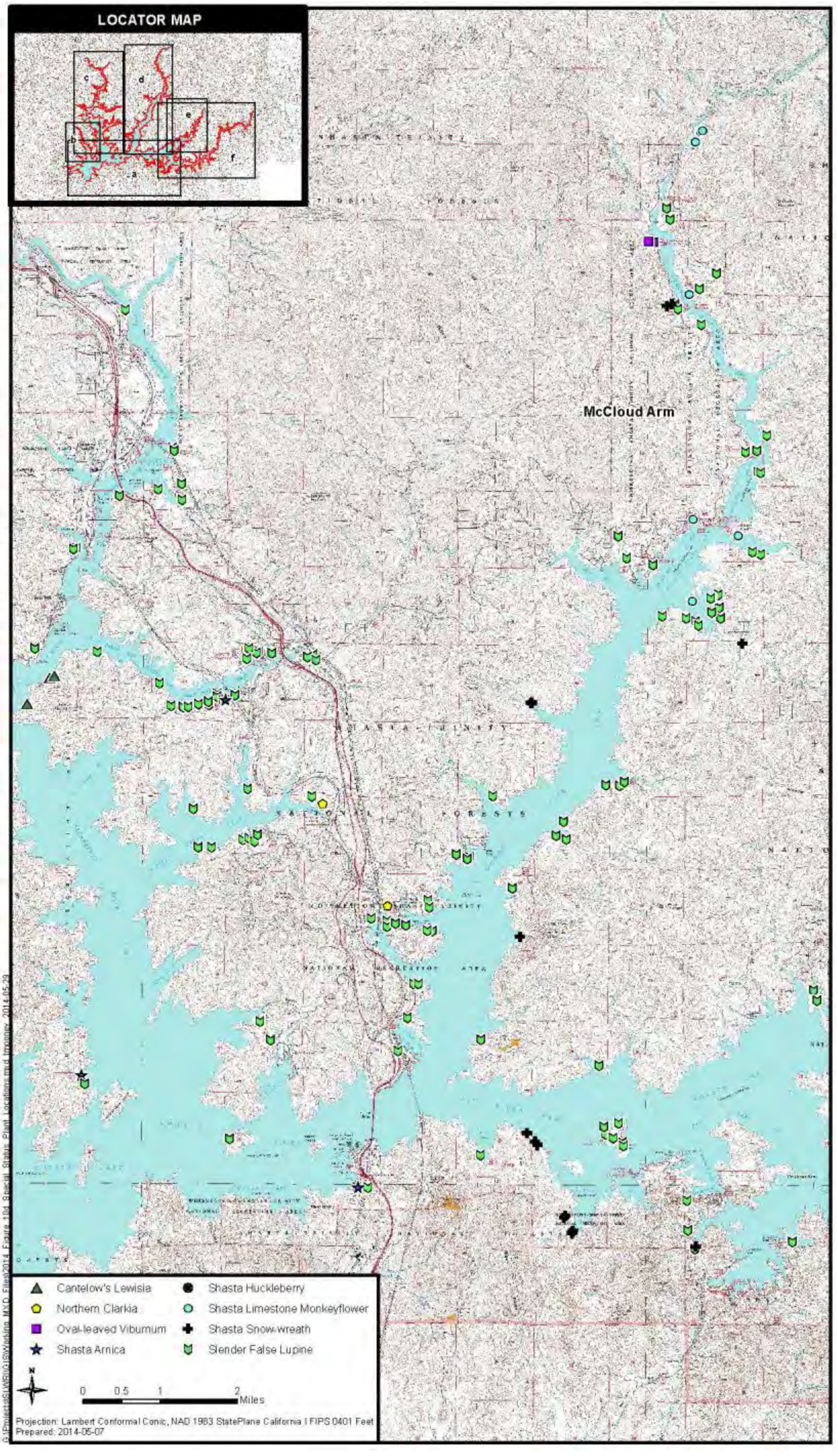

Figure 1-6d. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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Figure 1-6e. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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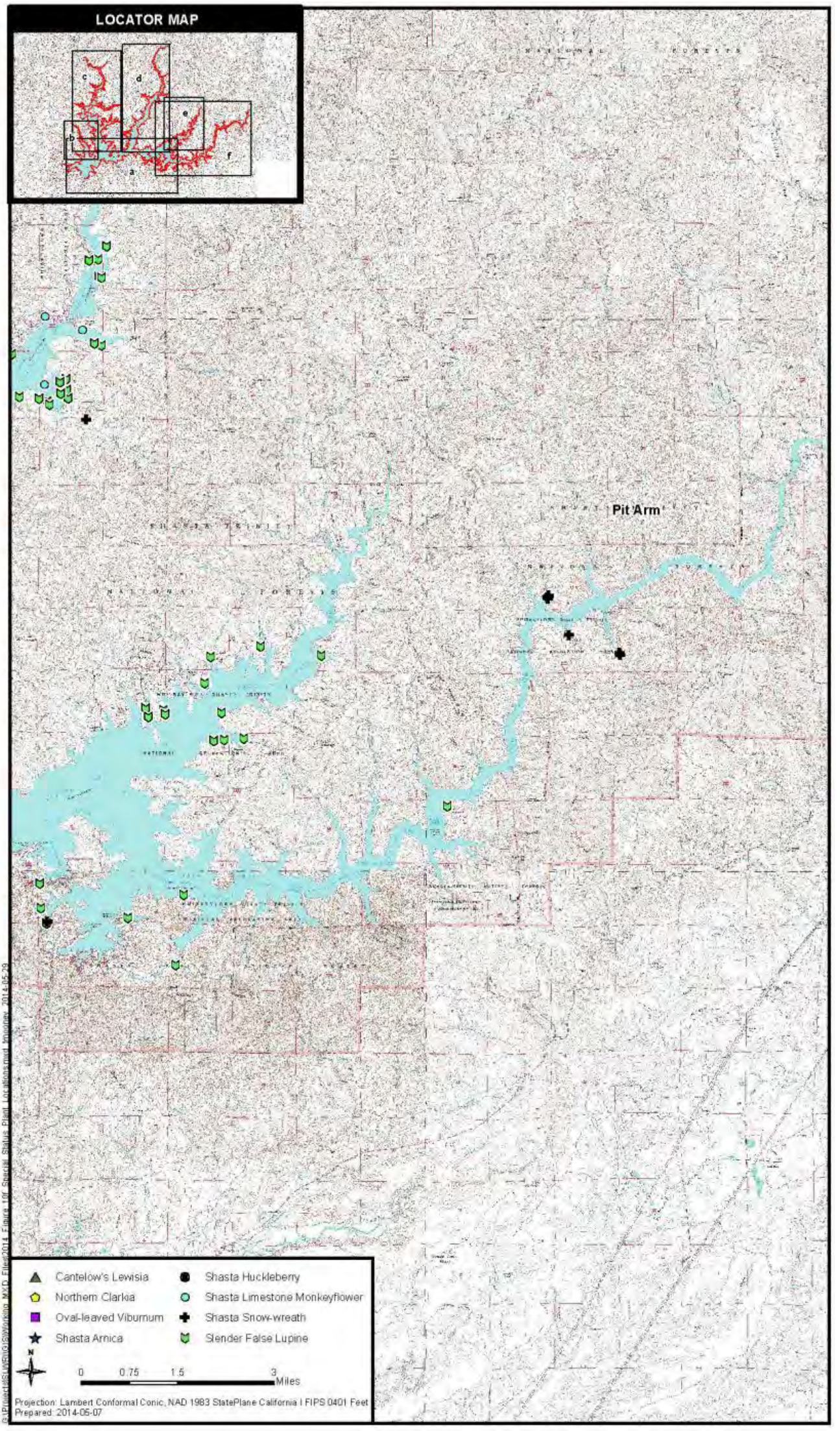

Figure 1-6f. Special-Status Plant Species Occurring in Shasta Lake and Vicinity

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Upper Sacramento River (Shasta Dam to Red Bluff) Based on review of CNDDB and CNPS database searches, a USFWS list of species that could be potentially affected in this portion of the primary study area, and previously prepared biological reports for the area, 25 special-status plant species were identified as possibly occurring in the primary study area between Shasta Dam and RBPP; therefore, their potential to occur in this portion of the study area was evaluated further. These special-status plant species, along with the legal status, habitat, and potential for occurrence of each species, are identified in Table 1-6.

Table 1-6. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Pumping Plant

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	MSCS	USFS	CRPR		
Shasta ageratina *Ageratina shastensis*	–	–	–	E	1B.2	Rocky carbonate outcrops in chaparral and lower montane coniferous forest; 1,300–5,900 feet elevation. Blooms June–October.	Could occur near Shasta Dam if suitable outcrops are present. Potential is low because most of the primary study area is below species' known elevation range.
Henderson's bent grass *Agrostis hendersonii*	–	–	m	–	3.2	Mesic sites in valley and foothill grassland, vernal pools; 230–1,000 feet elevation. Blooms April–May.	Could occur along the Sacramento River if suitable vernally mesic habitat is present.
Shasta County arnica *Arnica venosa*	–	–	–	E	4.2	Cismontane woodlands and lower montane coniferous forests, often in disturbed areas and roadcuts; 1,300 – 4,900 feet elevation. Blooms May – July.	Could occur along the Sacramento River and tributaries within the primary study area. Potential is low because most of the study area is below species' known elevation range.
Silky cryptantha *Cryptantha crinita*	–	–	m	–	1B.2	Gravelly streambeds within cismontane woodland, lower montane coniferous forest, riparian forest, riparian woodland, valley and foothill grassland; 275 – 4,000 feet elevation. Blooms April – May.	Could occur along the Sacramento River and tributaries within the primary study area.
Clustered lady's slipper *Cypripedium fasciculatum*	–	–	–	SM	4.2	Lower montane coniferous forest, North Coast coniferous forest; often in serpentinite seeps or on streambanks; 300 – 8,000 feet elevation. Blooms March – July.	Unlikely; no coniferous forest known in the primary study area.

Table 1-6. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Pumping Plant (contd.)

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	MSCS	USFS	CRPR		
Mountain lady's slipper *Cypripedium montanum*	–	–	–	SM	4.2	Broadleaved upland forest, cismontane woodland, lower montane coniferous forest, North Coast coniferous forest; 500 – 7,000 feet elevation. Blooms March – July.	Could occur at Shasta Dam or along the Sacramento River and tributaries.
Dwarf downingia *Downingia pusilla*	–	–	–	–	2.2	Mesic sites in valley and foothill grassland, vernal pools. Blooms March – May.	Could occur along the Sacramento River if suitable vernally mesic habitat is present.
Butte County fritillary *Fritillaria eastwoodiae*	–	–	–	S	3.2	Openings and sometimes serpentine areas in chaparral, cismontane woodland, and lower montane coniferous forest; 160 – 4,900 feet elevation. Blooms March – June.	Could occur along the Sacramento River and tributaries within the primary study area.
Adobe-lily *Fritillaria pluriflora*	–	–	m	–	1B.2	Chaparral, cismontane woodland, valley and foothill grassland; often in adobe soils; 200 – 2,300 feet elevation. Blooms February – April.	Could occur at Shasta Dam and along the Sacramento River.
Boggs Lake hedge-hyssop *Gratiola heterosepala*	–	E	m	–	1B.2	Marshes and swamps, vernal pools; 30 – 8,000 feet elevation. Blooms April – August.	Could occur along the Sacramento River and tributaries.
Rose mallow *Hibiscus lasiocarpus* var. *occidentalis*	–	–	m	–	1B.2	Freshwater marshes and swamps.	Could occur along the Sacramento River and tributaries.
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	–	–	m	–	1B.2	Mesic sites in valley and foothill grassland; 100 – 300 feet elevation. Blooms March – May.	Could occur along the Sacramento River if suitable vernally mesic habitat is present. Shasta Dam is higher than species' known elevation range.
Red Bluff dwarf rush *Juncus leiospermus* var. *leiospermus*	–	–	–	–	1B.1	Vernally mesic sites in chaparral, cismontane woodland, meadows and seeps, valley and foothill grassland, vernal pools; 100 –3,350 feet elevation. Blooms March – May.	Could occur at Shasta Dam or along the Sacramento River if suitable vernally mesic habitat is present.

Table 1-6. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Pumping Plant (contd.)

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	MSCS	USFS	CRPR		
Dubious pea *Lathyrus sulphureus* var. *argillaceous*	–	–	–	–	3	Cismontane woodland, lower montane coniferous forest, upper montane coniferous forest; 500 – 1,000 feet elevation. Blooms in April.	Could occur at Shasta Dam and along the Sacramento River.
Greene's legenere *Legenere limosa*	–	–	m	–	1B.1	Vernal pools; 1 – 3,000 feet elevation. Blooms April – June.	Could occur along Sacramento River if suitable vernal pool habitat is present.
Cantelow's lewisia *Lewisia cantelovii*	–	–	–	S	1B.2	Mesic granitic sites within broadleaved upland forest, chaparral, cismontane woodland, and lower montane coniferous forest; 1,250 – 4,500 feet. Sometimes in serpentinite seeps. Blooms May – October.	Could occur in the Shasta Dam area. The remainder of the primary study area is below species' known elevation range.
Bellinger's meadowfoam *Limnanthes floccosa* ssp. *bellingeriana*	–	–	m	–	1B.2	Mesic sites in cismontane woodland, meadows and seeps; 950 – 3,600 feet elevation. Blooms April – June.	Could occur at Shasta Dam. Potential along Sacramento River is low because majority of the primary study area is below species' known elevation range.
Shasta snow wreath *Neviusia cliftonii*	–	–	m	S	1B.2	Carbonate substrates in lower montane coniferous forest and riparian woodland; 1,000 – 1,600 feet elevation. Blooms May – June.	Could occur in Shasta Dam area. Unlikely to occur along Sacramento River because the primary study area is lower than species' known elevation range.
Slender Orcutt grass *Orcuttia tenuis*	E	E	m	–	1B.1	Vernal pools; 100 – 6,000 feet elevation. Blooms May – October.	Could occur along the Sacramento River if suitable vernal pool habitat is present. Federally designated critical habitat for this species occurs east of the Sacramento River, east of Cottonwood (Units 3A and 3B) and northeast of Anderson (Units 2C and 2D).
Ahart's paronychia *Paronychia ahartii*	–	–	m	–	1B.1	Cismontane woodland, valley and foothill grassland, vernal pools; 100 – 1,700 feet elevation. Blooms March – June.	Could occur at Shasta Dam and along the Sacramento River.

