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Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Sacramento County, California

Bushy Lake Restoration Project Area

January 26, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


121° 26' 31" W
121° 25' 36" W
635700
635800
635900
636000
636100
636200
636300
636400
636500
636600
636700
636800
636900
637000
38° 35' 31" N
38° 35' 3" N
4272600
4272500
4272400
4272300
4272200
4272100
4272000
4271900
4271800
Tribute Rd
Jedediah Smith Recreation Trl
204
118
247
Soil Map may not be valid at this scale.
Map Scale: 1:6,080 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1000 1500
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sacramento County, California
Survey Area Data: Version 22, Sep 1, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 23, 2022—Apr 24, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
118	Columbia sandy loam, drained, 0 to 2 percent slopes, occasionall y flooded	32.1	40.4%
204	Rossmoor fine sandy loam, 0 to 2 percent slopes	14.7	18.6%
247	Water	32.6	41.0%
Totals for Area of Interest		**79.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Sacramento County, California

118—Columbia sandy loam, drained, 0 to 2 percent slopes, occasionall y flooded

Map Unit Setting

National map unit symbol: hhls
Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 25 inches
Mean annual air temperature: 57 to 63 degrees F
Frost-free period: 230 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Columbia and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbia

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: sandy loam
H2 - 11 to 60 inches: stratified loamy sand to silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: OccasionalNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: Yes

Minor Components

Cosumnes

Percent of map unit: 3 percent
Landform: Flood plains

Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: Yes

Sailboat

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: Yes

Hicksville

Percent of map unit: 3 percent
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

Columbia, clay substratum

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: Yes

Unnamed, high water table

Percent of map unit: 1 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

Unnamed, frequently flooded

Percent of map unit: 1 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

Unnamed, rarely flooded

Percent of map unit: 1 percent
Hydric soil rating: No

204—Rossmoor fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hhpk
Elevation: 30 to 110 feet
Mean annual precipitation: 20 inches
Mean annual air temperature: 61 degrees F
Frost-free period: 275 to 300 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Rossmoor and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rossmoor

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 62 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

Minor Components

Columbia

Percent of map unit: 6 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

Xerofluvents

Percent of map unit: 5 percent
Landform: Channels
Hydric soil rating: Yes

Unnamed, gravelly subsoil

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, loamy sand
Percent of map unit: 2 percent
Hydric soil rating: No

247—Water

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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Appendix B: Fire Resiliency and Culturally Significant Plants

We tested the impact of fire on culturally significant plants: White root (*Carex barbarae*); Mugwort (*Artemisia douglasiana*); and Narrowleaf willow (*Salix exigua*).

White Root (*Carex barbarae*)

Ethnobotany: White root is a significant basketry material used by central California Native Americans, who use the long white rhizomes for the sewing strand in coiled baskets. White root was used by over one-third of California tribes for basket weaving. Other uses of white root include gathering the shoots into a loose knot to hold worms for fishing or to gather eggs.

Indigenous Traditional Resource Management: A significant portion of the riparian forest understory was tended prior to European settlement. It is highly likely that most areas with desirable rhizomes were harvested every two to four years. This maintained a lawn-like, grassy appearance under California riparian forests. Given the high population of native peoples in California, particularly in the low elevation range of Carex barbarae, it is probable that most available plants in suitable soils were sustainably harvested (Stevens, 1999).

Traditional Native American tending practices removed competing species and impediments to growth such as stones and branches. Tending practices aerated the soil and stimulated growth through pruning rhizomes. Plants were harvested every two to four years, and less than one-third of the plants were harvested. The season of harvest was late fall through early spring, coinciding with the times that the plants were dormant, and the soils were moist. In some cases, plants were replanted into new areas.

White root (*Carex barbarae*) bed at Bushy Lake (photo by Michelle Stevens)

Narrowleaf Willow or Coyote Willow (*Salix exigua*)

Ethnobotanic: The traditional value of willow for basket weaving and the manufacture of a family's material culture for household goods cannot be overestimated. Virtually all California tribes use willow in their baskets, including the Nissenan, Maidu, and Miwok tribes. Willow branches are used as the warp for twined baskets and the foundation in coiled baskets. Willows are used to weave water jugs, cradles for newborn infants, hats, cooking vessels, serving bowls, trays, seed beaters, and storage baskets. Some tribes use willow roots as a sewing strand.

