Rapid Assessment Mapping in the Sacramento River Ecological Management Zone - Colusa to Red Bluff

Sacramento River Monitoring and Assessment Program
Geographical Information Center
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Prepared by
Chuck Nelson
Melinda Carlson
Rebecca Funes

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Abstract

The 2007 Sacramento River Riparian Mapping effort is an update to the 1999 Sacramento River riparian map. This project was confined to the mainstem of the Sacramento River between Colusa and Red Bluff, an area known as the Ecological Management Zone (EMZ). The EMZ is located between River Mile 144 and RM 245. The project was funded by a CalFed Ecosystem Restoration Program grant to the California State University, Chico Research Foundation (RF). The interpretation and mapping was completed by the Geographical Information Center GIC), an auxiliary of the RF.

The GIC used CNPS's Rapid Assessment Protocol. Mapping was completed in 2008 using aerial photography taken in 2007 for the Sacramento River Monitoring and Assessment Project (SRMAP). The airphotos were flown at the nominal scale of RF=1:15,840 (1"=1320') and scanned at 800 DPI. Polygons were heads-up digitized on-screen using *ArcView* GIS software from ortho-rectified true color scans.

The final 2007 Sacramento River riparian map includes riparian vegetation alliances and invasive species with spatial attributes. Spatial data (GIS SHP files) and orthophotos will be made available on the GIC's server at http://www.sacramentoriver.org/sacmon.

1. Introduction

Public ownership of land adjacent to the Sacramento River has increased since 1986, when the State of California passed Senate Bill 1086 (SB 1086) which called for the development of a management plan that would protect, restore, and enhance fisheries and riparian habitat of the Sacramento River. SB 1086 authorized the establishment of an advisory council, the Sacramento River Conservation Area Forum or SRCAF, to guide this process.

Following the passage of SB 1086, the restoration of functioning channel processes and riparian habitats along the Sacramento River and their dynamic interaction became a regional and state goal. As a result, there were many property acquisitions and native vegetation restoration projects over the next 20 years.

The Sacramento River Monitoring Assessment Program (SRMAP)

Since 1986, there has been very little systematic evaluation of Sacramento River restoration efforts to see if they have been successful in achieving their objectives. In 2007, the CALFED Ecosystem Restoration Program awarded a grant to the CSU, Chico Research Foundation to quantitatively assess the extent to which restoration projects have achieved their stated goals. Partners in the project, called the Sacramento River Monitoring and Assessment Project or SRMAP, include researchers from CSU, Chico, the Geographical Information Center (an auxiliary of CSU, Chico), the University of California, Davis and Santa Cruz campuses, the Sacramento River Conservation Area Forum and The Nature Conservancy.

One goal of SRMAP is to develop a comprehensive report on monitoring methodology along the Sacramento River Ecological Management Zone (EMZ) between Colusa and Red Bluff which could help in evaluating restoration activities and determine whether or not these programs have restored ecosystem structure and function.

The SRMAP concept includes developing and applying environmental research methods in an effort to;

- *quantify the existing condition of riparian and channel habitats,*
- *evaluate the effectiveness of restoration and conservation actions to date,*
- *provide a description for how to best monitor conditions in the future, and*
- *develop a Sacramento River "scorecard" that would provide a scientific basis for drawing conclusions about conditions and a means to track changes over time*.

One way to measure the effectiveness of the programs evolving from the management plan called for by SB 1086 is to track changes in vegetation, land use and ownership in the EMZ. This data, along with historical maps and available ground monitoring data, can be used to analyze any changes in the extent and condition of habitat over time.

The first major step in the SRMAP process is to update the 1999 Sacramento River riparian map. This map provides the basis for future discussions and follow-up monitoring activities. Information including updated vegetation change and change in

channel dynamics will be cross walked with the 1999 and other available spatial data. Increase or loss in important indicator species help researchers evaluate restoration success and discuss strategies for future efforts.

2. Methodology

The Geographical Information Center's (GIC) mapping approach employs an iterative process of aerial photo interpretation and field verification. The mapping methodology includes the acquisition of aerial photo imagery, the development of a vegetation classification list, rapid assessment surveys, photo interpretation and vegetation alliance delineations as polygons in ArcGIS, final field verification and edits. Throughout the process, regular communication has occurred between regional experts, agency scientists and the photo interpreter.