Table 1-6. Special-Status Plant Species Known or with Potential to Occur in the Primary Study Area, Along the Sacramento River from Shasta Dam to Red Bluff Pumping Plant (contd.)

Species	Legal Status[1]					Habitat and Blooming Period	Potential for Occurrence
	USFWS	CDFW	MSCS	USFS	CRPR		
Pacific fuzzwort *Ptilidium californicum*	–	–	–	SM	4.3	An epiphytic on bark at the base of standing mature to old-growth trees or recently fallen logs; rarely on other organic substrates such as decaying logs and stumps, or humus covering boulders; 1,275 – 5,725 feet elevation.	Could occur along the Sacramento River and tributaries within the primary study area. Potential is low because most of the study area is below species' known elevation range.
Canyon Creek stonecrop *Sedum paradisum*	–	–	–	S	1B.3	Granitic, rocky areas in broadleafed upland forest, chaparral, lower montane coniferous forest, subalpine coniferous forest; 980 – 6,100 feet elevation. Blooms May – June.	Could occur along the Sacramento River and tributaries within the primary study area. Potential is low because most of the study area is below species' known elevation range.
English Peak greenbriar *Smilax jamesii*	–	–	m	S	1B.3	Found along streambanks and lake margins in broadleafed upland forest, lower montane, upper montane, and north coast coniferous forests, and marshes and swamps; 1,600 – 8,200 feet elevation. Blooms May – July, rarely through August.	Could occur along the Sacramento River and tributaries within the primary study area. Potential is low because most of the study area is below species' known elevation range.
Oval-leaved viburnum *Viburnum ellipticum*	–	–	–	–	2.3	Chaparral, cismontane woodland, lower montane coniferous forest; 800 – 4,600 feet elevation. Blooms May – June.	Could occur at Shasta Dam and along the Sacramento River.

Sources: CNDDB 2007, CNPS 2011, USFS 1995a, USFWS 2011

Notes:

[1] Legal Status

U.S. Fish and Wildlife Service Federal Listing Categories:
T Threatened
E Endangered

U.S. Forest Service Listing Categories:
E Endemic to specific region or National Forest
S Sensitive
SM Species considered rare or threatened and recommended for survey and management per Northwest Forest Plan 2002

California Department of Fish and Wildlife State Listing Categories:
R California Rare
T California Threatened
E California Endangered

California Rare Plant Rank Categories:
1B Plants rare, threatened, or endangered in California and elsewhere
2 Plants rare, threatened, or endangered in California but more common elsewhere
3 Plants for which more information is needed – a review list
4 Plants of limited distribution – a watch list

MSCS (Multi-Species Conservation Strategy) Listing Categories:
R recovery
r contribute to recovery
m maintain

Sixteen of the special-status plant species listed in Table 1-5 have the potential to occur within habitat present along the Sacramento River between Shasta Dam and RBPP. Many of these species, such as Boggs Lake hedge-hyssop (*Gratiola heterosepala*) (State listed as endangered, MSCS m, CRPR 1B.2), Ahart's dwarf rush (*Juncus leiospermus* var. *ahartii*) (MSCS m, CRPR 1B.2), Ahart's paronychia (*Paronychia ahartii*) (MSCS m, CRPR 1B.1), dwarf downingia (*Downingia pusilla*) (CRPR 2.2), Greene's legenere (*Legenere limosa*) (MSCS m, CRPR 1B.1), Henderson's bent grass (*Agrostis hendersonii*) (MSCS m, CRPR 3.2), Red Bluff dwarf rush (*Juncus leiospermus* var. *leiospermus*) (CRPR 1B.2), and slender Orcutt grass (*Orcuttia tenuis*) (Federally listed as endangered, State listed as endangered, MSCS m, CRPR 1B.1), typically occur in vernal pools, which are generally not present within the active floodplain of regulated rivers in the extended study area. Other special-status plants, however, could occur in the extended study area in the freshwater marshes, swamps, and riparian woodlands that are found along the river corridor. These species include rose mallow (*Hibiscus lasiocarpus* var. *occidentalis*) (MSCS m, CRPR 2) and silky cryptantha (*Cryptantha crinita*) (USFS SM, CRPR 1B.2). The remaining five species – adobe-lily (*Fritillaria pluriflora*) (MSCS m, CRPR 1B.2), Butte County fritillary (*Fritillaria eastwoodiae*) (USFS S, CRPR 3.2), dubious pea (*Lathyrus sulphureus* var. *agillaceous*) (CRPR 3), mountain lady's slipper (*Cypripedium fasciculatum*) (USFS SM, CRPR 4.2), and oval-leaved viburnum (*Viburnum ellipticum*) (CRPR 2.3) – may occur in annual grassland, chaparral, cismontane woodland, and lower montane coniferous forest vegetation communities along the river corridor.

Of the special-status species that could occur along the upper Sacramento River, four are known to occur along the edge of the Sacramento River channel or along a Sacramento River tributary within 0.2 mile of the river proper, and their establishment and reproduction could potentially be affected by changes in flow regime: silky cryptantha, rose mallow, and Ahart's paronychia (CNDDB 2007, University of California 2011).

Extended Study Area

Most of the special-status plant species listed in Table 1-5 have the potential to occur within the extended study area. Numerous additional special-status plant species could occur in the extended study area. Attachment 4 of this technical report contains comprehensive lists of all sensitive plant species in the extended study area that have been reported to the CNDDB, or that otherwise have the potential to occur in the extended study area.

Lower Sacramento River and Delta A number of special-status plant species could be affected in the lower Sacramento River and Delta by changes in hydrology (CALFED 2000a). These include species associated with vernal pool, riparian, marsh, and aquatic plant communities; and several other species with restricted distributions on or near channel banks, active floodplains, flood bypasses, and Delta waterways. These assemblages of special-status species are described below.

Species of Vernal Pool Communities In addition to species that are potentially present in the primary study area (Table 1-5), special-status plant species that may be associated with vernal pools along the lower Sacramento River and in the Delta region include alkali milk-vetch (*Astragalus tener* var. *tener*), brittlescale (*Atriplex depressa*), Hoover's spurge (*Euphorbia hooveri*), Contra Costa goldfields (*Lasthenia conjugens*), hairy Orcutt grass (*Orcuttia pilosa*), slender Orcutt grass (*Orcuttia tenuis*), bearded popcornflower (*Plagiobothrys hystriculus*), Delta woolly-marbles (*Psilocarphus brevissimus* var. *multiflorus*), Crampton's tuctoria (*Tuctoria mucronata*), and Greene's tuctoria (*Tuctoria greenei*). The following is a description of each of these species:

- *Brittlescale* is a CRPR 1B.2 and MSCS "m" ("maintain") species. Suitable habitat for this annual plant consists of vernal pools, seeps, grassland, chenopod scrub, and playas. It is known from Alameda, Butte, Colusa, Contra Costa, Fresno, Glenn, Merced, Solano, Stanislaus, Tulare, and Yolo Counties. Threats to this species include habitat loss because of development, incompatible grazing practices, and trampling (CNPS 2011).

- *Alkali milk-vetch* is a CRPR 1B.2 and MSCS "r" ("contribute to recovery") species. Suitable habitat for this annual plant consists of moist, level settings on alkaline soils with high clay content. It has been observed in varied vegetation including grassland, borders of drainages, fallow rice fields, and among weedy grasses and forbs. Although once more widely distributed, its current known distribution is centered in Solano County, and it also is known from Alameda, Merced, Napa, and Yolo counties. Several occurrences are on public land managed for game species. Threats to this species include habitat loss, incompatible grazing and game management practices (e.g., inundation of land for waterfowl during the growing season of Ferris's milkvetch), competition from the nonnative plants that now dominate much of the vegetation in which Ferris's milk vetch occurs, and small population sizes (10–400 individuals) that leave Ferris's milkvetch vulnerable to extirpation from chance events (CNDDB 2007; CNPS 2011).

- *Hoover's spurge* is Federally listed as threatened and is a CRPR 1B.2 and MSCS "m" species. Suitable habitat for this annual plant consists of relatively large, deep vernal pools among the rolling hills, remnant alluvial fans, and depositional stream terraces at the base of the Sierra Nevada foothills. This species is now concentrated primarily in the Vina Plains in Tehama and Butte Counties, with other occurrences in Glenn County as well as the Visalia-Yettem area of Tulare County and the Hickman–La Grange area of Stanislaus County. Critical habitat for this species occurs in the extended study area in Stanislaus, Merced, and Tulare Counties. Threats to this species include habitat loss, incompatible agricultural and grazing practices, and nonnative species (CNDDB 2007; CNPS 2011).

- *Contra Costa goldfields* is Federally listed as endangered and is a CRPR 1B.1 and MSCS "m" species. Suitable habitat for this annual plant consists of vernal pools and seasonally wet areas within woodland, alkaline playa, and valley and foothill grassland communities. The historic distribution of Contra Costa goldfields was once more extensive, but it is still known from at least one location in seven counties: Alameda, Contra Costa, Marin, Monterey, Napa, Solano, and Sonoma Counties. Threats to this species include habitat loss, hydrological alterations, incompatible grazing practices and nonnative plants (CNPS 2011).

- *Hairy Orcutt grass* is Federally listed as endangered and is a CRPR 1B.1 and MSCS "m" species. Suitable habitat for this annual plant consists of vernal pools in rolling topography on remnant alluvial fans and stream terraces in the Central Valley. The historical range included the eastern margins of Sacramento and San Joaquin Valleys from Tehama County south to Stanislaus County and through Merced and Madera Counties. This species is now concentrated primarily in the Vina Plains in Tehama County, with an isolated occurrence in central Butte County and other occurrences in Glenn, Madera, and eastern Stanislaus Counties. Critical habitat for this species occurs in the extended study area in Tehama, Stanislaus, Merced, and Madera Counties. Threats to this species include habitat loss, incompatible grazing practices, nonnative species, and trampling (CNDDB 2007; CNPS 2011).

- *Slender Orcutt grass* is Federally listed as threatened and is a CRPR 1B.1 and MSCS "m" species. Suitable habitat for this annual plant consists of vernal pools on remnant alluvial fans and high stream terraces and recent basalt flows in valley grassland and blue oak woodland. It has some ability to colonize artificial habitats, such as the margins of stock ponds. This species is now concentrated primarily in the vicinity of Dales, Tehama County. A secondary area of concentration is the Modoc Plateau in Lassen, Plumas, Shasta, and Siskiyou Counties, with a few occurrences in the Lake-Napa and Southeastern Sacramento Valley Vernal Pool Regions. Critical habitat for this species occurs in the extended study area in Tehama County. Threats to this species include habitat loss, incompatible grazing practices, nonnative species, and off-road vehicle use and trampling (CNDDB 2007; CNPS 2011).

- *Bearded popcornflower* is a CRPR 1B.1 species. This species was rediscovered in 2005 after not being seen since 1892. Suitable habitat for this annual plant consists of vernal pools, vernal swales, and other moist areas in grassland. It is currently known from vernal pools and mesic grasslands in Solano County. Threats to this species include habitat loss, discing of remaining habitat, and competition from the

nonnative plants that now dominate much of the vegetation in which bearded popcornflower occurs (CNPS 2011).

- *Delta woolly-marbles* is a CRPR 4.2 species. Suitable habitat for this annual plant consists of vernal pools, vernal swales, and other moist areas in grassland. This vernal pool species is currently known from Alameda, Napa, San Diego, San Joaquin, Santa Clara, Solano, Stanislaus, and Yolo Counties (CNPS 2011).

- *Crampton's tuctoria*, also known as Solano grass, is Federally listed and State listed as endangered, and is a CRPR 1B.1 and MSCS "r" species. Crampton's tuctoria is an annual plant of vernal pools. This species is thought to have once grown in isolated parts of the northern Delta in areas that flooded during the wet season, but any former habitat there has been long since reclaimed for agriculture. Only a few individuals of the plant now exist, mostly in Yolo County. Threats to this species include habitat loss, incompatible grazing practices, and small population sizes (10–400 individuals) that leave Crampton's tuctoria vulnerable to extirpation from chance events (CNDDB 2007; CNPS 2011).

- *Greene's tuctoria* is Federally listed as endangered and is a CRPR 1B.1 and MSCS "m" species. Suitable habitat for this annual plant species consists of vernal pools in valley grasslands. This species is currently found in widely separated occurrences in Butte, Merced, Shasta, and Tehama Counties. Sixty percent of the extant occurrences are in the Vina Plains area of Tehama and Butte Counties. Eastern Merced County has about 30 percent of the known occurrences. Other occurrences are located in Glenn and Shasta Counties. The species has been extirpated from Fresno, Madera, San Joaquin, Stanislaus, and Tulare Counties. Critical habitat for this species occurs in the extended study area in Tehama, Stanislaus, Tuolumne, Merced, Mariposa, and Madera Counties. Threats to this species include habitat loss, and incompatible grazing and agricultural practices (CNDDB 2007; CNPS 2011).