Traditional Resource Management: Poles of willow readily sprout and help to stabilize stream banks and provide habitat. Sweat lodges constructed of willow have been known to sprout and grow, even though the willows were subjected to very high heat. Willows are traditionally tended by pruning, to produce long straight stems. Before gathering, the weavers I have interviewed make offerings of thanks and pray for permission to gather (Stevens, unpublished field notes, 1998). Often tobacco or other offerings are given before beginning to gather. Willow bark is optimally gathered in the spring just before the buds appear and the sap rises; the bark can easily be slipped off the stem While still gathered from the time leaves fall in autumn, the bark has to be scraped from the stem and take more time and effort to prepare. Willow stems are coppiced for long, straight, pliable stems. Coppicing occurs through Indigenous Traditional Management practices, Traditional Fire Management, and with help from beavers, gathering stems.

A bed or sleeping bench of willow poles raised high off the ground indicated a wealthy man in the Miwok culture in California's Sierra Nevada. Willow is used to build ramadas or shade structures, for willow ribs in boats, to construct sweat lodges, and for different games. Willow has many medicinal uses, including tea for overall health, to reduce inflammation, used as an analgesic to treat infections, and as a poultice for skin ulcers.

Mugwort (*Artemisia douglasiana*)

Ethnobotany - Medicinal and Ceremonial: Mugwort (kachinu in Miwok) is an important spiritual and medicinal plant for many California tribes, including the Nissenan, Miwok, and Maidu people of the lower American River parkway. Douglas' sagewort (mugwort) is revered by. This plant is used in ceremonies for spiritual healing and to ward off bad spirits or energy and ghosts. It is often used as a smudge for spiritual purification. Mugwort is especially important after the death of a family member and for repatriation ceremonies (Duncan, 1961; MacCarthy, 2012). It is often placed in several locations in the home for protection (McCarthy et al., 2012). Miwok would plug their nostrils with its leaves, using the aroma to clear their heads (Barrett and Gifford,1933).

Other uses: Mugwort has insect-repellant properties. Leaves were placed in baskets and food storage containers to keep pests away. (Reid et al., 2009.). A Chumash myth indicates that leaves were used to line baby cradles (Timbrook, 2007). Leaves would be burned to stave off mosquitos (Bocek, 1982; Duncan, 1961). The Costanoan burned its branches to smoke bees from nests (Bocek, 1982).

Medicinal Uses: Many California tribes use mugwort for its many medicinal applications. The Miwok use the leaves to prepare a tea that is sipped to reduce swelling in any part of the body and use it to relieve prostate problems. (McCarthy et al 2012). Mugwort is commonly used as a remedy for poison oak rash (Duncan, 1961; McCarthy et al., 2012; Timbrook, 1990; 2007). Reports in the literature from the Costanoans, Pomo, and Maidu document its use as an analgesic to treat colds, fevers, and respiratory problems such as bronchitis and asthma (Bocek, 1982; Chestnut, 1902: Duncan, 1961); and for headaches and earaches (Barrett and Gifford, 1933; Bocek, 1982). Mugwort is also used as a compress for wounds, to treat sores and peptic ulcers, and urinary problems (Bocek, 1982). It was used regularly for women's health issues, such as treating premenstrual syndrome, improving circulation after childbirth (Chestnut, 1902), and terminating difficult pregnancies (Somaweera et al., 2013).

Mugwort (*Artemisia douglasiana*) at Bushy Lake (Photo by Alexandra von Ehrenkrook)

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Appendix C: California Rapid Assessment Methodology (CRAM) Methodology

METHODS - What is the California Rapid Assessment Method - Framework of the CRAM

A CRAM was conducted at Bushy Lake in 2016 and 2022 in order to provide a rapid means of checking progress along restoration trajectories. In 2016, we used CRAM to evaluate the health of the Bushy Lake depressional ecosystem as a baseline assessment. In 2022, at approximately the same time of year, we conducted post restoration CRAM analysis for comparison. CRAM is an efficient and cost-effective tool to assess the condition of a wetland ecosystem and the stressors that affect it (Stein et al., 2009). This methodology can be performed on scales ranging from an individual wetland to a watershed or a larger region (EcoAtlas 2016). Wetlands can also be evaluated to detect changes over periods of time. This information can then be used in planning wetland monitoring and restoration activities (EcoAtlas 2016).

What is the California Rapid Assessment Method?

The U.S. Environmental Protection Agency (USEPA) has proposed a three-tiered monitoring paradigm (Level 1-2-3) that provides a structured framework for conducting more integrated assessments of wetland resources across multiple scales (Solek et al 2008; Stein et al 2009). The California Rapid Assessment Method (CRAM) is a level two rapid assessment method used to provide rapid and scientifically defendable data regarding a given wetland's conditions at the time of the assessment. This method has been approved by the California Water Quality Monitoring Council and has been subjected to the peer review process of the California State Water Resources Control Board and California Environmental Protection Agency (EcoAtlas, 2014). The "Water Quality Control Plan for Wetlands" clarifies the State Water Boards' existing authority in protecting the beneficial uses of wetlands from pollution under both Porter Cologne and 401 certification of the Clean Water Act.