2.1 Aerial Photography

In 2007, the GIC contracted with American Aerial Services of Northern California (AAS) to fly and photograph the riparian corridor along the EMZ. These aerial images served as the basis for the delineation of riparian vegetation communities. While the SRMAP effort focuses on the Colusa to Red Bluff Ecological Management Zone, color aerial photography was flown for the entire 222 miles of the river between Verona and Redding, California, which constitute the Sacramento River Conservation Area as defined in SB 1086.

The GIC coordinated the aerial photo flight for optimum calendar dates in an effort to get the best signatures for riparian vegetation interpretation. The June 2007 flight corresponded to peak vegetative growth. Each aerial photograph included approximately a one-mile corridor on each side of the Sacramento River. In some areas, however, riparian vegetation does not extend much beyond the river's edge.

Aerial photographs were taken using true color 9" x 9" aerial film at a scale of 1:15,840. This scale has a resulting resolution of 4 inches equaling 1 mile. Color negatives were scanned by AAS at a pixel resolution of 1.2 feet using a geometrically accurate Wherli RM6 scanner and delivered to the GIC on DVD's. Using PCI's *Geomatica 10 Ortho Engine* software with airplane calibration measurements, United States Geological Survey (USGS) digital elevation models (DEM's), and real world control from the 1999 flight, the GIC ortho-rectified and clipped the aerial images. Digital ortho-photographs were rendered according to USGS Map Accuracy Standards and projected to UTM-meters (Universal Transverse Mercator) and NAD 83 (Datum).

The GIC adjusted the photos for tonal differences, and converted images to geo-referenced .SID tiles using *Mr. Sid* software. *Mr. Sid* is raster software that compresses memory intensive aerial images down to 5% of their original size while retaining pixel to pixel image fidelity when needed. Using the *Mr. Sid* online server, images from the 2007 mosaic can be clipped and downloaded as 8 megabyte .TIF images from the SRMAP project server (http://www.sacramentoriver.org/sacmon).

2.2 RAPID ASSESSMENT MAPPING

The GIC's mapping approach utilized the California Native Plant Society's Rapid Assessment Protocol. The Rapid Assessment Protocol (RA) is a reconnaissance-level method of vegetation and habitat sampling. RA data can be described with standard classifications and descriptions and can be illustrated in maps across any landscape. RA has become a California standard as agencies including California State Parks, the California Department of Fish and Game, the U.S. Forest Service and others have adopted this method for documenting vegetation patterns. In this project, vegetation is delineated at the alliance floristic level as defined by the Sawyer and Keeler-Wolf's *Manual of California Vegetation* (1995). Naming convention for the vegetation alliance was established by the dominant/characteristic canopy species.

2.2.1 AERIAL PHOTOGRAPHY INTERPRETATION

The June, 2007 orthophoto images serve as the basis for "heads-up" digitizing of vegetation cover and habitat types. "Heads-up" digitizing refers to the manual creation of vegetation and habitat polygons and associated data to an *ArcGIS* SHP (pronounced shape) file. A total of 15 vegetation types and 2 habitat types were delineated (see Appendix A for descriptions of each). The habitat types delineated include gravel bars and open water.

Vegetation cover types are delineated from adjacent types by changes in compositional and structural integrity of the vegetation as perceived by the interpreter. Representative stands were selected for rapid assessment surveys from an initial visual assessment of the aerial imagery. The rapid assessment data aided the characterization of aerial imagery signatures and subsequent polygonning, i.e., vegetation alliance type.

Polygons are assigned vegetation alliances using ocular estimates of the vegetation signatures to determine which species occupies the greatest canopy cover. The interpreter takes into consideration the species in the upper layer of vegetation and if it is characteristic of the alliance. A vegetation type is considered dominated by tree species if the average tree canopy cover is 10% or greater throughout the polygon. A vegetation type would be considered shrub-dominated if shrub density is greater than 10% over the polygon and tree cover is less than 10%. An herbaceous alliance is assigned to a polygon if a tree and shrub crown cover is less than 10%.

Polygons are only delineated if alliance boundaries are distinct and perceptible to the interpreter. There are areas where it is difficult to distinguish contiguous 0.5-acre polygons where one alliance is dominant. Since there is not a mixed riparian classification in the 2007 effort, mixed areas are ultimately divided into adjacent alliances. When interpreting very mixed areas, polygons are classified by which alliance signatures are the most predominant. Table 1 describes characteristics of vegetation signatures which were used in photo interpretation.