Species of Riparian and Marsh Communities In addition to species considered potentially present in the primary study area (Table 1-5), special-status plant species potentially associated with riparian and marsh communities along the lower Sacramento River and in the Delta region include bristly sedge (*Carex comosa*), Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*), Soft bird's-beak (*Chloropyron molle* ssp. *molle*), Delta button-celery (*Eryngium racemosum*), Northern California black walnut (*Juglans hindsii*), Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*), Mason's lilaeopsis (*Lilaeopsis masonii*), Delta mudwort (*Limosella australis*), Sanford's arrowhead (*Sagittaria sanfordii*), Marsh skullcap (*Scutellaria galericulata*), blue skullcap (*Scutellaria*

lateriflora), and Suisun Marsh aster (*Symphyotrichum lentum*). The following is a description of each of these species:

- *Bristly sedge* is a CRPR 2.1 and MSCS "r" species. This perennial, rhizomatous herb grows on lake edges and wet places in marshes and swamps across much of North America, but it is most abundant in the glaciated regions of Eastern North America (Flora of North America Editorial Committee 2002). It is widely distributed but rarely collected in California; it is known from Contra Costa, Lake, Mendocino, Sacramento, Santa Cruz, Shasta, San Joaquin, and Sonoma Counties. The conversion of wetlands to other land uses may have contributed to the rarity of bristly sedge in the Delta. Threats to this species include additional habitat loss, marsh drainage, and other alterations to hydrology, as well as road maintenance activities (CNPS 2011).

- *Suisun thistle* is Federally listed as endangered and is a CRPR 1B.1 and MSCS "R" ("Recovery") species. Habitat for this species is restricted to a narrow tidal band within large saltwater or brackish tidal marshes that have fully developed tidal channel networks. This species does not generally occur in fringe tidal marshes that are less than 300 feet wide (USFWS 1995). This species was thought to be extinct until it was rediscovered on Grizzly Island in 1989 (CNPS 2011). There are only two known occurrences of Suisun thistle remaining, both within Suisun Marsh in Solano County. Threats to this species include alterations to marsh hydrology, nonnative species, and trampling (CNPS 2011).

- *Soft bird's-beak* is Federally listed as endangered and State listed as rare, and is a CRPR 1B.2 and MSCS "R" species. This hemiparasitic annual species grows in saline and brackish marshes and is restricted to a narrow band, typically in a marsh's higher elevations. The species is known from Contra Costa, Napa, and Solano Counties. The remaining populations range in size from a single individual to more than 100,000 plants. Within populations the number of individuals fluctuates considerably from year to year, often by more than an order of magnitude. Conversion of wetlands to other land uses has contributed to the decline of soft bird's-beak. Current threats to the remaining populations include competition from nonnative plants (in particular perennial pepperweed, *Lepidium latifolium*), alteration of wetland hydrology (including trenching of wetlands for mosquito abatement and diking), grazing and trampling, and erosion (USFWS 1995; CNDDB 2007; CNPS 2011).

- *Delta button-celery* is a CRPR 1B.1 and MSCS "r" species. This biennial plant grows in open riparian scrub on river floodplains, primarily along the San Joaquin River; most occupied habitat receives periodic inundation. The species is known from Calaveras, Contra Costa, Merced, Stanislaus, and San Joaquin Counties. Threats to this

species include conversion of habitat to agricultural land uses, flood control, incompatible grazing practices, and various anthropogenic disturbances (e.g., off-road vehicles, road maintenance) (CNDDB 2007; CNPS 2011).

- *Northern California black walnut* is a CRPR 1B.1 and MSCS "r" species. Since the 1850s this tree species has experienced significant changes in its distribution, abundance, and the genetic composition of its populations. Before the 1850s native stands of Northern California black walnut appear to have been confined to three areas. The most extensive of these areas was along the lower Sacramento River in the vicinity of Walnut Grove (including Andrus and Grand Islands and adjacent islands). However, no pre-1850 individuals remain along the lower Sacramento River (Jepson 1910, Smith 1912). Despite practically being eliminated from an initially restricted distribution, Northern California black walnut has become widely distributed and abundant. Currently, Northern California black walnut occurs in riparian zones, on agricultural lands, along roadsides and as an urban "weed tree" throughout the Sacramento Valley and beyond (Griffin and Critchfield 1972; Resources Agency 2003). This change in its distribution was brought about by widespread planting as an ornamental, and its use as a rootstock for the English walnut (*Juglans regia*), and its subsequent dispersal and establishment within natural and ruderal vegetation. The initial plantings of Eastern black walnut, and the subsequent and extensive cultivation of English walnut, has led to hybridization of Northern California black walnut with these species. Therefore, although most existing Northern California black walnut trees closely resemble the early descriptions and collections of this species, their ancestry to some extent is likely to include other walnut species (CNPS 2011).

- *Delta tule pea* is a CRPR 1B.2 and MSCS "r" species. This perennial vine typically grows above the tidal zone in riparian scrub or at the edges of riparian forest, although it also occurs in marsh vegetation. The species is known from Contra Costa, Napa, Sacramento, San Joaquin, Solano, and Sonoma Counties. The decline of Delta tule pea populations has resulted primarily from habitat loss, installation of riprap and maintenance of levees, hydrologic alterations, and competition from nonnative invasive plants. These continue to threaten the species (CNDDB 2007; CNPS 2011).

- *Mason's lilaeopsis* is a CRPR 1B.1 and MSCS "R" species. This diminutive (less than 10 inches), rhizomatous perennial grows within the tidal zone on open sites along shores and eroding banks, at the toes of cut banks, and in adjacent marshes (Mason 1957, CNDDB 2007). The species is known from Alameda, Contra Costa, Marin, Napa, Sacramento, San Joaquin, and Solano Counties. The decline of

Mason's lilaeopsis populations has resulted primarily from habitat loss, altered hydrodynamics, installation of riprap and maintenance of levees, and accelerated erosion (resulting in part from boat wakes). These continue to be the primary threats affecting the species (CNDDB 2007; CNPS 2011).

- *Delta mudwort* is a CRPR 2.1 and MSCS "r" species. Like Mason's lilaeopsis, this diminutive (less than 10 inches), rhizomatous perennial grows within the tidal zone on open sites along shores, on eroding banks, at the toes of cut banks, and in adjacent marshes (Mason 1957, CNDDB 2007). The species is known from Contra Costa, Marin, Sacramento, San Joaquin, and Solano Counties. The decline of Delta mudwort populations has resulted primarily from habitat loss, altered hydrodynamics, installation of riprap and maintenance of levees, and accelerated erosion (resulting in part from boat wakes). These continue to be the primary threats affecting the species (CNDDB 2007; CNPS 2011).

- *Sanford's arrowhead* is a CRPR 1B.2 and MSCS "m" species. This rhizomatous, perennial plant grows as an emergent in freshwater (nontidal) marshes, ponds, ditches, and various other shallow, slow-moving freshwater habitats. It is widely distributed in the Central Valley but rare. Threats to this species include habitat loss, channel maintenance, and hydrologic alterations (Hickman 1993; CNPS 2011).

- *Marsh skullcap* and *blue skullcap* are CRPR 2.2 and MSCS "m" species. These rhizomatous perennial herbs are widely distributed in wetlands across North America, but are rare in California. These species are known from Sacramento and San Joaquin Counties in the Delta, and in California marsh skullcap also occurs in several counties in the northern Sierra Nevada and Modoc Plateau. Marsh skullcap is known from just three sites in the Delta, and all were growing in tidal marsh vegetation. Blue skullcap is known from just two sites. The conversion of wetlands to other land uses may have contributed to the rarity of these species in the Delta (CNDDB 2007; CNPS 2011).

- *Suisun Marsh aster* is a CRPR 1B.2 species. This perennial grows primarily within the tidal zone, in patches of one to several hundred stems. However, although it does grow along banks, it also often is away from the water's edge and within vegetation denser than vegetation surrounding Mason's lilaeopsis or Delta mudwort. The decline of Suisun aster populations has been caused primarily by habitat loss, installation of riprap and maintenance of levees, hydrologic alterations, and competition from nonnative invasive plants. These continue to be the primary threats affecting the species (CNDDB 2007; CNPS 2011).

Species of Aquatic Communities Eel-grass pondweed (*Potamogeton zosteriformis*) is a CRPR 2.2 and MSCS "m" species. This submerged aquatic plant of assorted freshwater habitats is rare in California but more common elsewhere. In California, it has been documented in Contra Costa, Lake, Lassen, Modoc, and Shasta Counties. Overall, the distribution, abundance, and threats affecting this species in California are not well known (CNPS 2011).

CVP/SWP Service Areas Special-status plants are not likely to occur in a substantial portion of the CVP and SWP service areas because the agricultural and urban land uses tend to preclude suitable habitat for most native species.

General agricultural practices result in monotypic stands of vegetation for the growing season and bare ground in fall and winter. Special-status plant species are unlikely to occur in agricultural habitat because of the soil disturbance inherent in the agricultural practices. In areas not intensively cultivated, such as fallow fields, roads, ditches, and levee slopes, regular maintenance precludes the establishment of ruderal vegetation or native vegetation communities; thus, such areas are not likely to support many special-status plant species. Further, because agricultural ditches are generally subject to maintenance, they have minimal suitable habitat for special-status plants.

Developed land includes areas with roads and buildings but also includes barren areas that have been disturbed and are unvegetated. Special-status plant species are unlikely to occur in developed land areas because most vegetation has been removed, and these areas remain highly disturbed.

Areas with ruderal vegetation are dominated by herbaceous, nonnative, weedy species and may support stands of noxious weeds. Ruderal vegetation generally occurs in areas subject to periodic disturbances, and the species in this land cover type are generally weedy to invasive. For these reasons, no special-status plants are expected to occur in ruderal vegetation communities.

Although agricultural and developed land uses account for most of the CVP and SWP service areas, a portion of these areas still remains in natural vegetation, Because of the large size of the CVP and SWP service areas, this natural vegetation is distributed over a wide range of climate and soils, and is varied in structure and species composition. Consequently, a large number of special-status plant species has the potential to occur in the natural vegetation that remains within the CVP and SWP service areas. (See Attachment 1)

Invasive Species

Primary Study Area

Shasta Lake and Vicinity and Potential Sacramento River Downstream Restoration Sites Nonnative plant species introduced to the region are of concern in the Shasta Lake and vicinity portion of the primary study area. When plants that evolved in one region of the globe are moved by humans to another

region, a few flourish, crowding out native vegetation and wildlife that feed on the native species. Some invasive plants can even change ecosystem processes such as hydrology, fire regimes, and soil chemistry. These invasive plants have a competitive advantage because they are no longer controlled by their natural predators and can quickly spread. In California, approximately 3 percent of the plant species growing in the wild are considered invasive, but they inhabit a much greater proportion of the landscape (Cal-IPC 2007).

Plant pests are defined by law, regulation, policy, and technical organizations, and are regulated by many different bodies, including the California Department of Food and Agriculture (CDFA), U.S. Department of Agriculture, and the Cal-IPC. CDFA uses an action-oriented pest-rating system. The low rating assigned to a pest by CDFA does not necessarily mean that the pest is not a problem; rather, the rating system is meant to prioritize response by CDFA and county agricultural commissioners. Plants on CDFA's highest priority "A" list are defined as plants "of known economic importance subject to state-county enforced action involving eradication, quarantine regulation, containment, rejection or other holding action."

Cal-IPC has developed a list of plant pests specific to California wildlands. The Cal-IPC list is based on information submitted by land managers, botanists, and researchers throughout the state and on published sources. To determine plant pests potentially occurring in the Shasta Lake and vicinity portion of the primary study area, this list was reviewed and local agencies (BLM, USFS, California Department of Transportation, and Shasta County Department of Agriculture) were contacted to gather information about known weed locations (Table 1-7). Additional noxious weed information has been recorded by Reclamation from observations made during botanical and other technical studies. Attachment 5 describes each weed source location, the potential mode of spread, and the risk of spread at each of the known sites.

Management actions have been required to prevent the loss of habitat caused by some of the more invasive exotic species that outcompete native vegetation. However, these management actions have been limited and have been confined primarily to areas adjacent to campgrounds and USFS facilities.