The framework of the CRAM is divided into three levels:

1.) Landscape Assessment (Level 1) uses remote sensing data and field surveys to catalogue the wetlands of a region (EcoAtlas, 2014).

2.) Rapid Assessment (Level 2) uses field diagnostics and existing data to assess conditions at wetland sites (EcoAtlas, 2014).

3.) Intensive Site Assessment (Level 3) provides the field data necessary to validate the CRAM, characterizes reference condition, and tests hypotheses about the causes of wetland conditions as observed through Levels 1 and 2 using quantitative methods such as assessment of plant community composition and soils analysis (EcoAtlas, 2014).

This report does not include a thorough description of the California Rapid Assessment Method; this information may be obtained from the CRAM website (www.cramwetlands.org), including information about the development, application, and implementation of CRAM. In general, it is important for present purposes to emphasize that CRAM is an assessment method for wetland condition; CRAM is not a wetland identification/delineation methodology or a wetland functional assessment methodology.

CRAM Depressional Module Assessment Areas

The CRAM field evaluation was conducted using the Depressional Module (CWMW 2013, Version 6.1). According to the existing CRAM classification system for wetlands (CRAM Depressional Wetlands Field Book 2013, Version 6.1). Depressional wetlands occur in topographic lows (i.e., closed elevation contours) that allow the accumulation of surface water and, in some cases, groundwater. These systems can be natural or artificial in origin and can occur on the landscape as isolated basins with distinct boundaries, or as a complex of shallows and seasonally wet depressions created by the slight topographic relief with indistinct boundaries, or as a large complex of interconnected basins.

Depressional wetlands often lack a direct hydrologic connection to surface waters, and their hydrologic regime may be determined by groundwater discharge, overland runoff, and precipitation (CRAM Depressional Wetlands Field Book 2013, Version 6.1). However, many depressional wetlands (e.g., stockponds, constructed wetlands, or oxbows) are directly connected to surface waters and. Depressional wetlands can be perennial (perennially/permanently flooded) or seasonal (seasonally or temporarily flooded), and may lack surface ponding or saturated conditions during dry years1. As defined by CRAM, perennially flooded depressional wetlands have some amount of surface ponding for at least 9 months during most years (i.e. in greater than 5 out of 10 years). Seasonally flooded depressional wetlands are defined as supporting surface ponding for between 4 and 9 months of the year, and temporarily flooded depressional wetlands possess surface water between 2 weeks and 4 months of the year.

Explaining Attributes and Metrics

Depressional CRAM module focuses on characterizing the following attributes for each wetland class: 1) Buffer and Landscape Context, 2) Hydrology, 3) Physical Structure, and 4) Biotic Structure. Each CRAM module assesses these same four attributes, although the metrics used in each module vary to address class-specific relationships within a wetland. In each module, an "Index Score" is calculated as the average of the four attribute scores. Interpreting the results of a CRAM application requires the researcher to consider the effects of each attribute score. (CRAM metrics are subject to change as site conditions change over time, so they can be very sensitive indicators of change, such as those caused by restoration projects.) Indicators that make up the various sub-metrics of each attribute have been found to directly correlate to the overall condition of the ecosystem (Stein et al., 2009). The sub-metrics of each attribute are totaled into a raw score; then, a final score is calculated for each attribute. The final Index Score for the assessment area is calculated from the average of the four final attribute scores (CWMW 2013, Version 6.1).

1.0 Attribute 1: Buffer and Landscape Context

Aquatic Area Abundance

Aquatic Area Abundance is a measure of an assessment area's spatial association with other aquatic resources; it measures the distance of the closest aquatic feature to the study site in the four cardinal compass directions CRAM Depressional Wetlands Field Book 2013, Version 6.1).

1.1 Percent of Assessment Area with Buffer

The percent of assessment area with buffer metric assesses the overall quality and presence of the buffer (CWMW 2013, Version 6.1). All assessment areas are surrounded by cover types that provide 100% buffer. This metric score is unlikely to change.

1.2 Average Buffer Width

The average buffer width measures the ability of the buffer to serve as habitat for wildlife, to reduce the inputs of non-point source contaminants, to control erosion, and to protect the wetland from human activities (CWMW 2013, Version 6.1).

1.3 Buffer Condition

The buffer condition assesses the extent and quality of plant cover, the overall condition of the substrate (soil disturbance), and the amount of human visitation (CWMW 2013, Version 6.1).