TABLE 1. GUIDELINES FOR CHARACTERIZING SIGNATURES IN THE 2007 AERIAL IMAGERY

VEGETATION ALLIANCE	*COLOR*	*TEXTURE*
Black Walnut	Very dark green	Matted flattish tops
California Sycamore	Med green	Similar to valley oak
Freemont Cottonwood	Med gray green	Wispy, flattish to rounded tops
Gravel Bar	Light gray	Smooth
Giant Reed	Mint green	Fronds to mounded
Goodding's Willow	Medium dark green	Wispy in mature, pointed tops in younger
Mixed Willow	Gray to medium green	Small semi-coarse mounds
California Annals	Golden yellow-browns	Smooth to rough
Box Elder	Yellow-green	Flattish tops
Blackberry Scrub	Medium to dark green	Mounded w/round edges
Water Primrose	Light yellow-green	Smooth with small to large holes
Riparian Scrub	Variable	Variable w/low growth
Valley Oak	Dark green	Round mounded tops
Perennial Grassland	Dark to medium blue-greens	Smooth to rough w/low growth
Open Water	Variable	Smooth to choppy
Floating-leaved Plants	Light green to brownish	Smooth or grainy
Bulrush-Cattails	Bulrush- Gray-browns	Coarse and choppy
	Cattails, in bloom- Reddish-brown	Smooth

2.2.2 FIELD VERIFICATION

Rapid assessment protocol was utilized during fall 2007 field verification to determine which vegetation types existed in the project area and to introduce aerial photo signatures to corresponding vegetative communities. Representative stands were selected for rapid assessment surveys and more difficult areas were "red flagged". These "red flagged" areas included polygons where patterns were unusual or areas where use was questionable , i.e., restorations sites. Flagged areas were marked and these became mandatory stops on field days. Draft riparian maps were printed in the lab for verification. Additional area checks were made along the way.

Rapid assessment surveys were performed in representative stands of each alliance and information recorded include site location, geology and soil, slope, site history, tree diameter, height classes, age classes for shrubs and percent coverage of vegetation. Rapid assessment forms include space for up to 20 major vegetation species encountered along with their respective cover. Sites are linked to individual aerial photographs that include GPS points in UTM coordinates and representative ground directional photographs. A field form for an area sampled as Fremont Cottonwood (*Populus fremontii*) alliance is included in Appendix D.

Vegetation rapid assessment field forms were collected in fifty-nine (59) locations in an attempt to acquire representative sampling of all the alliances mapped. Table 2 shows the distribution of rapid assessment surveys by alliance.

TABLE 2. DISTRIBUTION OF RAPID ASSESSMENT

SURVEYS BY ALLIANCE *Alliance*	*RA Surveys Performed*
Box Elder	10
Black Walnut	10
California Sycamore	6
Cottonwood	14
Goodding's Willow	2
Gravel Bar	1
Mixed Willow	5
Perennial Grasses	3
Valley Oak	8

As a part of the iterative field verification process, this mapping project included a number of additional "area checks" where rapid assessment surveys were not completed but vegetation alliances were verified. Again, areas which were more difficult to interpret using aerial photographs were targeted. These areas included young and mature restoration sites in addition to particular alliances, such as mature Black Walnut and California Sycamore. We note that it was difficult to distinguish the signature for California Sycamore from that of the Valley Oak. Field verification sites were accessed on foot or by vehicle on public lands, but also via boat on the Sacramento River. Many of the adjacent polygons were verified during the area checks as well.

2.2.3 MAP PRODUCTION

The minimum mapping unit in the 2007 riparian map is 0.5 acres. Invasive species alliances are the exception to this rule. For ecosystem monitoring purposes it was desired to capture any clearly visible stands of exotics. Invasive species alliances such as *Arundo donax*, *Ludwigia peploides*, and *Rubus discolor*, were mapped down to 0.1 acre.

In addition to the polygon topology developed, the GIS database includes information for each mapped polygon including alliance; height class (1-6) and density cover class (sparse, open, moderate and dense) for tree alliances. Additional fields were completed in the database if the polygon was a restoration area, i.e., unit name, year restored (if known), forest type planted (if known), and any interpreter comments. The following attributes are possible for each polygon, although a number of polygons will not have all attributes assigned.