Table 1-7. Nonnative Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area

Common Name	Scientific Name	Cal-IPC Rating[1]	CDFA Rating[2]	Habitat
Silver wattle	*Acacia dealbata*	Moderate	None	Mixed woodlands, riparian
Barbed goatgrass	*Aegilops triuncialis*	High	B	Grassland, rangeland, oak woodland
Tree of heaven	*Ailanthus altissima*	Moderate	None	Grassland, oak woodland, riparian
Broomsedge	*Andropogon virginicus*	None	None	Riparian, disturbed areas
Giant reed	*Arundo donax*	High	None	Riparian
Slender wild oats	*Avena barbata*	Moderate	None	Coastal scrub, grassland, oak woodland, forest
Common wild oats	*Avena fatua*	Moderate	None	Coastal scrub, grassland, oak woodland, forest
Black mustard	*Brassica nigra*	Moderate	None	Disturbed areas, fields
Rattlesnake grass	*Briza maxima*	Limited	None	Grassland
Ripgut brome	*Bromus diandrus*	Moderate	None	Dunes, scrub, grassland, woodland, forest
Soft brome	*Bromus hordeaceus*	Limited	None	Grassland, sage brush, serpentine soils
Red brome	*Bromus madritensis* ssp. *rubens*	High	None	Interior scrub, woodlands, grassland
Cheatgrass	*Bromus tectorum*	High	None	Interior scrub, woodlands, grassland
Italian thistle	*Carduus pycnocephalus*	Moderate	C	Forest, scrub, grasslands, woodlands.
White knapweed	*Centaurea diffusa*	Moderate	A	Great Basin scrub, coastal prairie
Spotted knapweed	*Centaurea maculosa*	High	A	Riparian, grassland, wet meadows, forests
Maltese star-thistle	*Centaurea melitensis*	Moderate	None	Disturbed areas, fields
Yellow star-thistle	*Centaurea solstitialis*	High	C	Grassland, woodlands, occasionally riparian
Rush skeleton weed	*Chondrilla juncea*	Moderate	A	Grassland
Canada thistle	*Cirsium arvense*	Moderate	B	Grassland, riparian areas, forests
Bull thistle	*Cirsium vulgare*	Moderate	None	Riparian areas, marshes, meadows
Poison hemlock	*Conium maculatum*	Moderate	None	Riparian areas
Field bindweed	*Convolvulus arvensis*	Evaluated, not listed	C	Agricultural weed
Pampas grass	*Cortaderia selloana*	High	None	Coastal, riparian
Bermuda grass	*Cynodon dactylon*	Moderate	C	Riparian scrub, common landscape weed
Gypsyflower	*Cynoglossum officinale*	Moderate	None	Disturbed areas
Hedgehog dogtailgrass	*Cynosurus echinatus*	Moderate	None	Grassland, oak woodland, disturbed areas
Scotch broom	*Cytisus scoparius*	High	C	Coastal scrub, oak woodland
Orchardgrass	*Dactylis glomerata*	Limited	None	Grassland, disturbed areas
Fuller's teasel	*Dipsacus sativus*	Moderate	None	Fields, disturbed areas

Table 1-7. Nonnative Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Cal-IPC Rating[1]	CDFA Rating[2]	Habitat
Barnyardgrass	*Echinochloa crus-galli*	None	None	Wet, disturbed areas. fields
Medusa-head	*Elymus caput-medusae*	High	C	Grassland, scrub, woodland
Longbeak stork's bill	*Erodium botrys*	Evaluated, not listed	None	Many upland habitats
Redstem stork's bill	*Erodium cicutarium*	Limited	None	Many upland habitats
Tall fescue	*Festuca arundinacea*	Moderate	None	Pasture
Rat-tail fescue	*Festuca myuros*	Moderate	None	Coastal sage scrub, chaparral
Italian ryegrass	*Lolium multiflorum*	Moderate	None	Grassland, oak woodlands, pinyon-juniper woodland
Fig	*Ficus carica*	Moderate	None	Riparian woodland
Fennel	*Foeniculum vulgare*	High	None	Grassland, scrub
French broom	*Genista monspessulana*	High	C	Coastal scrub, oak woodland, grassland
Cutleaf geranium	*Geranium dissectum*	Limited	None	Grassland, disturbed areas
English ivy	*Hedera helix*	High	None	Coastal forest, riparian areas
Common velvet grass	*Holcus lanatus*	Moderate	None	Fields, meadows
Mediterranean barley, foxtail	*Hordeum marinum, H. murinum*	Moderate	None	Grassland
Common St. John's wort	*Hypericum perforatum*	Moderate	C	Many habitats, disturbed
Rough cat's ear	*Hypochaeris radicata*	Moderate	None	Grassland, woodland
Pale yellow iris	*Iris pseudacorus*	Limited	None	Riparian, fresh emergent wetland
Perennial sweetpea	*Lathyrus latifolius*	None	None	Woodland, roadsides
Water primrose	*Ludwigia peploides*	High	None	Ponds, lakes
Hyssop loosestrife	*Lythrum hyssopifolia*	Limited	None	Marsh, pond
Horehound	*Marrubium vulgare*	Limited	None	Pasture, grassland
Burclover	*Medicago polymorpha*	Limited	None	Grassland, disturbed areas
Parrotfeather	*Myriophyllum aquaticum*	High	None	Ponds, lakes
Oleander	*Nerium oleander*	Evaluated, not listed	None	Riparian areas
Pokeweed	*Phytolacca americana*	None	None	Riparian forest, riparian woodland
Annual rabbitsfoot grass	*Polypogon monspeliensis*	Limited	None	Riparian areas
Wild radish	*Raphanus sativus*	Limited	None	Fields, disturbed areas
Black locust	*Robinia pseudoacacia*	Limited	None	Riparian areas, canyons
Himalayan blackberry	*Rubus armeniacus*	High	None	Riparian areas, marshes, oak woodlands
Cutleaf blackberry	*Rubus laciniatus*	None	None	Riparian areas, marshes, oak woodlands

Table 1-7. Nonnative Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Cal-IPC Rating[1]	CDFA Rating[2]	Habitat
Common sheep sorrel	*Rumex acetosella*	Moderate	None	Grassland, disturbed areas
Curly dock	*Rumex crispus*	Limited	None	Grassland, vernal pools, meadows, riparian
Bouncingbet	*Saponaria officinalis*	Limited	None	Oak woodland, streambed
Tansy ragwort	*Senecio jacobaea*	Limited	B	Grassland, riparian
Rattlebox	*Sesbania punicea*	High	None	Riparian
Johnsongrass	*Sorghum halepense*	None	C	Disturbed sites, moist places
Spanish broom	*Spartium junceum*	High	None	Coastal scrub, grassland, wetlands, oak woodland, forests
Spreading hedgeparsley	*Torilis arvensis*	Moderate	None	Grassland, woodland, disturbed areas
Puncturevine	*Tribulus terrestris*	None	C	Dry, disturbed areas
Rose clover	*Trifolium hirtum*	Limited	None	Grassland, woodland
Common mullein	*Verbascum thapsus*	Limited	None	Meadows, riparian, sagebrush, pinyon-juniper woodland
Periwinkle	*Vinca major/ Vinca minor*	Moderate	None	Riparian, oak woodlands, coastal scrub

Notes:

[1] Cal-IPC Inventory Categories

High Severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Widely distributed ecologically.

Moderate Substantial and apparent ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal, although generally dependent on ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic (Cal-IPC 2013).

[2] CDFA Pest Ratings of Noxious Weed Species and Noxious Weed Seed

A – Eradication, containment, rejection, or other holding action at the state-county level.

B – Intensive control or eradication, where feasible, at the county level.

C – Control or eradication as local conditions warrant, at the county level.

Q – Rating as "A" is pending at the state or county level.

Key:

Cal-IPC = California Invasive Plant Council

CDFA = California Department of Food and Agriculture

Upper Sacramento River (Shasta Dam to Red Bluff) and Lower Sacramento River and Delta A number of nonnative species have been introduced and become abundant in the riparian areas and marshes (fresh emergent wetlands) of the Sacramento Valley and Delta (Hunter et al. 2003). Several of these invasive nonnatives, including red sesbania (*Sesbania punicea*), Himalayan blackberry (*Rubus discolor*), giant reed (*Arundo donax*), and perennial pepperweed (*Lepidium latifolium*), form dense, monotypic stands that preclude the establishment of native species (Bossard, Randall, and Hoshovsky

2000). In general, these species displace native plants, reduce biodiversity, alter river flows, and reduce wildlife habitat values. Table 1-8 lists the most problematic of those species in Sacramento Valley and Delta riparian areas and marshes – invasive species rated by Cal-IPC; many of these species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure (Cal-IPC 2006).

Table 1-8. Cal-IPC High-Rated Invasive Plants of Sacramento Valley and Delta Riparian and Marsh Habitats

Scientific Name **Common Name**	**Cal-IPC Rating**	**CDFA Rating**	**Primary Riparian/ Marsh Habitat(s)**	**Plant Type**
Ailanthus altissima Tree-of-heaven, Chinese sumac	M	C	Marsh, riparian forest/woodland/scrub	Tree
Arundo donax Giant reed	H	B	Riparian forest/scrub	Perennial grass
Bromus diandrus Ripgut brome, great brome	M	–	Riparian scrub	Annual grass
Bromus madritensis ssp. *rubens* Red brome, foxtail chess	H	–	Riparian woodland/scrub	Annual grass
Centaurea melitensis Malta starthistle, tocalote	M	C	Riparian scrub	Annual herb
Centaurea solstitialis Yellow starthistle	H	C	Riparian scrub	Annual herb
Cirsium vulgare Bull thistle	M	C	Marsh	Perennial herb
Conium maculatum Poison hemlock	M	–	Riparian forest	Perennial herb
Cortaderia selloana, Cortaderia jubata Pampasgrass, white pampasgrass, jubatagrass	H	B	Riparian scrub	Perennial grass
Delairea odorata Cape-ivy, German ivy	H	–	Riparian forest	Perennial vine
Dipsacus fullonum Common teasel, wild teasel	M	–	Bog and fen, riparian scrub, marsh	Perennial herb
Egeria densa Brazilian waterweed, egeria	H	C	Lakes, ponds, reservoirs	Perennial aquatic herb
Eucalyptus globules Bluegum, Tasmanian bluegum	M	–	Marsh, riparian forest/woodland	Tree
Ficus carica Edible fig	M	–	Riparian forest, marsh	Shrub/tree
Foeniculum vulgare fennel	H	–	Riparian scrub/woodland	Perennial herb
Geranium dissectum Cutleaf geranium	L	–	Riparian woodland	Annual herb
Hedera helix, Hedera canariensis English ivy and Algerian ivy	H	–	Riparian forest, marsh	Perennial vine/shrub
Hypochaeris glabra Smooth cat's-ear	L	–	Riparian woodland	Annual herb

Table 1-8. Cal-IPC High-Rated Invasive Plants of Sacramento Valley and Delta Riparian and Marsh Habitats (contd.)

Scientific Name **Common Name**	**Cal-IPC Rating**	**CDFA Rating**	**Primary Riparian/ Marsh Habitat(s)**	**Plant Type**
Hypochaeris radicata Common cat's ear, rough cat's-ear	M	–	Riparian forest/woodland/scrub	Annual herb
Lepidium latifolium Perennial pepperweed, tall whitetop	H	B	Tidal and nontidal marsh, riparian scrub	Perennial herb
Lolium multiforum, Festuca perennis Italian ryegrass	M	–	Riparian scrub	Annual/biennial grass
Ludwigia peploides Creeping waterprimrose, California waterprimrose	H	–	Rivers, streams, canals	Perennial aquatic herb
Lytrum hyssopifolium Hyssop loosestrife, grass poly	L	–	Marsh	Perennial herb
Lythrum salicaria Purple loosestrife	H	B	Tidal and nontidal marsh	Perennial herb
Mentha pulegium Pennyroyal, European pennyroyal	M	–	Marsh, bog and fen, riparian forest	Perennial herb
Myoporum laetum Ngaio tree, false sandalwood	M	–	Marsh	Shrub/tree
Myriophyllum spicatum Spike watermilfoil	H	C	Lakes, ponds, reservoirs	Perennial aquatic herb
Potamogeton crispus Curly-leaved pondweed, curled pondweed	M	–	Lakes, ponds, reservoirs, rivers, streams, canals	Perennial aquatic herb
Pyracantha angustifolia, P. crenulata, P. coccinea Narrowleaf firethorn, scarlet firethorn	L	–	Riparian woodland	Shrub
Ranunculus repens Creeping buttercup	L	–	Riparian forest/woodland	Perennial herb
Rubus armeniacus (= R. discolor) Himalayan blackberry	H	–	Riparian woodland/forest/scrub, nontidal marsh	Shrub
Rumex acetosella Sheep sorrel	M	–	Riparian scrub	Perennial herb
Rumex crispus Curly dock	L	–	Bog and fen, riparian forest/woodland	Perennial herb
Saponaria officinalis Bouncing-bet, bouncing betty	L	–	Riparian woodland	Perennial herb
Sesbania punicea Red sesbania, scarlet wisteria	H, A	B	Riparian woodland, marsh	Tree
Tamarix chinensis, T. gallica, T. parviflora, T. ramosissima Chinese tamarisk, French tamarisk, small flower tamarisk, salt cedar	H	B	Riparian forest/woodland, marsh	Tree, shrub
Torilis arvensis Hedgeparsley, spreading hedgeparsley	M	–	Riparian woodland	Annual herb
Verbascum thapsus Common mullein, wooly mullein	L	–	Riparian scrub	Perennial herb

Table 1-8. Cal-IPC High-Rated Invasive Plants of Sacramento Valley and Delta Riparian and Marsh Habitats (contd.)

Source: Cal-IPC 2006

Notes:

Cal-IPC Inventory Ratings:

A = Alert – Plant species with the potential to spread explosively; infestations currently small and localized

H = High – species that have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure

M = Moderate –species that have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure

L = Limited –species that are invasive but their impacts are minor on a statewide level or there was not enough information to justify a higher score

CDFA Weed Ratings:

B = known to be of economic or environmental detriment, and of limited distribution, if present in California

C = known to be of economic or environmental detriment, and usually widespread, if present in California

Key:

Cal-IPC = California Invasive Plant Council

CDFA = California Department of Food and Agriculture

Waters of the United States, Including Wetlands, in Shasta Lake and Vicinity

Reclamation delineated wetlands and other waters of the United States under Federal jurisdiction (jurisdictional waters) in the impoundment area between 2004 and 2010. Between 2009 and 2013, jurisdictional waters in the relocation areas were delineated on all public lands and on private lands where access was granted.. These data will be provided in a wetland delineation report prepared for submittal to the USACE. The wetland delineation report is in preparation and has not been verified by the USACE. All information regarding jurisdictional waters is preliminary.

Jurisdictional waters occur in the impoundment and relocation areas as wetlands and other waters. For wetlands, the impoundment area is defined as the area between 1,070 and 1,090 msl surrounding Shasta Lake. For other waters, the impoundment area includes the lacustrine waters associated with Shasta Lake below 1,070 msl. Wetlands include fresh emergent/riparian wetland, intermittent swale, riparian wetland, seasonal wetland, seep/spring wetland, and vegetated ditch. Other waters include ephemeral, intermittent, and perennial streams, roadside ditches, seep/spring waters, and lacustrine. Because some construction activities associated with the impoundment and relocation areas extend into Shasta Lake below the existing full pool elevation, the surface area of the lake is included in the delineation results. Approximately 46 acres of wetlands and 30,000 acres of other waters occur in the impoundment and relocation areas. Total jurisdictional waters in the impoundment and relocation areas, excluding Shasta Lake at full pool, include approximately 46 acres of wetlands and 103 acres of other waters.