2.0 Attribute 2: Hydrology –

2.1 Water Source

The water source affects the extent, duration, and frequency of saturated or ponded conditions within an Assessment Area and assesses whether water inputs to the site are from natural or artificial sources (CWMW 2013, Version 6.1).

2.2 Hydroperiod

The hydroperiod is the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. Depressional wetlands typically have a high degree of variation; this metric assesses the seasonal patterns of the water levels and how closely these levels correspond to natural inundation/drainage cycles (CWMW 2013, Version 6.1).

2.3 Hydrologic Connectivity

The hydrologic connectivity assesses water flowing into and out of the wetland and the wetland's ability to accommodate floodwaters (CWMW 2013, Version 6.1).

3.0 Attribute 3: Physical Structure

3.1 Structural Patch Richness

The structural patch richness metric is a surrogate for determining potential habitat types for both terrestrial and aquatic species and is evaluated using 17 different patch types (CWMW 2013, Version 6.1).

3.2 Topographic Complexity

This metric refers to the micro- and macro-topographic relief and variety of elevations within a wetland due to physical and abiotic features and elevation gradients that affect moisture gradients of that influence the path of flowing water (CWMW 2013, Version 6.1).

4.0 Attribute 4: Biotic Structure

4.1 Number of plant layers

The CRAM methodology for assessing Biotic Structure is composed of the number of plant layers, the number of co-dominant plant species, and percent invasive species (CWMW 2013, Version 6.1). To be counted as a plant canopy layer (floating/canopy forming, short, medium,

tall, and very tall), the layer must cover at least 5% of the assessment area and include only those plants within prescribed plant heights. Having more plant layers is important for habitat complexity and preventing encroachment of invasive species.

4.2 Number of co-dominant species

Once a layer has been determined, the co-dominant plant species represent at least 10% relative cover of the assessment area (CWMW 2013, Version 6.1). The total numbers of co-dominant species are summed from each plant layer, and are counted only once.

4.3 Percent invasion

The percent invasion calculates the percent of invasive plant species from the dominant plant species for all layers of plants in the assessment area (CWMW 2013, Version 6.1). The invasive status for many California wetland and riparian plant species is based on the Cal-IPC list.

4.4 Number of Upland Encroachment Groups

This metric considers the presence of specific species groups within the assessment area, which indicate the degree of encroachment of upland vegetation into the wetland (CWMW 2013, Version 6.1).

4.5 Horizontal Interspersion

Horizontal Interspersion refers to the variety and interspersion of plant "zones," or patches of monocultures or obvious multi-species association that are arrayed along gradients of elevation, moisture, or other environmental factors that seem to affect the plant community organization in a two-dimensional plan view. Interspersion is essentially a measure of the number of distinct plant zones or "communities AND the amount of edge between them (CWMW 2013, Version 6.1).

4.6 Plant Life Forms

The Plant Life Forms metric captures the number of different plant structure types that are present within the assessment area (CWMW 2013, Version 6.1). Each plant life forms provides unique functions for animal habitat as well as influencing hydrologic and physical processes.

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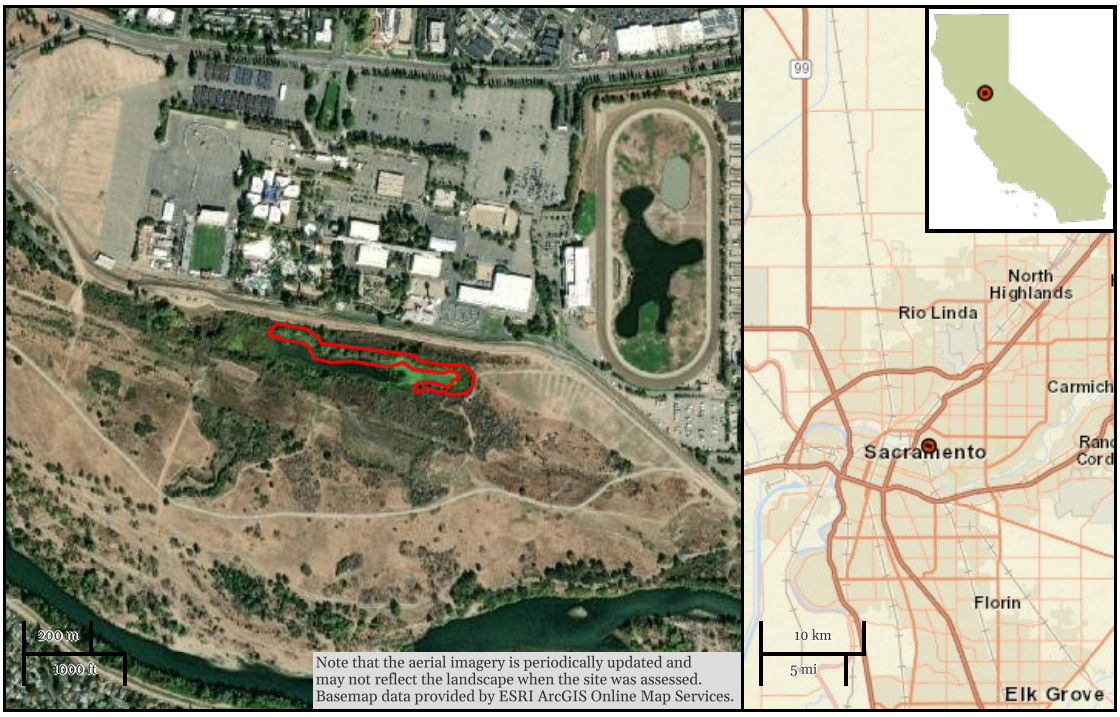
CRAM