- FID: unique number assigned by *ArcGIS* program to each polygon.
- SHAPE: attribute assigned by *ArcGIS* program to describe topology of SHP file.
- CLASS: the vegetation alliance as determined through aerial photo interpretation and field sampling. Vegetation alliances are described in Appendix A.
- COMMENTS: includes interpreter observations which may be useful to others using this data.
- RESTORATION: Y indicates riparian restoration occurred within the polygon. UNIT: refers to the agency ascribed name for the tract of land.
- HEIGHT: the estimated height of the dominant species. Six height classes (1-6) were used and correspond to the following: 1-seedling (0-6.6'), 2-sapling (<20'),

3-pole (20-33'), 4-small tree (34-65'), 5-medium to large (>66'), 6-multi-layered tree (>66' with 6.6' to 32.8' below).

- COVER: the estimated total cover of the upper vegetation layer in the polygon. Four cover classes were used and correspond to the following: Sparse (10-24%), Open (25-39%), Moderate (40-59%) and Dense (60-100%).

No minimum mapping scale was applied to this effort due to the desire to map any occurrence of exotic species.

3. Conclusion

A total of X alliances were mapped, equaling 8,070 polygons over 32,811 total acres. A distribution of polygons and acreage by alliance is detailed in the table below.

ALLIANCE	TOTAL ACREAGE	TOTAL # POLYGONS
Bulrush-Cattail (Scripus-Thypha)	28	26.6
Box elder (Acer negundo)	396	862
Blackberry scrub (Rubus discolor)	231	337.8
Black walnut (Juglans hindsii)	598	2542.6
California Annual Grasslands/Herblands	584	4087.4
California sycamore (Platanus racemosa)	47	83.1
Fremont cottonwood (Populus fremontii)	876	7773.9
Floating-leaved plants	77	65.4
Gravel Bar	390	1701.2
Giant reed (Arundo donax)	1748	131.3
Goodding's willow (Salix gooddingii)	19	77.9
Water Primrose (Ludwigia peploides)	223	381.4
Mixed Willow	633	1791.9
Open Water	338	6230
Perennial Grassland	268	266.9
Riparian Scrub	771	2426.2

Valley oak (Quercus lobata)	843	4025.5
TOTALS	8070	32811.1

Constraints on the accuracy of the 2007 riparian map is based on the resolution of imagery obtained, the differentiation of vegetation signatures during the June 2007 flight, and time and access constraints for ground-truthing.

In the 1999 riparian map, a mixed riparian category existed. Through consultation with agency and other regional experts, it was decided to not have a mixed riparian vegetation classification and to separate out different tree species when possible. Field surveys suggest that it would be appropriate to have a mixed category, as both aerial photo signatures and field verification indicate there are areas of high tree species diversity where it is difficult to distinguish contiguous 0.5-acre polygons where one alliance is dominant. The use of stereoscopic photo pairs could potentially aid future interpretation of vegetation alliance boundaries.

3.1 Statistical Sampling

In addition to GIC field verification, a second mapping validation is being developed by our UC, Davis partners using a procedure that will randomly sample sites. Graduate students from UCD will be sampling sites to determine whether their mapping effort is in agreement with the GIC effort. UCD students were trained to recognize GIC classifications to assure that both teams are using similar criteria. Statistics will discuss rates of agreement versus disagreement. Field work will verify differences and a statistical score will be done based on 20-30 sampled sites.

Stands to be sampled will be selected by evaluation prior to a site visit (i.e. delineated from aerial photos), or on-site (during reconnaissance to determine extent and boundaries, location of other similar stands, etc.). UCD sampling includes:

- giving interpreters the proper names for the mapping units and a proper field orientation,
- classification and mapping of sample sites,
- providing ground-truthing sites as needed to validate the mapping effort and generate statistics, and
- establishing a set of monitoring points that can be revisited in the future.

The GIC is also hoping to get input from Holl and Wood during their structural phase. This sampling work will be co-occurring on pre-existing sites as part of this monitoring effort.

3.2 Crosswalk Comparison and Calibration

The GIC will perform a crosswalk and comparison between the two mapping efforts (1999 – 2007) as a component of the SRMAP's monitoring objectives and consists of two actions. First, a tabular reconciliation of map class attributes will be created through expert judgment in coordination with our UCD partners and the California Department of

Fish and Game. Secondly, an iterative quality assurance procedure is being developed by UCD to assure that this crosswalk procedure is acceptable. A crosswalk of our 2007 and corresponding 1999 classifications is included as Appendix C.