Jurisdictional waters occur in the potential Sacramento River downstream restoration areas as wetlands and other waters. Wetlands include fresh emergent wetlands, pond, riparian wetlands, and riparian/fresh emergent wetland complex. Other waters include ephemeral, intermittent, and perennial streams.

Approximately 67 acres of wetlands and 100 acres of other waters occur in the potential Sacramento River downstream restoration areas.

The delineation was conducted in accordance with the routine on-site method identified in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (USACE 2006). Each on-site wetland determination was based on field observations of soil, vegetation, and hydrologic characteristics. Delineation of "other waters" was based on the presence of an ordinary high-water mark (OHWM) and whether the feature is tributary to waters of the United States. Data points were characterized and documented for 10 percent of all wetland features delineated. In each relocation area, at least one pair of data points was recorded for each wetland feature type. Soil pits were dug to a depth sufficient to document the presence or confirm the absence of hydric soil or hydrology indicators. The indicator status of wetland plants was determined using the National List of Plant Species That Occur in Wetlands: California Region 0 (Reed 1988). Positive indicators of hydric soils were observed in the field in accordance with the criteria outlined in Field Indicators of Hydric Soils in the United States (NRCS 2006). The hydric status of each soil map unit located in the Shasta Lake and vicinity portion of the primary study area was reviewed using the Web Soil Survey (Soil Survey Staff 2010). Indicators of depth and duration of soil saturation, ponding, and drainage patterns and the OHWM were observed in the field. The boundaries of each wetland feature and the three-parameter data points were mapped using rectified color aerial photography and/or a Trimble Pathfinder Pro XH Global Positioning System capable of sub-foot accuracy.

Main Body

The wetland delineation of the impoundment area along the Main Body was conducted from January to April 2010. Jurisdictional waters include seep/spring, riparian, and vegetated ditch wetlands and ephemeral stream, intermittent stream, perennial stream, seep/spring, and roadside ditch waters. Total acres of jurisdictional waters occurring in the Main Body are summarized in Table 1-9.

Big Backbone Arm

The wetland delineation along the Big Backbone Arm was conducted during November 2006. Jurisdictional waters included seep/spring and riparian wetlands and ephemeral stream, intermittent stream, and perennial stream waters. Total acres of jurisdictional waters occurring in the Big Backbone Arm are summarized in Table 1-9.

Sacramento Arm

The wetland delineation along the Sacramento Arm was conducted from September through early December 2010 and during March, April, and June 2010. Jurisdictional waters include seep/spring, riparian, seasonal, and riparian/fresh emergent wetlands and ephemeral stream, intermittent stream,

perennial stream, seep/spring, and roadside ditch waters. Total acres of jurisdictional waters occurring in the Sacramento Arm are summarized in Table 1-9.

Table 1-9. Jurisdictional Waters in the Impoundment Area

Jurisdictional Water Type	Impoundment Area						
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm	Total
Wetlands							
Fresh emergent/ riparian wetland	0.00	0.00	5.32	0.00	0.00	0.00	5.32
Intermittent swale	0.00	0.00	0.00	0.00	0.00	0.04	0.04
Riparian wetland	1.09	1.73	7.05	8.34	1.49	0.77	20.47
Seasonal wetland	0.00	0.00	0.42	0.00	0.14	0.02	0.58
Seep/spring wetland	0.77	0.23	0.80	0.41	0.16	0.47	2.84
Vegetated ditch	0.13	0.00	0.00	0.02	0.00	0.00	0.15
Total wetlands	1.99	1.96	13.59	8.77	1.79	1.30	29.40
Other Waters of the United States							
Ephemeral stream	0.28	0.01	0.62	0.28	0.13	0.12	1.44
Intermittent stream	1.42	0.24	2.42	0.91	0.92	2.58	8.49
Perennial stream	1.55	3.00	9.78	20.27	2.39	1.57	38.56
Roadside ditch	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Seep/spring other waters	0.03	0.00	0.001	0.01	0.0001	0.00	0.04
Lacustrine	10,196.88	1,014.12	7,225.14	5,032.68	2,081.60	4,372.80	29,923.22
Total other waters	10,200.16	1,017.37	7,237.97	5,054.15	2,085.04	4,377.07	29,971.76
Total waters of the United States	10,202.15	1,019.33	7,251.56	5,062.92	2,086.83	4,378.37	30,001.16

Note:
* Acreage values are presented in acres and are approximate.

McCloud Arm

The wetland delineation along the McCloud Arm was conducted during December 2009 and in April, June, and November 2010. Jurisdictional waters include seep/spring, riparian, and vegetated ditch wetlands and ephemeral stream, intermittent stream, perennial stream, and seep/spring waters. Total acres of jurisdictional waters occurring in the McCloud Arm are summarized in Table 1-9.

Squaw Creek Arm

The wetland delineation along the Squaw Creek Arm was conducted from late August through September 2004. Jurisdictional waters include seep/spring, riparian, and seasonal wet meadow wetlands and ephemeral stream, intermittent stream, perennial stream, and seep/spring waters. Total jurisdictional acres of waters occurring in the Squaw Creek Arm are summarized in Table 1-9.

Pit Arm

The wetland delineation along the Pit Arm was conducted from late November 2006 through April 2007. Jurisdictional waters include riparian, seep/spring, seasonal, and intermittent swale wetlands and ephemeral stream, intermittent stream, and perennial stream waters. Total acres of jurisdictional waters occurring in the Pit Arm are summarized in Table 1-9.

Relocation Areas

Wetland delineations at the relocation areas were conducted between January 2010 and March 2013. Jurisdictional waters include wetlands and other waters. Wetlands include fresh emergent, intermittent swale, riparian, seep/spring, and seasonal wetlands and vegetated ditches. Other waters present include ephemeral, intermittent, and perennial streams; seep/spring; and roadside ditches. Total acres of jurisdictional waters occurring in the relocation areas are summarized in Table 1-10.

Potential Sacramento River Downstream Restoration Areas

Wetland delineations at the potential Sacramento River downstream restoration areas were conducted between March and November 2013. Jurisdictional waters occur in the potential Sacramento River downstream restoration areas as wetlands and other waters. Wetlands include fresh emergent wetlands, pond, riparian wetlands, and riparian/fresh emergent wetland complex. Other waters include ephemeral, intermittent, and perennial streams. Approximately 67 acres of wetlands and 100 acres of other waters occur in the potential Sacramento River downstream restoration areas. Total acres of jurisdictional waters occurring in the relocation areas are summarized in Table 1-11.

Characterization of Wetland Features

Jurisdictional wetlands occurring in the Shasta Lake and vicinity portion of the primary study area include fresh emergent/riparian wetland, intermittent swale, riparian wetland, seasonal wetland, seep/spring wetland, and vegetated ditch.

Fresh emergent/riparian wetlands are uncommon in the Shasta Lake and vicinity portion of the primary study area, occurring at only one location along the Sacramento Arm. This location consists of a former USFS recreation site developed at the confluence of Salt Creek and Shasta Lake, immediately east of I-5. This former recreation site, coupled with an undercrossing at I-5, has partially impounded the flows of Salt Creek, resulting in the development of an area characterized by a complex of fresh emergent and riparian wetland vegetation.

Table 1-10. Jurisdictional Waters in the Relocation Areas

Jurisdictional Water Type	Relocation Areas						
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm	Total
Wetlands							
Fresh emergent wetland	0.00	N/A	0.07	0.01	0.00	0.00	0.07
Fresh emergent /riparian wetland	0.00	N/A	0.40	0.00	0.00	0.00	0.40
Intermittent swale	0.00	N/A	0.78	0.00	0.00	0.001	0.78
Riparian wetland	0.15	N/A	3.55	0.39	0.17	0.13	4.39
Seasonal wetland	0.01	N/A	11.30	0.00	0.02	0.00	11.33
Seep/spring wetland	0.03	N/A	0.06	0.12	0.05	0.16	0.42
Vegetated ditch	0.06	N/A	0.002	0.01	0.002	0.00	0.07
Total wetlands	0.25	N/A	16.16	0.52	0.24	0.29	17.46
Other Waters of the United States							
Ephemeral stream	0.24	N/A	1.16	0.85	0.03	0.09	2.37
Intermittent stream	0.78	N/A	2.96	1.25	0.20	0.33	5.52
Perennial stream	0.00	N/A	0.28	0.54	0.24	0.002	1.06
Non-vegetated ditch	0.04	N/A	0.12	0.00	0.00	0.00	0.16
Roadside ditch	0.00	N/A	0.003	0.00	0.00	0.00	0.003
Seep/spring other waters	0.00	N/A	0.00	0.00	0.03	0.00	0.03
Total other waters	1.02	N/A	4.40	2.64	0.50	0.42	8.98
Total waters of the United States	1.31	N/A	20.68	3.16	0.74	0.71	26.60

Note:
*Acreage values are presents in acres and are approximate.

Table 1-11. Jurisdictional Waters in the Potential Sacramento River Downstream Restoration Areas

Jurisdictional Water Type	Potential Sacramento River Downstream Restoration Areas					
	Henderson Open Space	Tobiasson Island	Shea Island Complex	Kapusta Island	Anderson River Park	Reading Island
Wetlands						
Fresh emergent wetland	1.16	0.68	1.07	0.15	9.19	5.14
Pond	3.51	N/A	N/A	N/A	N/A	N/A
Riparian wetland	1.88	1.58	4.64	10.23	12.09	15.24
Riparian/fresh emergent wetland complex	N/A	N/A	0.05	N/A	3.62	N/A
Total Wetlands	6.55	2.26	5.76	10.38	24.9	17.38
Other Waters of the United States						
Ephemeral stream	0.01	N/A	N/A	N/A	N/A	N/A
Intermittent stream	N/A	N/A	N/A	N/A	0.02	0.02
Perennial stream	1.34	3.12	10.93	8.83	0.68	4.59
Total Other Waters	1.35	3.12	10.93	8.83	0.70	4.61
Total Waters of the U.S.	7.89	5.38	16.69	19.21	25.59	24.99

Note:
*Acreage values are approximate.

Dominant overstory species include Goodding's black willow (OBL[1]), arroyo willow (FACW), red willow (assume FACW), and shining willow (OBL). Fresh emergent species include pennyroyal (*Mentha pulegium*–OBL), willow dock (*Rumex salicifolius*–OBL), and broadleaf cattail (*Typha latifolia*). Wetland hydrology and soils criteria are met through evidence of frequent flooding, including sediment deposits, watermarks, drift lines, and drainage patterns.

Intermittent swales occur along the Big Backbone and Pit arms. These features are characterized as linear, or somewhat linear, drainages that lack evidence of scour and are dominated by wetland plant species resulting from seasonally saturated soils. Typical species occurring in these features include seep monkey flower (*Mimulus guttatus*–OBL), spiny fruit buttercup (*Ranunculus muricatus*–FACW), slender rush (*Juncus tenuis*–FACW), and centaury (*Centaurium venustum*–NL). Wetland hydrology and soils criteria are met through evidence of long-duration saturation, including saturation in the upper 12 inches, aquic moisture regime, and drainage patterns.

[1] OBL = Obligate Wetland Plants—Estimated probability of occurring in wetland >99 percent.
FACW = Facultative Wetland Plants—Estimated probability of occurring in wetland >67 percent to 99 percent.
FAC = Facultative Plants—Estimated probability of occurring in wetland 33 percent to 67 percent.
FACU = Facultative Upland Plants—Estimated probability of occurring in wetland 1 percent to <33 percent.
UPL = Obligate Upland Plants—Estimated probability of occurring in wetland <1 percent.
NI = No Indicator—Plants for which insufficient information was available to determine an indicator status.
NL = Not listed—Plants not listed in Reed 1988.

Riparian wetlands are common throughout the Shasta Lake and vicinity portion of the primary study area and generally occur as "stringers," or narrow features found immediately adjacent to intermittent or perennial streams. Typical species found in riparian wetlands include arroyo willow (FACW), Goodding's black willow (OBL), white alder (FACW), Oregon ash (FACW), Indian rhubarb (*Darmera peltata*-NL), mugwort (*Artemisia douglasiana*-FACW), California wild grape (FACW), and Himalayan blackberry (FACW). Wetland hydrology and soils criteria are met through evidence of frequent flooding, including sediment deposits, watermarks, drift lines, and drainage patterns.

Seasonal wetlands occur along the Sacramento, Squaw Creek, and Pit arms. These features are dominated by herbaceous vegetation and are typically adjacent to other wetland features or are depressions that frequently pond. Typical plant species found in these features include slender rush (FACW), sword leaf rush (*Juncus ensifolius*–FACW), seep monkey flower (OBL), yampah (*Perideridia californica*–FACW), annual checker bloom (*Sidalcea calycosa*–OBL), little quaking grass (*Briza minor*–FACW), California oatgrass (*Danthonia californica*–FACW), and spiny fruit buttercup (FACW). Wetland hydrology and soils criteria are met through evidence of long-duration saturation, including saturation in the upper 12 inches, an aquic moisture regime, and drainage patterns.

Seep/spring wetlands are found throughout the Shasta Lake and vicinity portion of the primary study area. These features form at locations where groundwater flows meet the ground surface. Hydrophytic vegetation typically colonizes the area where water is provided by the seep/spring. Typical species include white alder (FACW), chain fern (*Woodwardia fimbriata*–FACW), goat's beard (*Aruncus dioicus*–FACW), Indian rhubarb (NL), seep monkey flower (*Mimulus guttatus*–OBL), horsetail (*Equisetum arvense* –FAC), red stem dogwood (*Cornus stolonifera*–FACW), spicebush (NL), Himalayan blackberry (FACW), and western azalea (FAC). The wetland hydrology and soils criteria are met through evidence of long-duration saturation, including inundation, saturation in the upper 12 inches, watermarks, and drainage patterns.