California Rapid Assessment Method

Summary Assessment Report



Basic Information

eCRAM ID	8844
Assessment Area Name	Bushy Lake Restoration Project
Project Name	
Assessment Area ID	Bushy 22-1
Project ID	Buchy Lake Restoration Project 22-2
Wetland Type	perennial/seasonal depressional
CRAM Version	6.1
Visit Date	2022-09-23
AA Category	restoration
Practitioners	Michelle Stevens (other practitioner)
Other Practitioners	Dawn Cunningham, Justin Chappelle, Leticia Morris
County	Sacramento
Ecoregion	sacramento valley
AA Centroid Latitude	38.58893
AA Centroid Longitude	-121.43336
AA Size (Hectares)	1.90809
Is this a public record?	No

Origin of Wetland	artificial
Type of Management	general wildlife, waterfowl/birds
Type of Depressional Wetland	fresh water
AA Encompasses	portion of the wetland
Hydrologic State	ponded/inundated
Apparent Hydrologic Regime	perennially flooded
Does wetland connect with floodplain of nearby stream?	Yes
Does the wetland have a defined outlet?	No
Does the wetland have a defined inlet?	Yes
Are the inlet and outlet at the same location?	No
Is the topographic basin of the wetland distinct?	Yes
Vernal Pool Category	
Comments	Bushy Lake was last surveyes in 2016. There have been a lot of changes on the site, most notably a wildfire in June 2021. The CRAM provides baseline information for development of an Eco Cutlural Restoration Plan

Metric Scores

Attribute	Buffer And Landscape Context	52.79
	Aquatic Area Abundance	D (3)
	Percent Of AA With Buffer	A (12)
	Average Buffer Width	B (9)
	Buffer Condition	B (9)
Attribute	Hydrology	66.67
	Water Source	C (6)
	Hydroperiod	B (9)
	Hydrologic Connectivity	B (9)
Attribute	Physical Structure	87.50
	Structural Patch Richness	B (9)
	Topographic Complexity	A (12)
Attribute	Biotic Structure	100.00
	Number Of Plant Layers Present	A (12)
	Number Of Co-Dominant Species	A (12)
	Percent Invasion	A (12)
	Plant Community Score	12
	Horizontal Interspersion And Zonation	A (12)

	Vertical Biotic Structure	A (12)
Index Score		**77**

Stressors 12 total, 6 with significant negative effect - indicated below with *

Attribute	Biotic Structure
	Excessive human visitation*
	Lack of treatment of invasive plants adjacent to AA or buffer
	Lack of vegetation management to conserve natural resources
	Mowing, grazing, excessive herbivory (within AA)
	Tree cutting/sapling removal*
Attribute	Buffer And Landscape Context
	Active recreation (off-road vehicles, mountain biking, hunting, fishing)*
	Urban residential*
Attribute	Hydrology
	Actively managed hydrology
	Dike/levees*
	Flow diversions or unnatural inflows
	Point Source (PS) discharges (POTW, other non-stormwater discharge)
Attribute	Physical Structure
	Trash or refuse*

This report was created on Sunday February 26, 2023, 3:46 PM using the SFEI eCRAM Mapper at www.cramwetlands.org
The data provided in this report is for informational purposes only and may not be sufficient for the purposes of fulfilling the requirements of a regulatory permit. Please see "Using CRAM (California Rapid Assessment Method) To Assess Wetland Projects As an Element of Regulatory and Management Programs" CWMW, Oct. 13, 2009.