In addition, minor adjustments to the 1999 riparian map will be made as this process moves forward. For instance, because restoration involves planting trees in rows simulating an orchard, it is very similar on aerials to a farming operation. For this reason many restoration sites were omitted during the 1999 mapping because they were interpreted as agricultural uses. With parcel ownership overlays, it is possible to separate these lands and make the changes.

Also, a few key indicator invasive species like black walnut and ludwigia peploides were not mapped on the 1999 maps but are included in the 2007 effort. Given time and funding constraints, the GIC will attempt to pull out key indicator alliance areas from the 1999 aerials as a way to quantitatively measure their spread throughout the project area.

3.3 GIS SERVER SETUP/2007 SACRAMENTO RIVER RIPARIAN MAP

All monitoring data collected for this project will be uploaded to the SRMAP database at http://www.sacramentoriver.org/sacmon. Upon final completion and validation of the riparian GIS coverage, the GIC will compile and plot the 2007 map of riparian vegetation (including invasive species) that includes channel location and attributes for the Sacramento River Ecological Management Zone-Red Bluff to Colusa (EMZ). In addition, we will also compile layers for cultural (human) land use and land ownership in EMZ. All final spatial data will be made available on the GIC's server for public download. The GIC is responsible for database upkeep and information distribution via our Sacramento River Website. Data and metadata creation and updating will meet Federal Geographic Data guidelines

Other available aerial photography and GIS coverages will be uploaded to the GIC server. Currently, the 1999 riparian map, a composite 1991-96 riparian map that includes valley portions of major tributary rivers and streams, and available scanned digital orthophoto mosaics are online. The GIC would like to obtain digital orthophotos of the Sacramento River for 1938, 1952, and 1978 for upload to the server. The GIC also plans to include studies by researchers including Steve Greco, Evan Girvetz, and Eric Larsen of UCD who have studied the river over time, using overlapping measurements to detect changes in area by vegetation type, change in composition of vegetation type in a given place, and change in channel dynamics.

Our goal is to compile all available digital aerial and GIS data on this server to aid others who wish to take this effort to the next level. This will include available property map and ownership information and additional digital aerials available from state and federal agencies. The intent is that the site will function as an archive for Sacramento River spatial data.

4. Acknowledgements

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Appendix A. Sacramento River Riparian Vegetation Descriptions

Tree-Overstory Vegetation

Acer negundo alliance
Box Elder alliance

Box elder is the characteristic or dominant canopy tree. Fremont cottonwood, Northern California black walnut, valley oak and Oregon ash may also be present in the overstory. Mexican elderberry, California pipevine, California wild rose may be present in the shrub layer. Mugwort and Santa Barbara sedge may be found in the herb layer. These stands are commonly found between roads (and/or the river) and Fremont Cottonwood stands.

Juglans x hindsii alliance
Northern California black walnut hybrid alliance

Northern California black walnut is the characteristic or dominant canopy tree. Fremont cottonwood, and valley oak may also be present in the overstory. Understory plants that may be present are box elder, and Oregon ash. The shrub layer is characterized by Rubus discolor, Mexican elderberry, California pipevine and California wild grape. The herb layer supports varied non-natives and natives including mugwort. These stands generally occur on older floodplains, river and stream low-flow margins, seeps, stream and river banks and terraces. Microtopography is even to undulating. Surface soil texture varies from sandy loam to silt loam and silty clay loam.

Populus fremontii alliance
Fremont cottonwood alliance

Fremont cottonwood dominates the overstory tree layer. Box elder, Goodding's black willow, Northern California black walnut, Oregon ash and white alder are often subdominants. California wild grape, California pipevine, blackberries, and narrow-leaved willow may be present in the shrub layer. Santa Barbara sedge and mugwort may be present in the herb layer. Fremont cottonwood is found in areas with soils intermittently or seasonally flooded, or saturated along riparian corridors.

Salix gooddingii alliance
Goodding's black willow alliance

Goodding's black willow is the dominant canopy tree. Fremont cottonwood and Oregon ash may be subdominants. Poison oak, blackberries, narrow-leaved willow, arroyo willow, buttonbush and California wild rose are common in the shrub layer. Stinging nettle, mugwort and Santa Barbara sedge are often found in the herb layer. Goodding's black willow is found in wetland habitats that may be seasonally flooded or saturated and flood plains with low gradient depositions along rivers, streams and meadow edges.