Vegetated ditches are uncommon in the Shasta Lake and vicinity portion of the primary study area but do occur along the Main Body, along the McCloud Arm, and in several relocation areas. These features consist of ditches that have been excavated to drain adjacent uplands, parking areas, roads, or railways. These features are generally low gradient and provide hydrologic conditions suitable for colonization by hydrophytic vegetation. Dominant plant species include nutsedge (*Cyperus eragrostis*–FACW), seep monkey flower (OBL), broadleaf cattail, and rush (*Juncus* sp.–assume FACW). Wetland hydrology and soil criteria were met by long-duration inundation and long-duration saturation.

Jurisdictional waters (i.e., other waters) occurring in the Shasta Lake and vicinity portion of the primary study area include ephemeral, intermittent, and perennial streams, roadside ditches, and seep/spring waters.

Ephemeral streams are common throughout the Shasta Lake and vicinity portion of the primary study area. These features are linear drainages characterized by indicators of scour and deposition, minor drift lines, and sediment deposits, but lack a groundwater component that contributes to their flow. The wetland hydrology is provided by sheet flow; these features typically cease flowing soon after storm or runoff events. Ephemeral streams are characterized by poorly defined wetland hydrology indicators and are typically found in headwater areas with relatively small drainage areas.

Intermittent streams are the most common jurisdictional feature in the Shasta Lake and vicinity portion of the primary study area. Intermittent streams range from small, poorly defined tributaries to larger, well-defined streams that flow into the summer. Like ephemeral streams, intermittent streams flow seasonally, but, in addition to precipitation and sheet flow from adjacent slopes, these features have a groundwater component to their flow regime. Intermittent streams are characterized by the presence of a defined bed and bank, and scour and deposition. Other characteristics, such as algae growth or hydrophytic vegetation in or adjacent to the stream, indicate longer inundation periods. Wetland hydrology and hydric soil criteria are met through evidence of frequent flooding, including water marks, algal matting, drift lines, and sediment deposits.

Perennial streams occur throughout the Shasta Lake and vicinity portion of the primary study area. These features are characterized by perennial flow and are often bounded by riparian wetlands. Dominant substrates consist of boulders, bedrock, cobble, sand, and gravel. Wetland hydrology and hydric soil criteria are met through evidence of frequent flooding, including water marks, algal matting, drift lines, and sediment deposits.

Roadside ditches are uncommon in the Shasta Lake and vicinity portion of the primary study area, but some are found along the Sacramento Arm. These ditch features occur near roadways and railroad tracks and have been excavated solely to drain uplands. Wetland vegetation is sparse or absent. The wetland boundaries were indicated by sediment and drift deposits.

Seep/spring other waters are uncommon in the Shasta Lake and vicinity portion of the primary study area, but some are found along the Main Body, the Sacramento Arm, the McCloud Arm, and the Squaw Creek Arm. These features form at locations where groundwater flows meet the ground surface; however, the features are not dominated by hydrophytic vegetation. The wetland hydrology and soils criteria are met through evidence of long-duration saturation, including inundation, saturation in the upper 12 inches, watermarks, and drainage patterns.

Regulatory Framework

Biological resources in California are protected and/or regulated by a variety of Federal and State laws and policies. In addition, in many parts of California, there are local or regional habitat and species conservation planning efforts in which a project applicant may participate. Key regulatory and conservation planning issues applicable to the project and alternatives under consideration are discussed below.

Federal

Endangered Species Act

Pursuant to the Federal Endangered Species Act (ESA), USFWS and the National Marine Fisheries Service have authority over projects that may result in "take" of a Federally listed species. In general, ESA Section 7 prohibits persons (including private parties) from "taking" listed endangered or threatened fish and wildlife species on private property, and from "taking" listed endangered or threatened plant species in areas under Federal jurisdiction or in violation of State law (16 U.S. Code (USC) 1532, 50 Code of Federal Regulations (CFR) 17.3). Under the ESA, the definition of "take" is to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" as part of an intentional or negligent act or omission. The term "harm" includes acts that result in death or injury to wildlife. Such acts may include significant habitat modification or degradation if it results in death or injury to wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Section 7(a) of the ESA, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed for listing or is listed as endangered or threatened. Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with USFWS.

As defined in the ESA, critical habitat is a specific geographic area that is essential for the conservation of a threatened or endangered species and that may require special management and protection. It may include an area that is not currently occupied by the species but that will be needed for its recovery. Critical habitats are designated to ensure that actions authorized by Federal agencies will not destroy or adversely modify critical habitat, thereby protecting areas necessary for the conservation of the species.

Clean Water Act

The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. USACE regulates discharges of fill or dredged materials into waters of the United States under Section 404 of the CWA (33 USC 1251–1376). Waters of the United States include lakes, rivers,

streams, and their tributaries and adjacent wetlands. Wetlands are defined under Section 404 as areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support (and that do support under normal circumstances) a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3, 40 CFR 230.3). Activities resulting in a discharge of dredged or fill material that require a permit under Section 404 include, but are not limited to, placing fill or riprap, grading, mechanized land clearing, and dredging. Any activity that results in the deposit of dredged or fill material below the ordinary high-water mark of waters of the United States or within a jurisdictional wetland usually requires a Section 404 permit, even if the area is dry at the time the activity takes place. To comply with the Section 404 policy that there be no net loss of wetlands, the project cannot affect the total acreage of wetlands within the project boundary.

Section 401 Water Quality Certification

Under Section 401 of the CWA, an applicant for a Section 404 permit must obtain a certificate from the appropriate State agency stating that the intended dredging or filling activity is consistent with the State's water quality standards and criteria. In California, the authority to grant water quality certification is delegated by the State Water Resources Control Board to the nine regional water quality control boards (RWQCB).

Rivers and Harbors Act

USACE regulates the construction of structures in, over, or under; excavation of material from; or deposition of material into "navigable waters of the United States" under Section 10 of the Federal Rivers and Harbors Act (33 USC 401 et seq.). Navigable waters of the United States are defined as those waters subject to the ebb and flow of the tide shoreward to the mean high-water mark or those that are currently used, have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. A letter of permission or permit from USACE is required before any work may be completed within navigable waters. Projects are permitted under either individual or general (i.e., nationwide) permits. The specific applicability of the permit types is determined by USACE on a case-by-case basis. Based on a preliminary conversation with the USACE (San Francisco District, Eureka Field Office), the project is expected to be permitted under Nationwide Permit Number 27.

U.S. Forest Service Sensitive Species

The National Forest Management Act requires USFS to "provide for a diversity of plant and animal communities" (16 USC 1604(g)(3)(B)) as part of its multiple-use mandate. USFS must maintain "viable populations of existing native and desired nonnative species in the planning area" (36 CFR 219.19). The Sensitive Species program is designed to meet this mandate and to demonstrate USFS's commitment to maintaining biodiversity on National Forest System lands. The program is a proactive approach to conserving species to prevent a trend toward listing under the ESA and to ensure the continued existence of viable, well-distributed populations. A "Sensitive Species" is any

species of plant or animal that has been recognized by the Regional Forester to need special management to prevent the species from becoming threatened or endangered.

Shasta-Trinity National Forest Land and Resource Management Plan

The Shasta-Trinity National Forest (STNF) Land and Resource Management Plan (LRMP) contains forest goals, standards, and guidelines designed to guide the management of the STNF. The following goals, standards, and guidelines related to botanical resource issues associated with the primary study area were excerpted from the STNF LRMP (USFS 1995).

Biological Diversity

Goals (LRMP, p. 4-4)

- Integrate multiple resource management on a landscape level to provide and maintain diversity and quality of habitats that support viable populations of plants, fish, and wildlife.

Standards and Guidelines (LRMP, p. 4-14)

- **Natural Openings** – Management of natural openings will be determined at the project level consistent with desired future conditions.

- **Snags** – Over time, provide the necessary number of replacement snags to meet density requirements as prescribed for each land allocation and/or management prescription. Live, green culls and trees exhibiting decadence and/or active wildlife use are preferred.

- **Hardwood** – Apply the following standards in existing hardwood types:

  – Manage hardwood types for sustainability.

  – Conversion to conifers will only take place to meet desired future ecosystem conditions.

  – Where hardwoods occur naturally within existing conifer types on suitable timber lands, manage for a desired future condition for hardwoods as identified during ecosystem analysis consistent with management prescription standards and guidelines. Retain groups of hardwoods over single trees.

Threatened, Endangered, and Sensitive Species (Plants and Animals)

Goals (LRMP, p. 4-5)

- Monitor and protect habitat for Federally listed threatened and endangered and candidate species. Assist in recovery efforts for

threatened and endangered species. Cooperate with the State to meet objectives for state listed species.

- Manage habitat for sensitive plants and animals in a manner that will prevent any species from becoming a candidate for threatened and endangered status.

Botany (Sensitive and Endemic Plants)

Standards and Guidelines (LRMP, pp. 4-14 through 4-16)

- Map, record, and protect essential habitat for known and newly discovered sensitive and endemic plant species until conservation strategies are developed.

- Analyze the potential effects of all ground-disturbing projects on sensitive and endemic plants and their habitat. Mitigate project effects to avoid a decline in species viability at the Forest level.

- Monitor the effects of management activities on sensitive and endemic plants. If monitoring results show a decline in species viability, alter management strategy.

- Provide reports of sensitive plant populations to the CDFW annually.

- Coordinate sensitive plant inventory and protection efforts with the CDFW, the USFWS, the Nature Conservancy, CNPS, and other concerned agencies, organizations, and adjacent landowners.

- Protect type localities of sensitive and endemic plants for their scientific value.

U.S. Forest Service Survey and Manage Standards and Guidelines

The 1994 Record of Decision for Amendments to USFS and BLM Planning Documents within the Range of the Northern Spotted Owl and Standards and Guidelines for Management for Late-Successional and Old-Growth Related Species in the Range of the Northern Spotted Owl (Northwest Forest Plan (NWFP) Record of Decision (ROD)) amended or was incorporated into BLM and USFS land management plans to require certain actions for rare amphibians, mammals, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods that occupy late-successional and old-growth forests (USFS and BLM 1994). These rare species were identified in Appendix C of the NWFP ROD collectively as Survey and Manage (S&M) Species. The NWFP ROD also established protection buffers on matrix lands for certain species (i.e., protection buffer species) that were not on the 1994 S&M list and required that those buffers be managed as part of the Late Successional Reserve network. Four survey strategies were developed to guide management of S&M species: (1)

manage known sites; (2) survey before ground-disturbing activities; (3) conduct extensive surveys; and (4) conduct general regional surveys.

The NWFP ROD also established overall objectives for managing S&M species populations that were referred to as "persistence objectives." These objectives were based on the USFS viability provision in the 1982 National Forest System Land and Resource Management Planning Regulation for the National Forest Management Act of 1976. This provision is targeted toward vertebrate species, but was also applied to nonvertebrate species to the extent practicable, as described in the NWFP ROD. The provision generally states that the USFS shall manage habitat "to maintain viable populations of existing native and desired non-native vertebrate species in the planning area" (36 CFR 219.19). Although the viability standard is part of the USFS planning regulations, the protections for S&M species were also applied to BLM lands in the NWFP ROD with a goal of protecting the long-term health and sustainability of all Federal forests within the range of the northern spotted owl (NSO) and the species that inhabit them. Because of the uncertainty associated with the continued persistence of species due to natural factors, the NWFP ROD noted that compliance with the planning regulations is not subject to precise numerical interpretations and cannot be fixed at any single threshold; rather, "as in any administrative field, common sense and agency expertise must be applied" (NWFP ROD, p. 44).

In 2001, the Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (2001 S&M ROD) (USFS and BLM 2001) modified the management direction provided in the NWFP ROD for S&M and protection buffer species and amended BLM and USFS land management plans in the range of the northern spotted owl accordingly. The list of S&M species was also modified to remove 72 species in all or part of their range because new information indicated they were secure or otherwise did not meet the basic criteria for S&M. Species remaining on the list were assigned to one of six categories using the following criteria: their relative rarity, the ability to reasonably and consistently locate occupied sites during surveys before habitat disturbing activities, and the level of information known about the species or group of species. The 2001 S&M ROD also removed the direction specific to protection buffer species, excluding these species from S&M Standards and Guidelines requirements. As part of the 2001 Standards and Guidelines, objectives, criteria, and management direction were defined for each category. Specific criteria were also established to add, remove, or change species categories based on new information and as part of the annual species review processes.

In 2004 and again in 2007, the BLM and USFS issued a ROD to eliminate the S&M requirements of the 2001 S&M ROD and to provide protection for species on the S&M lists by managing them under the agencies' special-status species programs. As a result of litigation, the requirements of the 2001 S&M ROD

were reinstated. In a subsequent court-mandated settlement agreement (USFS and BLM 2011), the list of S&M species was modified. The settlement agreement also made the following modifications: (1) acknowledged existing exemption categories (2006 Pechman Exemptions); (2) updated the 2001 S&M species list; (3) established a transition period for application of the species list; and (4) established new exemption categories (2011 Exemptions). Agency decisions made after September 30, 2012, are required to use the 2011 S&M list. Some species considered in the S&M program also occur on non-federal lands. The requirements of the 1994 NWFP ROD and 2001 S&M ROD as modified under the 2011 Settlement Agreement apply only to lands managed by the BLM and USFS within the range of the northern spotted owl. Currently the BLM and USFS are implementing the 2001 S&M ROD as modified by the 2011 Settlement Agreement.