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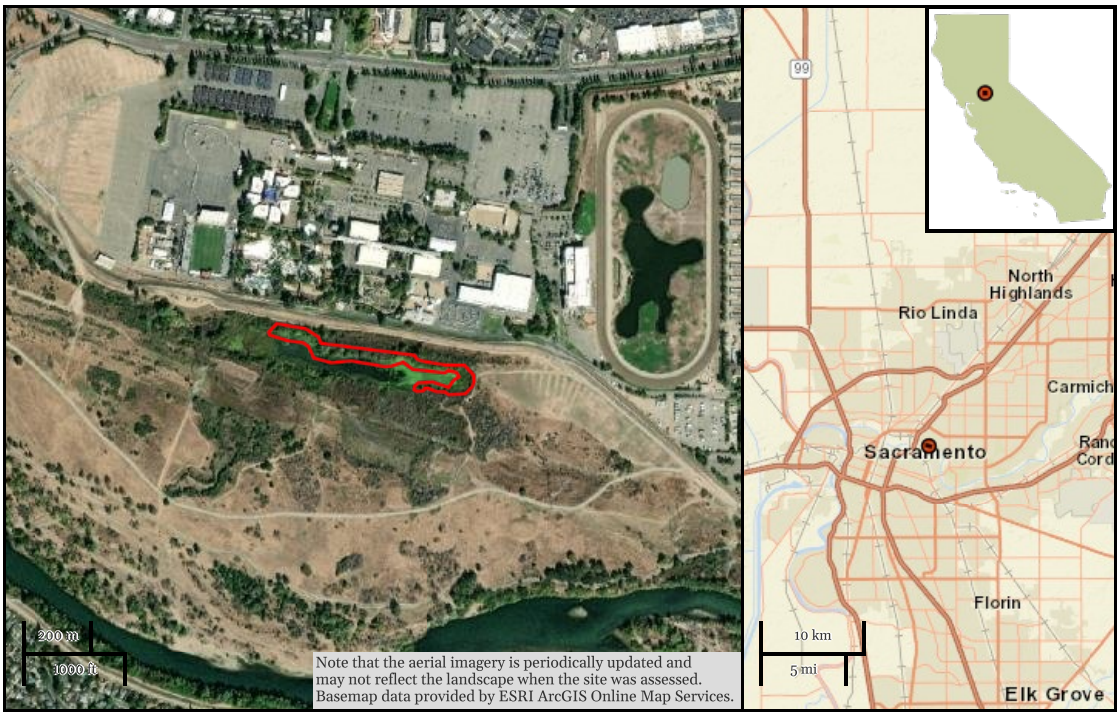
CRAM

California Rapid Assessment Method

Summary Assessment Report



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	Aquatic Area Abundance	D (3)
	Percent Of AA With Buffer	A (12)
	Average Buffer Width	B (9)
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	Water Source	C (6)
	Hydroperiod	B (9)
	Hydrologic Connectivity	B (9)
Attribute	Physical Structure	87.50
	Structural Patch Richness	B (9)
	Topographic Complexity	A (12)
Attribute	Biotic Structure	100.00
	Number Of Plant Layers Present	A (12)
	Number Of Co-Dominant Species	A (12)
	Percent Invasion	A (12)
	Plant Community Score	12
	Horizontal Interspersion And Zonation	A (12)

	Vertical Biotic Structure	A (12)
Index Score		**77**

Stressors 12 total, 6 with significant negative effect - indicated below with *

Attribute	Biotic Structure
	Excessive human visitation*
	Lack of treatment of invasive plants adjacent to AA or buffer
	Lack of vegetation management to conserve natural resources
	Mowing, grazing, excessive herbivory (within AA)
	Tree cutting/sapling removal*
Attribute	Buffer And Landscape Context
	Active recreation (off-road vehicles, mountain biking, hunting, fishing)*
	Urban residential*
Attribute	Hydrology
	Actively managed hydrology
	Dike/levees*
	Flow diversions or unnatural inflows
	Point Source (PS) discharges (POTW, other non-stormwater discharge)
Attribute	Physical Structure
	Trash or refuse*

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Appendix D. Avian species observed at Bushy Lake, state and federal listing status, cultural significance, and habitat use.