Quercus lobata alliance
Valley oak alliance

Valley oak is the dominate tree in the canopy. Oregon ash, Fremont cottonwood, box elder and California sycamore may also be present. Mexican elderberry, poison oak, California pipevine and California wild grape are common in the shrub layer. Structure is an intermittent deciduous tree canopy and an open to intermittent shrub layer. The herbaceous layer may be open to intermittent. The herbaceous layer may contain mugwort and dock. Numerous non-native grasses and forbs also occur in the herbaceous layer. Valley oak appears in older floodplains, riparian corridors, uplands, valley

bottoms, and gentle slopes with alluvial or residual soils. Soils are intermittently flooded, or seasonally saturated.

***Platanus racemosa* alliance**
California sycamore alliance
California sycamore is the dominant canopy tree. Fremont cottonwood, Goodding's black willow, and valley oak may also be found in the overstory. Arroyo willow, California wild rose and mule fat may be present in the shrub layer. Slender wild oats and bromes are commonly occurring species in the herb layer. California sycamore is found in riparian corridors, braided, depositional channels of intermittent streams, gullies, seeps, springs and river banks, and terraces adjacent to floodplains subject to high intensity flooding. Soils are alluvial, open cobbly to rocky.

Shrub-Overstory Vegetation

***Rubus discolor* alliance**
Himalayan blackberry alliance
Blackberry scrub
Himalayan blackberry is the sole or dominant species in this non-native, invasive alliance. The treatment of this alliance is broad to recognize the importance of this introduced species in the vegetation of California.

Mixed willow alliance
Willow stands may or may not be dominated by a single species. Stands of mixed willow have environment conditions similar to cottonwood and other willow species. Willow species may include narrow-leaved willow, and arroyo willow. Young Goodding's black willow and Fremont cottonwood are sometimes common components. The herbaceous layer is often non-native grasses and forbs. Wetlands habitats seasonally flooded and saturated. Water chemistry is fresh. Willow habitats tend to be on floodplains and low gradient depositions along rivers and streams.

Riparian scrub
Riparian scrub is characterized by a variety of different shrubs and small trees of sapling to pole size. Common shrub species may include Mexican elderberry, poison oak, California wild grape, buttonbush, coyote-brush, mule fat, American black nightshade and, to a lesser degree, Himalayan and California blackberries and willows. Small trees may include Fremont cottonwood, white alder, box elder, Northern California black walnut, Oregon ash and Goodding's black willow. The herbaceous layer is various native and non-native perennials and annuals. Riparian scrub is common in seasonally flooded areas and low gradient depositions along rivers.

***Arundo donax* alliance**
Giant reed alliance
Giant reed dominates the herb layer. Other species that may be present include Oregon ash, Goodding's black willow, narrow-leaved willow and Himalayan blackberry. Giant reed is found in habitats that are permanently saturated with a shallow water table and palustrine persistent emergent freshwater wetlands. Giant reed, a very invasive grass was introduced into California in the 1880s. This species establishes and persists in riparian areas, and reduces or replaces native species. Today in many locations giant reed forms dense monocultures. The treatment here of this alliance is broad to recognize the importance of this introduced species in the vegetation of California. Giant reed is mapped to individual plants when possible.

California annual grassland/herbaceous alliance
California Annual Grassland is found in uplands, i.e., all topographic locations. Composition varies greatly and it may have many alien and non-native annual grasses and herbs. Bromes, rye grasses, foxtail, oats, mustards, star thistle, clovers, lupines, hedge parsley and filaree may be present plus numerous others. This alliance is affected by light, shading, litter and differences in micro topography.

Introduced perennial grassland
Perennial grasslands may include blue wild rye, Bermuda grass, Johnson grass, bentgrass, bristlegrass, Dallas grass, Santa Barbara sedge, smartweed, dock, chenopods, cocklebur, and vervain. Areas dominated by an introduced grass are included in this definition as well. In wetlands, habitat is seasonally, permanently saturated with shallow water table. In upland areas, grasslands are found at all topographic locations. Soils may include clay, loam, or sand.

***Scirpus-typha* series**
Bulrush –cattail series
In wetlands, habitat is permanently flooded, regularly flooded, semi permanently flooded, seasonally flooded, irregularly flooded, or irregularly exposed. Water chemistry includes fresh, mixohaline, hyperhaline, mixosaline, hypersaline. Bay, estuary, dune swale, slough terrace edges, berm, backwater, bank, bottomland, mouth margins of rivers, channel, creek, ditch margins, lake beds, lagoon, pond, reservoir margins, and along geologic faults. Soils are peaty. This series occurs in alkali, brackish, or freshwater marshes.