Management Guide for the Shasta and Trinity Units of the Whiskeytown-Shasta-Trinity National Recreation Area

A portion of the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA) is included in the Shasta Lake and vicinity portion of the primary study area. The 2014 NRA Management Guide for the Shasta and Trinity Units of the NRA contains management guidance intended to achieve or maintain a desired condition. This guidance takes into account opportunities, management recommendations for specific projects, and mitigation measures needed to achieve specific goals. The following guidance related to strategies for botanical and wetland resource issues associated with the Shasta Lake and vicinity portion of the primary study area were excerpted from the NRA Management Guide (USFS 2014).

- Protect known populations of threatened, endangered and sensitive plant, lichen, and fungi species and their habitats, and implement mitigation measures if necessary to maintain or enhance their continued viability. Conservation strategies for these species will be used as they are developed. Survey for special-status plants, lichens and fungi before ground-disturbing projects.

- Follow the national direction for the use of native plant materials in the revegetation, restoration, and rehabilitation of NFS lands. This includes making native plant materials the first choice in revegetation for restoration and rehabilitation of native ecosystems where timely natural regeneration of the native plant community will not occur.

- Do not authorize, fund, or carry out actions that are likely to cause or promote the introduction or spread of invasive species unless, pursuant to guidelines that it has prescribed, the USFS has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. An integrated approach for addressing

invasive plant problems will be explored since it offers the most thoroughly effective treatment of invasive plants by using a variety of treatment options to eradicate, control, or contain invasive plants where they occur. The combination of treatment methods, including manual, mechanical, biological, controlled grazing, prescribed burning, cultural, and herbicidal methods, will be tailored to fit each site-specific situation and each type of invasive plant. By proposing several methods for invasive plant control, this approach recognizes that using only one management method is unlikely to be effective in all situations.

- Dead, dying and live defective trees are an important part of a healthy, functioning forest ecosystem. They play many ecological roles in forests such as altering plant succession and providing wildlife habitat. Retention of these types of trees is necessary to meet the needs of snag dependent species and ecosystem health.

U.S. Forest Service Noxious Weed Management Policy 20900

USFS Manual Policy 20900, Noxious Weed Management (USFS 2011), includes the following policy for the management of aquatic and terrestrial invasive species (including vertebrates, invertebrates, plants, and pathogens), based on an integrated pest management approach, throughout the National Forest System:

1. Initiate, coordinate, and sustain actions to prevent, control, and eliminate priority infestations of invasive species in aquatic and terrestrial areas of the National Forest System using an integrated pest management approach, and collaborate with stakeholders to implement cooperative invasive species management activities in accordance with law and policy.

2. When applicable, invasive species management actions and standards should be incorporated into resource management plans at the forest level, and in programmatic environmental planning and assessment documents at the regional or national levels.

3. Determine the vectors, environmental factors, and pathways that favor the establishment and spread of invasive species in aquatic and terrestrial areas the National Forest System, and design management practices to reduce or mitigate the risk for introduction or spread of invasive species in those areas.

4. Determine the risk of introducing, establishing, or spreading invasive species associated with any proposed action, as an integral component of project planning and analysis, and where necessary provide for alternatives or mitigation measures to reduce or eliminate that risk before project approval.

5. Ensure that all Forest Service management activities are designed to minimize or eliminate the possibility of establishment or spread of invasive species on the National Forest System, or to adjacent areas. Integrate visitor use strategies with invasive species management activities on aquatic and terrestrial areas of the National Forest System. At no time are invasive species to be promoted or used in site restoration or re-vegetation work, watershed rehabilitation projects, planted for bio-fuels production, or other management activities on national forests and grasslands.

6. Use contract and permit clauses to require that the activities of contractors and permittees are conducted to prevent and control the introduction, establishment, and spread of aquatic and terrestrial invasive species. For example, where determined to be appropriate, use agreement clauses to require contractors or permittees to meet Forest Service-approved vehicle and equipment cleaning requirements/standards before using the vehicle or equipment in the National Forest System.

7. Make every effort to prevent the accidental spread of invasive species carried by contaminated vehicles, equipment, personnel, or materials (including plants, wood, plant/wood products, water, soil, rock, sand, gravel, mulch, seeds, grain, hay, straw, or other materials).

    a) Establish and implement standards and requirements for vehicle and equipment cleaning to prevent the accidental spread of aquatic and terrestrial invasive species on the National Forest System or to adjacent areas.

    b) b. Make every effort to ensure that all materials used on the National Forest System are free of invasive species and/or noxious weeds (including free of reproductive/propagative material such as seeds, roots, stems, flowers, leaves, larva, eggs, veligers, and so forth).

8. Where States have legislative authority to certify materials as weed-free (or invasive-free) and have an active State program to make those State-certified materials available to the public, forest officers shall develop rules restricting the possession, use, and transport of those materials unless proof exists that they have been State-certified as weed-free (or invasive-free), as provided in 36 CFR 261 and Departmental Regulation 1512-1.

9. Monitor all management activities for potential spread or establishment of invasive species in aquatic and terrestrial areas of the National Forest System.

10. Manage invasive species in aquatic and terrestrial areas of the National Forest System using an integrated pest management approach to achieve the goals and objectives identified in Forest Land and Resource Management plans, and other Forest Service planning documents, and other plans developed in cooperation with external partners for the management of natural or cultural resources.

11. Integrate invasive species management funding broadly across a variety of National Forest System programs, while associating the funding with the specific aquatic or terrestrial invasive species that is being prioritized for management, as well as the purpose and need of the project or program objective.

12. Develop and use site-based and species-based risk assessments to prioritize the management of invasive species infestations in aquatic and terrestrial areas of the National Forest System. Where appropriate, use a structured decision making process and adaptive management or similar strategies to help identify and prioritize invasive species management approaches and actions.

13. Comply with the Forest Service performance accountability system requirements for invasive species management to ensure efficient use of limited resources at all levels of the Agency and to provide information for adapting management actions to meet changing program needs and priorities. When appropriate, use a structured decision making process to address invasive species management problems in changing conditions, uncertainty, or when information is limited.

14. Establish and maintain a national record keeping database system for the collection and reporting of information related to invasive species infestations and management activities, including invasive species management performance, associated with the National Forest System. Require all information associated with the National Forest System invasive species management (including inventories, surveys, and treatments) to be collected, recorded, and reported consistent with national program protocols, rules, and standards.

15. Where appropriate, integrate invasive species management activities, such as inventory, survey, treatment, prevention, monitoring, and so forth, into the National Forest System management programs. Use inventory and treatment information to help set priorities and select integrated management actions to address new or expanding invasive species infestations in aquatic and terrestrial areas of the National Forest System.

16. Assist and promote cooperative efforts with internal and external partners, including private, State, tribal, and local entities, research organizations, and international groups to collaboratively address priority invasive species issues affecting the National Forest System.

17. Coordinate as needed with Forest Service Research and Development and State and Private Forestry programs, other agencies included under the National Invasive Species Council, and external partners to identify priority/high-risk invasive species that threaten aquatic and terrestrial areas of the National Forest System. Encourage applied research to develop techniques and technology to reduce invasive species impacts to the National Forest System.

18. As appropriate, collaborate and coordinate with adjacent landowners and other stakeholders to improve invasive species management effectiveness across the landscape. Encourage cooperative partnerships to address invasive species threats within a broad geographical area.

U.S. Bureau of Land Management Resource Management Plan

BLM manages a number of public lands in the primary study area and vicinity generally located west of Shasta Dam. These areas are included in the Shasta Management Area and specifically include the Interlakes Special Recreation Management Area. These areas fall under the Northern California BLM district and the resource management plan of the Redding BLM field office. The purpose of BLM's resource management plans is to provide overall direction for managing and allocating public resources in the planning area. BLM is responsible for administering the following strategies related to resource issues common to the portion of the Redding District lands located near the primary study area and vicinity (BLM 1992, 1993):

- Provide a regional opportunity for motorized recreation with a focus within the Chappie-Shasta Off-Highway Vehicle Area.

- Enhance nonmotorized recreation opportunities within the area via a greenway connecting Redding to Shasta Dam along the Sacramento River.

- Maintain or improve the long-term sustained yield of forest products available from commercial forestlands.

- Improve the long-term condition and protection of deer winter range habitat.

- Maintain special-status species habitat.

- Maintain the existing scenic quality of the areas.

- Maintain opportunities to explore and develop freely available minerals on public lands.

Executive Order 11990: Protection of Wetlands

Executive Order 11990 established the protection of wetlands and riparian systems as the official policy of the Federal government. It requires all Federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 11312: Invasive Species

Executive Order 11312 directs all Federal agencies to prevent and control introductions of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health impacts. Executive Order 11312 established a national Invasive Species Council made up of Federal agencies and departments and a supporting Invasive Species Advisory Committee composed of State, local, and private entities. The Invasive Species Council and Advisory Committee oversee and facilitate implementation of the Executive Order, including preparation of a National Invasive Species Management Plan.

State

California Endangered Species Act

Under the California Endangered Species Act (CESA), CDFW has the responsibility for maintaining a list of endangered and threatened species (California Fish and Game Code, Section 2070). CDFW also maintains a list of "candidate species," which are species for which CDFW has issued a formal notice that they are under review for addition to the list of endangered or threatened species. In addition, CDFW maintains lists of "species of special concern," which serve as species "watch lists." Pursuant to the requirements of CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any State-listed endangered or threatened species may be present in the project study area and, if so, whether the proposed project would have a potentially significant impact on any of these species. In addition, CDFW encourages informal consultation on any proposed project that may affect a species that is a candidate for State listing.

Project-related impacts on species listed as endangered or threatened under the CESA would be considered significant. State-listed species are fully protected under the mandates of the CESA. "Take" of protected species incidental to otherwise lawful management activities may be authorized under Section 2081 of the California Fish and Game Code. Under the CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the definition does not include "harm" or "harass," as the Federal act does. As a result, the threshold for take under the CESA is higher than that under the ESA.

Authorization from CDFW would be in the form of an incidental take permit or as a consistency determination (Section 2080.1(a) of the Fish and Game Code). Section 2080.1(a) of the Fish and Game Code authorizes CDFW to accept a Federal biological opinion as the take authorization for a State-listed species when a species is listed under both the ESA and the CESA.

California Native Plant Protection Act

The Native Plant Protection Act (California Fish and Game Code Sections 1900–1913) prohibits the taking, possessing, or sale within the state of any plants with a State designation of rare, threatened, or endangered, as defined by CDFW. The act's definition of "endangered" and "rare" closely parallel the CESA definitions of "endangered" and "threatened" plant species. Project impacts on these species are not considered significant unless the species are known to have a high potential to occur within the area of disturbance associated with construction of the project.

Section 1602 of the California Fish and Game Code – Streambed Alteration

Diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by CDFW, pursuant to Section 1602 of the California Fish and Game Code. The regulatory definition of stream is a body of water that flows at least periodically or intermittently through a bed or channel that has banks and supports wildlife, fish, or other aquatic life. This includes watercourses that have a surface or subsurface flow that supports or has supported riparian vegetation. CDFW's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife. A CDFW streambed alteration agreement must be obtained for a project that would result in an impact on a river, stream, or lake.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Act requires that each of the nine RWQCBs prepare and periodically update basin plans for water quality control. Each basin plan sets forth water quality standards for surface water and groundwater and actions to control nonpoint and point sources of pollution to achieve and maintain these standards. Basin plans offer an opportunity to protect wetlands through the establishment of water quality objectives. The RWQCB's jurisdiction includes Federally protected waters as well as areas that meet the definition of "waters of the State." "Waters of the State" is defined as any surface water or groundwater, including saline waters, within the boundaries of the state. The RWQCB has the discretion to take jurisdiction over areas not Federally protected under Section 401 provided they meet the definition of waters of the State. Mitigation requiring no net loss of wetlands functions and values of waters of the State is typically required by the RWQCB.

California Department of Fish and Wildlife Species Designations

CDFW maintains an informal list of species called "species of special concern." These are broadly defined as wildlife species that are of concern to CDFW because of population declines and restricted distributions, and/or because they are associated with habitats that are declining in California. These species are inventoried in the CNDDB regardless of their legal status. Impacts on species of special concern may be considered significant.

California Department of Fish and Wildlife /California Native Plant Society California Rare Plant Ranking System

CNPS is a statewide nonprofit organization that seeks to increase understanding of California's native flora and to preserve this rich resource for future generations. CDFW and CNPS assign rare plant ranks through the collaborative efforts of the Rare Plant Status Review Group composed of over 300 botanical experts from government, academia, nongovernment organizations, and the private sector and managed jointly by CDFW and CNPS. California native plants meeting the rarity or endangerment criteria are assigned a CRPR. These plants were formerly referred to as CNPS listed species; however, in March 2010, CDFW adopted the name CRPR for the rarity and endangerment categories to eliminate the false impression that these assignments are the exclusive work of CNPS and that CNPS has had undue influence over the regulatory process. CRPR 1 and 2 species generally qualify as endangered, rare, or threatened within the definition of State CEQA Guidelines (California Code of Regulations Section 15380). In general, CRPR 3 and 4 species do not meet the definition of endangered, rare, or threatened pursuant to CEQA Section 15380; however, these species may be evaluated by the lead agency on a case-by-case basis to determine significance criteria under CEQA.

California Department of Fish and Wildlife Special-Status Natural Communities Designations

CDFW maintains a list of plant communities that are native to California. On that list, CDFW identifies special-status natural communities (e.g., sensitive natural communities), which it defines as communities that are of limited distribution statewide or within a county or region, and are often vulnerable to the environmental effects of projects. Occurrences of special-status natural communities are included in the CNDDB; however, no new occurrences have been added to the CNDDB since the mid-1990s, when funding for tracking natural communities was reduced. These correspond to communities with State rarity ranks of S1–S3: S1 = critically imperiled, S2 = imperiled, and S3 = vulnerable. These communities may or may not contain special-status species or their habitat. Because of their limited distribution in California, most types of wetlands and riparian communities are considered special-status natural communities. Impacts on special-status natural communities may be considered significant.