D1. Avian species observed at Bushy Lake

Confirmed Nesting	Year-round Resident but not Confirmed Nesting	Summer (Spring through Fall) Resident but not Confirmed Nesting	Winter (Fall through Spring) Resident	Migrant	Flyover Only	CalExpo Racetrack Pond/RV Park Only	eBird Records for Bushy Lake but Surveys haven't been Recorded to Date
Canada Goose	Ring-necked Pheasant	Osprey	Cackling Goose	Sora	Greater White-fronted Goose	Canvasback	Mute Swan
Wood Duck	Pied-billed Grebe	Barn Swallow	Sharp-shinned Hawk	Solitary Sandpiper	Snow Goose	Ring-necked Duck	Cinnamon Teal
Mallard	Rock Pigeon	Cliff Swallow	Merlin	Band-tailed Pigeon	Ross's Goose	Bufflehead	Green-winged Teal
Gadwall	Eurasian Collared-Dove	Northern Rough-winged Swallow	Peregrine Falcon	Vaux's Swift	Tundra Swan	Common Goldeneye	Hooded Merganser
California Quail	White-throated Swift	Wrentit	Say's Phoebe	Black Swift	Northern Pintail	Barrow's Goldeneye	Eared Grebe
Wild Turkey	Virginia Rail	Lark Sparrow	Common Raven	Allen's/Rufous Hummingbird	Northern Shoveler	Common Merganser	Common Gallinule
Mourning Dove	American Coot	Bullock's Oriole	Ruby-crowned Kinglet	Lewis's Woodpecker	American Wigeon	Ruddy Duck	Long-billed Dowitcher
Anna's Hummingbird	Double-crested Cormorant	Hooded Oriole	Blue-gray Gnatcatcher	Olive-sided Flycatcher	Sandhill Crane	Greater Yellowlegs	Spotted Sandpiper
Black-chinned Hummingbird	Great Blue Heron	Western Tanager	Hermit Thrush	Western Wood-Pewee	Long-billed Curlew	Calliope Hummingbird	Cattle Egret
Killdeer	Great Egret	Black-headed Grosbeak	Cedar Waxwing	Pacific-slope Flycatcher	California Gull	Red-breasted Sapsucker	Golden Eagle
Red-shouldered Hawk	Snowy Egret	Blue Grosbeak	American Pipit	Willow Flycatcher	Ring-billed Gull	Mountain Bluebird	Great Horned Owl
Red-tailed Hawk	Green Heron	Lazuli Bunting	Purple Finch	Dusky Flycatcher	Herring Gull	Varied Thrush	Barn Owl
Swainson's Hawk	Black-crowned Night-Heron		Pine Siskin	Warbling Vireo	Glaucous-winged Gull		Loggerhead Shrike
Nuttall's Woodpecker	Turkey Vulture		Fox Sparrow	Purple Martin	"Thayer's" Iceland Gull		Violet-green Swallow
Downy Woodpecker	White-tailed Kite		Dark-eyed Junco	Bank Swallow	American White Pelican		Golden-crowned Kinglet
American Kestrel	Northern Harrier		White-crowned Sparrow	Marsh Wren	White-faced Ibis		Brown Creeper
Black Phoebe	Cooper's Hawk		Golden-crowned Sparrow	Swainson's Thrush	Bald Eagle		Rock Wren
Ash-throated Flycatcher	Belted Kingfisher		Savannah Sparrow	Yellow-breasted Chat	Budgerigar		Phainopepla
Western Kingbird	Acorn Woodpecker		Lincoln's Sparrow	Yellow Warbler	Horned Lark		Scaly-breasted Munia
California Scrub-Jay	Northern Flicker		Western Meadowlark	Wilson's Warbler	Lawrence's Goldfinch		Chipping Sparrow
Tree Swallow	Yellow-billed Magpie		Yellow-rumped Warbler	Black-throated Gray Warbler	Tricolored Blackbird		White-throated Sparrow
Bushtit	American Crow				Great-tailed Grackle		Yellow-headed Blackbird
White-breasted Nuthatch	Oak Titmouse						Northern Waterthrush
Bewick's Wren	House Sparrow						Nashville Warbler
House Wren	American Goldfinch						Palm Warbler
European Starling	Brewer's Blackbird						Townsend's Warbler
Northern Mockingbird	Orange-crowned Warbler						
Western Bluebird							
American Robin							
House Finch							
Lesser Goldfinch							
Song Sparrow							
California Towhee							Key
Spotted Towhee							State Species of Special Concern
Red-winged Blackbird							State Threatened
Brown-headed Cowbird							State Endangered
Common Yellowthroat							State Fully Protected

D2. Habitat use of avian species with state or federal listings and cultural significance.