***Ludwigia peploides* alliance**
Water primrose alliance
Stands of Ludwigia are characterized by an aquatic herbaceous layer that is intermittent to dense. The Ludwigia alliance is considered dominated by an invasive subspecies native to South America. The treatment of this alliance is broad to recognize the importance of this introduced species in the vegetation of California.

Pondweeds and floating leaved plants alliance
Wetland habitats are permanently flooded, intermittently exposed fresh water such as ditches, lakes, ponds, and slow streams. Species may include leafy pond weed and long-leaved pond weed, duckweed and others.

Habitat Types

Open Water
Water,either standing or moving.

Gravel Bar
Gravel or sand bars. Gravel bars appear as open, unvegetated areas on aerial photos, but ground-truthing may reveal several species of annual and short-lived perennial grasses, forbs and sub shrubs. The vegetation coverage is less than 50%.

APPENDIX B.
PLANT SPECIES LISTED

Tree species

Box elder	Acer negundo californicum
California sycamore	Platanus racemosa
Fremont cottonwood	Populus fremontii
Goodding's black willow	Salix gooddingii
Northern California black walnut	Juglans hindsii
Oregon ash	Fraxinus latifolia
Valley oak	Quercus lobata
White alder	Alnus rhombifolia

Shrub species

American black nightshade	Solanum americana
Arroyo willow	Salix lasiolepis
Buttonbush	Cephalanthus occidentalis
California blackberry	Rubus ursinus
California pipevine	Aristolochia californica
California wild grape	Vitis californica
California wild rose	Rosa californica
Coyote-brush	Baccharis pilularis
Himalayan blackberry	Rubus discolor
Mexican elderberry	Sambucus mexicana
Mule fat	Baccharis salicifolia
Narrow-leaved willow	Salix exigua
Poison oak	Toxicodendron diversiloba

Herbaceous and Grass species

Bentgrass	Agrostis spp.
Bermuda grass	Cynodon dactylon
Blue wild-rye	Elymus glaucus glaucus
Bristle grass	Setaria spp.
Bulrush	Scirpus spp.
Cattail	Typha spp.
Chenopod	Chenopodium spp.
Clovers	Trifolium spp.
Cocklebur	Xanthium spp.
Dallasgrass	Paspalum dilatatum
Dock	Rumex spp.
Mugwort	Artemesia douglasiana
Star thistle	Centaura solstisialis
Stinging nettle	Urtica dioica and U. urens
Bermuda grass	Cynodon dactylon
Bromes	Bromus spp.
Fileree	Erodium spp.

Foxtail	Alopecurus spp. or Hordeum spp.
Giant reed	Arundo donax
Hedge-parsley	Torilis arvense
Johnson grass	Sorghum halepense
Lupins	Lupinus spp.
Mustards	Brassica spp.
Pampas grass	Cordaderia spp.
Pokeweed	Phytolacca americana
Rye grasses	Lolium spp.
Santa Barbara sedge	Carex barbarae
Slender oats	Avena barbata
Smartweed	Polygonum spp.
Soft chess	Bromus hordeaceus
Vervain	Verbena spp.

Floating-leaved plants

Duckweed	Wolffia brasiliensis
Leafy pondweed	Potamogeton foliosus
Long-leaved pondweed	Potamogeton nodosus
Yellow water primrose	Ludwigia peploides peploides

APPENDIX C.
CROSSWALK BETWEEN THE CNPS AND THE GIC SACRAMENTO RIVER MAPPING CLASSIFICATION

Mapped Vegetation Type	GIC '07 Code	CNPS Code
TREE		
Temporarily or Seasonally Flooded – Deciduous Forests		
Box elder *(Acer negundo)*	BE	1340
Black walnut *(Juglans hindsii)*	BW	1350
Fremont cottonwood *(Populus fremontii)*	CW	1360
California sycamore *(Platanus racemosa)*	CS	1370
Goodding's black willow *(Salix gooddingii)*	GW	1380
Deciduous Woodlands		
Valley oak *(Quercus lobata)*	VO	2230
SHRUBLANDS		
Intermittently or Temporarily Flood Deciduous Shrublands		
Mixed willow	MW	3000
Riparian scrub	RS	3000
Blackberry *(Rubus discolor)*	BS	3410
HERBACEOUS GRASSES		
Temporarily Flooded Grasslands		
Giant cane *(Arundo donax)*	GR	4310
Introduced perennial grassland	PG	4500
Bulrush-cattail	BC	4513
California annual grasslands-herbaceous	CA	4710
Semi-permanently Flooded Herbs		
Water primrose *(Ludwigia peploides)*	LP	5410
Floating-leaved plants	FL	6101
LAND USE - LITTLE OR NO VEGETATION - WATER		
Gravel bar	GB	9400
Water	OW	9800