Local

Shasta, Tehama, Glenn, Sutter, Sacramento, and Yolo counties and the cities of Redding, Colusa, and Sacramento have established codes and policies that address protection of natural resources, including vegetation, sensitive species, and trees, and are applicable to the project.

Shasta County's general plan emphasizes that the maintenance and enhancement of quality fish and wildlife habitat is critical to the recreation and tourism industry, and acknowledges that any adverse and prolonged decline of these resources could result in negative impacts on an otherwise vibrant industry. The general plan identifies efforts to protect and restore these habitats to sustain the long-term viability of the tourism and recreation industry (Shasta County 2004).

The City of Redding's general plan strives to strike a balance between development and conservation by implementing several measures such as creek-corridor protection, sensitive hillside development, habitat protection, and protection of prominent ridge lines that provide a backdrop to the city (City of Redding 2000).

Tehama County's general plan update provides an overarching guide to future development and establishes goals, policies, and implementation measures designed to address potential changes in county land use and development. The general plan identifies the importance of retaining agriculture as one of the primary uses of land in Tehama County.

Glenn County's general plan provides a comprehensive plan for growth and development in Glenn County for the next 20 years (2007–2027). This plan recognizes that public lands purchased for wildlife preservation generate economic activity as scientists and members of the public come to view and study remnant ecosystems (Glenn County 1993).

The City of Colusa's general plan seeks to promote its natural resources through increased awareness and improved public access (City of Colusa 2007).

Sutter County's general plan contains policies that generally address preservation of natural vegetation, including wetlands. It requires that new development mitigate the loss of Federally protected wetlands to achieve "no net loss," but it does not include any other specific requirements.

Sacramento County's general plan contains policies that promote protection of marsh and riparian areas, including specification of setbacks and "no net loss" of riparian woodland or marsh acreage (Sacramento County 1993). It also addresses the need to conserve vernal pools and ephemeral wetlands to ensure no net loss of vernal pool acreage. Several policies specifically promote protection of native oak trees, and, in some areas of the county, seek to ensure

that there is no net loss of canopy area. The general plan for the County of Sacramento is currently under revision.

The City of Sacramento Municipal Code addresses the protection of trees within the city boundaries, including general protection of all trees on city property and specific protection of heritage trees.

Yolo County's general plan aims to provide an active and productive buffer of farmland and open space separating the Bay Area from Sacramento, and integrating green spaces into its communities.

Federal, State, and Local Programs and Projects

California Bay-Delta Authority

The California Bay-Delta Authority was established as a State agency in 2003 to oversee implementation of CALFED for the numerous Federal and State agencies working cooperatively to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem. The CALFED Ecosystem Restoration Program has provided a funding source for projects that include those involving acquisition of lands within the Sacramento River Conservation Area, initial baseline monitoring and preliminary restoration planning, and preparation of long-term habitat restoration management and monitoring plans.

Cantara Trustee Council

The Cantara Trustee Council administers a grant program that has provided funding for numerous environmental restoration projects in the primary study area, including programs in the Fall River watershed, Sulphur Creek, the upper Sacramento River, Middle Creek, lower Clear Creek, Battle Creek, Salt Creek, and Olney Creek. The Cantara Trustee Council is a potential local sponsor for future restoration actions in the primary study area. The Cantara Trustee Council includes representatives from CDFW, USFWS, the Central Valley RWQCB, California Sportfishing Protection Alliance, and Shasta Cascade Wonderland Association.

Resource Conservation Districts

Numerous resource conservation districts (RCD) are within the study area. Once known as soil conservation districts, RCDs were established under California law with a primary purpose to implement local conservation measures. Although RCDs are locally governed agencies with locally appointed, independent boards of directors, they often have close ties to county agencies and the National Resources Conservation Service. RCDs are empowered to conserve resources within their districts by implementing projects on public and private lands and to educate landowners and the public about resource conservation. They are often involved in the formation and coordination of watershed working groups and other conservation alliances. In the Shasta Lake and upper Sacramento River vicinity, districts include the

Western Shasta County RCD and the Tehama County RCD. To the east are the Fall River and Pit River RCDs, and to the west and north are the Trinity County and Shasta Valley RCDs.

Riparian Habitat Joint Venture

The Riparian Habitat Joint Venture (RHJV) was initiated in 1994 and includes signatories from 18 Federal, State, and private agencies. The RHJV promotes conservation and the restoration of riparian habitat to support native bird population through three goals:

- Promote an understanding of the issues affecting riparian habitat through data collection and analysis.
- Double riparian habitat in California by funding and promoting on-the-ground conservation projects.
- Guide land managers and organizations to prioritize conservation actions.

RHJV conservation and action plans are documented in the Riparian Bird Conservation Plan (RHJV 2004). The conservation plan targets 14 "indicator" species of riparian-associated birds and provides recommendations for habitat protection, restoration, management, monitoring, and policy. The report notes habitat loss and degradation as one of the most important factors causing the decline of riparian birds in California. The RHJV has participated in monitoring efforts within the Sacramento National Wildlife Refuge Complex and other conservation areas. The RHJV's conservation plan identifies lower Clear Creek as a prime breeding area for yellow warblers and song sparrows, advocating a continuous riparian corridor along lower Clear Creek. Other recommendations of the conservation plan apply to the North Delta Offstream Storage Investigation study area in general.

Sacramento River Advisory Council

In 1986 the California Legislature passed Senate Bill (SB) 1086, which called for a management plan for the Sacramento River and its tributaries to protect, restore, and enhance fisheries and riparian habitat in an area stretching from the confluence of the Sacramento River with the Feather River and continuing northward to Keswick Dam, about 4 miles north of Redding. The law established an advisory council that included representatives of Federal and State agencies, county supervisors, and representatives of landowners, water contractors, commercial and sport fisheries, and general wildlife and conservation interests. Responsibilities of the advisory council included development of the Sacramento River Conservation Area Forum Handbook to guide management of riparian habitat and agricultural uses along the river (Resources Agency 2003). This action also resulted in formation in May 2000 of the Sacramento River Conservation Area (SRCA) Forum, a nonprofit, public benefit corporation with a board of directors that includes private landowners

and public interest representatives from a seven-county area, an appointee of the California Natural Resources Agency (Resources Agency), and ex-officio members from six Federal and State resource agencies. The work of the organization is generally focused on planning actions and river management within the SRCA planning area.

Sacramento River Conservation Area Program

SB 1086 called for a management plan for the Sacramento River and its tributaries to protect, restore, and enhance both fisheries and riparian habitat. The SRCA Program has an overall goal of preserving remaining riparian habitat and reestablishing a continuous riparian ecosystem along the Sacramento River between Redding and Chico, and reestablishing riparian vegetation along the river from Chico to Verona. The program is to be accomplished through an incentive-based, voluntary river management plan. The Upper Sacramento River Fisheries and Riparian Habitat Management Plan(Resources Agency 1989), identifies specific actions to help restore the Sacramento River fishery and riparian habitat between the Feather River and Keswick Dam. The Sacramento River Conservation Area Forum Handbook (Resources Agency 2003) is a guide to implementing the program. The Keswick Dam–to–Red Bluff portion of the conservation area includes areas within the 100-year floodplain, existing riparian bottomlands, and areas of contiguous valley oak woodland, totaling approximately 22,000 acres. The 1989 fisheries restoration plan recommended several actions specific to the extended study area:

- Fish passage improvements at RBPP (partially complete)
- Modification of the Spring Creek Tunnel intake for temperature control (completed)
- Spawning gravel replacement program (ongoing)
- Development of side-channel spawning areas, such as those at Turtle Bay in Redding (ongoing)
- Structural modifications to Anderson-Cottonwood Irrigation District Dam to eliminate short-term flow fluctuations (completed)
- Maintaining instream flows through coordinated operation of water facilities (ongoing)
- Improvements at Coleman National Fish Hatchery (partially complete)
- Measures to reduce acute toxicity caused by acid mine drainage and heavy metals (ongoing)
- Various fisheries improvements on Clear Creek (partially complete)

- Flow increases, fish screens, and revised gravel removal practices on Battle Creek (beginning summer 2006)

- Control of gravel mining, improvements of spawning areas, improvements of land management practices in the watershed, and protection and restoration of riparian vegetation along Cottonwood Creek

Sacramento River National Wildlife Refuge

The Sacramento River National Wildlife Refuge (SRNWR) is composed of many units between the cities of Red Bluff and Princeton. The SRNWR along the middle Sacramento River is part of the Sacramento National Wildlife Refuge Complex, consisting of five refuges and three wildlife management areas within the Sacramento Valley. Reaches and subreaches of the river are delineated based generally on transitions in fluvial geomorphic riverine conditions, although county boundaries were considered as well. The middle Sacramento River region between Red Bluff and Colusa includes three units within the Chico Landing Subreach that contain restoration project sites addressed in the Sacramento River–Chico Landing Subreach Habitat Restoration Draft Environmental Impact Report (CBDA 2005). In addition, three areas proposed for restoration in this area occur within the larger SRNWR units that were evaluated in the Environmental Assessment for Proposed Restoration Activities on the Sacramento River National Wildlife Refuge (USFWS 2001; CBDA 2005).

In June 2005, USFWS issued the Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment and Finding of No Significant Impact (USFWS 2005) to serve as an integrated management plan for land that it acquires and manages for inclusion in the SRNWR. The SRNWR final comprehensive conservation plan includes goals, objectives, and strategies to guide management of lands within the SRNWR. It also includes assessments of and establishes parameters for "compatible uses," which are uses that are considered compatible with the primary purposes for which the area was established. Riparian habitat restoration projects are being implemented under cooperative agreements between USFWS and other entities such as The Nature Conservancy (TNC) in accordance with the SRNWR final comprehensive conservation plan.

Sacramento River Preservation Trust

The Sacramento River Preservation Trust is a private, nonprofit organization active in environmental education and advocacy to preserve the natural environmental values of the Sacramento River. The trust has participated in various conservation and land acquisition projects, including securing lands for the SRNWR. The group is pursuing designation of a portion of the Sacramento River between Redding and Red Bluff as a national conservation area.

Sacramento River Watershed Program

The Sacramento River Watershed Program is an effort to bring stakeholders together to share information and work together to address water quality and other water-related issues within the Sacramento River watershed. The group is funded congressionally through the U.S. Environmental Protection Agency. The program's primary goal is "to ensure that current and potential uses of Sacramento River watershed resources are sustained, restored, and where possible, enhanced while promoting the long-term social and economic vitality of the region." The Sacramento River Watershed Program manages grants for the Sacramento River Toxic Pollutants Control Program; performs extensive water quality monitoring, data collection, and data management for the watershed; and is instrumental in the study and monitoring of toxic pollutants. Although the program does not implement restoration projects, it is a potential partner for coordinating research and monitoring through consensus-based collaborative partnerships and promoting mutual education among the stakeholders of the Sacramento River watershed.

Sacramento Watersheds Action Group

The Sacramento Watersheds Action Group (SWAG) is a nonprofit corporation that secures funding for, designs, and implements projects that provide watershed restoration, streambank and slope stabilization, erosion control, watershed analysis, and road removal. SWAG has successfully worked with local groups, agencies, and organizations to fund and complete restoration projects on the Sacramento River and tributaries downstream from Keswick Dam. Their projects include development of the Sulphur Creek Watershed Analysis and Action Plan, the Whiskeytown Lake Shoreline Erosion Control Project, the Sulphur Creek Crossing Restoration Project, and the Lower Sulphur Creek Realignment and Riparian Habitat Enhancement Project. SWAG is a potential local sponsor for watershed restoration actions in the study area.

Shasta Land Trust

The Shasta Land Trust is a regional, nonprofit organization dedicated to conserving open space, wildlife habitat, and agricultural land. The trust works with public agencies and private landowners and is funded primarily through membership dues and donations. It employs various voluntary programs to protect and conserve valuable lands using conservation easements, land donations, and property acquisitions. The trust is a potential local partner for restoration activities in the Shasta Dam–to–Red Bluff area.

The Nature Conservancy

TNC is a private, nonprofit organization involved in environmental restoration and conservation throughout the United States and the world. TNC approaches environmental restoration primarily through strategic land acquisition from willing sellers and obtaining conservation easements. Some of the lands are retained by TNC for active restoration, research, or monitoring activities, while others are turned over to government agencies such as USFWS or CDFW for long-term management. Lower in the Sacramento River basin, TNC has been

instrumental in acquiring and restoring lands in the SRNWR and managing several properties along the Sacramento River. It also has pursued conservation easements on various properties at tributary confluences, including Cottonwood and Battle Creeks.

The Trust for Public Land

The Trust for Public Land is a national, nonprofit organization involved in preserving lands with natural, historic, cultural, or recreational value, primarily through conservation real estate. The trust's Western Rivers Program has been involved in conservation efforts along the Sacramento River between Redding and Red Bluff (BLM's Sacramento River Bend Management Area), Battle Creek, Paynes Creek, Inks Creek, and Fenwood Ranch in Shasta County. The group promotes public ownership of conservation lands to ensure public access and enjoyment.

Chapter 2
Botanical Resources and Wetlands Attachments

This technical report includes the following attachments:

- Attachment 1, “Lists of All Special-Status Plant Species Known from or Potentially Present in the Primary and Extended Study Areas”
- Attachment 2, “List of Plant Species Observed in the Shasta Lake and Vicinity Portion of the Primary Study Area”
- Attachment 3, “Special-Status Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area”
- Attachment 4, “List of All Sensitive Plant Species in the Extended Study Area Reported to the CNDDB”
- Attachment 5, “Known Weed Source Locations, Potential Mode of Spread, and Risk of Spread”

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Chapter 3
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