Species	Habitat Use	Significance	Photo
American White Pelican (*Pelecanus erythrorhynchos*)	Known for its utilization of rivers, lakes, and riparian areas, the American White Pelican likes to utilize bodies of water that are relatively shallow. The areas these species tend to habit are areas that are currently on the decline, like marshlands and lakes like Bushy Lake. Known for skimming the top of the water for fish and insects in some cases (Audobon 2023).	Species of Special Concern (breeding) Priority 3 in California	 Photo taken by Gerrit Vyn (The Cornell Lab 2023).
Yellow Warbler (*Setophaga petechia*)	The Yellow Warbler is known for being very hardy and covering a wide range of areas. The species utilizes areas like the streams left from beaveways such as the willow patches that are along the stream's edge as habitat. Because these areas are heavily covered, they offer protection for the bird as well. Known for eating small insects both flying and ground-dwelling (Audobon 2023).	Considered a Bird Species of Special Concern (breeding), Priority 2 in California Listed as endangered under the United State Federal Endangered Species List	 Photo taken by Brad Imhoff (The Cornell Lab 2023).

Yellow–Breasted Chat (*Icteria virens*)	The Yellow-Breasted Chat utilizes heavily wooded (willow and heavily dense shrub) areas near streams and lakes. The species' ideal habitat is near water since its primary food source is insects and seeds (Audobon 2023).	Currently considered a Bird Species of Special Concern (breeding) Priority 3 in California	 Photo taken by Kent Jensen (The Cornell Lab 2023).
Purple Martin (*Progne subis*)	The Purple Martin is known to utilize more open areas near bodies of water, specifically lakes and streams since their diet consists of insects. They however do utilize dense trees for nesting and have been observed inhabiting previous woodpecker nesting areas since they find safety in heavily covered areas for nesting (Audobon 2023).	Considered a Bird Species of Special Concern (breeding) Priority 2 in California	 Photo taken by Reanna Thomas (The Cornell Lab 2023).

Olive - Sided Fly Catcher *(Contopus cooperi*)	The Olive-Sided Fly species has been primarily observed in high-elevation areas but has been seen in lower-elevation areas and utilizes streams, lakes, and smaller bodies of water. While it has feeding habits for a smaller bird, it can eat almost any insect which is why it favors bodies of water (Audobon 2023).	Considered a Bird Species of Special Concern (breeding) Priority 2 in California	 Photo taken by Luke Seitz (The Cornell Lab 2023).
Black Swift (*Cypseloides niger*)	The Black Swift, while not common in heavily populated areas like Sacramento, has been observed utilizing streams and bodies of water similar to Bushy Lake. They are larger, and their diet consists of flying insects primarily. Their nests are known to be found in areas near water (Audobon 2023).	Considered a Bird Species of Special Concern (breeding) Priority 3 in California	 Photo taken by Michael Bolte (The Cornell Lab 2023).
Vaux's Swift (*Chaetura vauxi*)	The Vaux's Swift is observed in areas of higher populations near streams, rivers, and lakes since these areas are normally heavily populated with flying and ground-dwelling insects, the food sources for this species (Audobon 2023).	Considered a Bird Species of Special Concern (breeding) Priority 2 in California	

			Photo taken by Joachim Bertrands (The Cornell Lab 2023).
Northern Harrier (*Circus hudsonius*)	The Northern Harrier covers a good variety of areas but habit riparian, streams, lakes, and open grassland habitats. It has this kind of variety because of its diverse diets of insects, mammals, and other bird species. This species, while not in the name, is considered to be a hawk (Audobon 2023).	Considered a Bird Species of Special Concern (breeding) Priority 3 in California	 Photo taken by Tom Reed (The Cornell Lab 2023).
Song Sparrow (*Melospiza melodia*)	The Song Sparrow is known for the distinctive song it sings. The habitat this species is known for are streams, brush, and riparian lands. Its main food source is insects, and these areas are abundant in them and are normally heavily covered for protection from predators (Audobon 2023).	Considered a Bird Species of Special Concern (breeding) Priority 3 in California	 Photo taken by Jonathan Irons (The Cornell Lab 2023).

Northern Flicker (*Colaptes auratus*)	Culturally significant in the indigenous community. The Northern Flicker has been observed eating many kinds of food, from insects to fruits and berries depending on the area. Known for needing tree cavities since they are cavity-nesting birds. Willows have also been a popular habitat for this species since they have ample cover from predators (Audobon 2023).	Tribes in Northern California utilize Northern flicker's orange feathers for ceremonies,	 Photo taken by Matt Davis (The Cornell Lab 2023).
Raven (*Corvus corax*)	Culturally significant in the indigenous community. The Raven is a larger bird and is particularly interesting since they can eat a variety of food, even garbage. These birds are very opportunistic and will utilize many areas for nesting, but trees and areas of the mid-and upper canopy have been the ideal range for the species (Audobon 2023).	Culturally significant bird and symbol in Native cultures.	 Photo taken by Christopher Lindsey (The Cornell Lab 2023).