APPENDIX D.
RAPID ASSESSMENT FORM- POPULUS FREMONTII ALLIANCE

CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM
(Revised Aug. 23, 2007)

For Office Use:	Final database #:	Final vegetation type name:	Alliance / Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo #:	Date:	Name(s) of surveyors:
SR0002	155 (6-07)	9-21-07	Melinda Carlson

GPS waypoint #: _____ GPS name: _____ GPS datum: (e.g. NAD 83) _____ Zone: 10S / 10T / 11S (circle one)

UTM field reading: UTME 590647 UTMN 4395326 GPS Error: ± ____ ft / m

Is GPS within stand? Yes / No If No, cite from GPS point to stand, the distance _____(in meters) and bearing _____(degrees)

Elevation: ft / m Photograph #'s: 5-8

Geology code: 07 Soil Texture code: MESIL | Upland or Wetland/Riparian (circle one)

Topography: Macro: top upper mid lower (bottom) | Micro: convex flat concave (undulating) (circle one)

% Surface cover (sum to 100%) Lg rock: 0 Sm rock 0 Bare/Fine: 1 Litter: 84 BA Stems: 15 Water: 0

Slope exposure, Actual °: _____ General: NE NW SE (SW) Flat Variable /All (circle one)

Slope steepness, Actual °: _____ General: 0° (1-5°) 5-25° > 25° (circle one)

Size of stand: <1 acre___ 1-5 acres___ >5 acres X Plot: Yes (No) If yes, denote size: 100 m² / 400m² / 1000 m² / Other

Site history, stand age, and comments: Bidwell River Access (St. Parks) Fishing - river access. Trail to river. Cottonwood overstory appears to be the most mature tree in the stand. Black willow & Black walnut mature to mid size. River is to the west and River Rd and Big Chico Creek Day Use is located to the E. Large

Type/ Level of disturbance codes: 15 / L 13/M ___/___ ___/___ ___/___ "Other" flooded in 2006

II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH : T1 (<1" dbh), (T2 Other Tree) (1-6" dbh), T3 (6-11" dbh), (T4 CF) (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), (S3) mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) % Non-Vasc cover: _____ Total % Vasc Veg cover: 55

% Cover -Overstory Tree Conifer/Hardwood: ___/40 Low-Medium Tree: 10 Shrub: 6 Herbaceous: 8

Height Class - Overstory Conifer/Hardwood: ___/08 Low-Medium Tree: 04 Shrub: 04 Herbaceous: 03

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 20 major species), Stratum, and Approximate % cover. Stratum categories: T= Overstory tree, U= Low-Medium Tree, S = Shrub, H= Herb, N= Non-vascular. *% cover intervals for reference:* <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

Strata	Species	% cover	Strata	Species	% cover
T	Populus fremontii	25	H	cynodon dactylon	2
T	Juglans hindsii	8	H	unknown grass Agrostis	2
T	Salix goddingii	10	H	Lolium multiflorum	<1
T	Acer negundo	1	H	Carex barbarae	<1
S	Vitis californica	3	H	Rumex crispus	<1
H	Artemisia douglasii	4	H	Rumex pulcher	<1
S	Sambucus mexicana	3	H	Brassica nigra	<1
S	Rubus discolor	<1	H	Sonchus sp.	<1
S	Phytolacca americana	<1	H	Sorghum halepense	<1
			H	Torilis arvensis purpurea	<1

Unusual species: _____

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Populus fremontii

Field-assessed association name (optional): _____

Adjacent alliances: _____ / _____

Confidence in alliance identification: L M (H) Explain: _____

Other identification problems: Late in season - Herbs drying up

Has the vegetation changed since air photo taken? Yes / (No) If Yes, What has changed?

Polygon is more than one type: (Yes, No) _____ (Note: type with greatest coverage in polygon should be entered in above section)

Other types: _____

Appendix E - Example: RM190 – Stony Creek Aerial and Overlay