U.S. Fish & Wildlife Service

Stone Lakes National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Assessment

Vision Statement

Stone Lakes National Wildlife Refuge belongs to a limited group among the 540 national wildlife refuges that protect fish, wildlife, and habitat within an urban area. Through collaboration with public and private partners, Stone Lakes conserves and enhances a range of scarce Sacramento-San Joaquin Delta and Central Valley habitats and the fish, wildlife, and plants they support. It sustains freshwater wetlands, wooded riparian corridors, and grasslands that facilitate wildlife movement and compensate for habitat fragmentation. Managed wetlands are of sufficient size to maintain abundant wildlife populations. Grasslands consist of a sustainable mix of native and desirable nonnative species that support a variety of grassland-dependent species. The Refuge reduces further habitat fragmentation and buffers the effects of urbanization on agricultural lands and adjacent natural areas within the Delta region.

The Refuge pursues a land conservation program that complements other regional efforts and initiatives. Management efforts expand and diversify habitats for migratory birds and a range of species at risk. The Refuge promotes cooperative farming opportunities and strives to maintain traditional agricultural practices in southwestern Sacramento County that have proven benefits for migratory birds experiencing declines, such as long-billed curlews (*Numenius americanus*), Swainson's hawks (*Buteo swainsoni*) and sandhill cranes (*Grus canadensis*). Through cooperation with other agencies, conservation organizations, neighbors, and other partners, the Refuge develops and manages wetlands in a manner that reflects historic hydrologic patterns and is consistent with local, State, and Federal floodplain management goals and programs.

Stone Lakes was established as a national wildlife refuge because of passionate support from people who recognized its ecological importance and critical role for the floodplain of the Beach-Stone Lakes basin.. The community sees the Refuge as a sanctuary for fish, wildlife and the habitats upon which they depend, a site for recreation and learning and a natural setting that can enrich their lives according to their values. Visitors representing the area's diversity enjoy increasing opportunities for accessible recreation that harmonizes with Refuge conservation efforts, such as hunting, fishing, wildlife observation and photography. The education community looks to the Refuge as a key partner in environmental education programming. Volunteers from all walks of life find an outlet for their interests and talents in a responsive and appreciative setting.

Disclaimer

CCPs provide long term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Stone Lakes
National Wildlife Refuge

Draft Comprehensive Conservation Plan

Prepared by:
U.S. Fish and Wildlife Service
California/Nevada Refuge Planning Office
2800 Cottage Way, W-1832
Sacramento, CA 95825

Stone Lakes National Wildlife Refuge
1624 Hood-Franklin Road
Elk Grove, CA 95758

September 2006

Approved by: _____ **Date**_____

California/Nevada Operations Manager

Contents

1 Introduction 1
Introduction 1
Purpose and Need for the Comprehensive Conservation Plan (CCP) 1
U.S. Fish and Wildlife Service and National Wildlife Refuge System 1
U.S. Fish and Wildlife Service Responsibilities 1
The National Wildlife Refuge System 2
Legal and Policy Guidance 2
Stone Lakes National Wildlife Refuge 5
Location 5
Refuge Setting 5
History of Refuge Establishment and Acquisition 7
Land Protection 7
Land Conservation Methods 8
Partnerships 11
Refuge Purposes 13
Related Projects and Studies in the Area 13
U.S. Fish and Wildlife Service 13
Other Agencies and Projects 14

2 The Planning Process 17
The Planning Process 17
The Stone Lakes CCP Process 17
Issues Identified by the Public 18
Management 18
General Access 19
Boating/Waterskiing 20
Horseback Riding 20
Fishing 20
Hunting 21
Education/Interpretation 22
Wildlife Observation 22
Other Comments 23
General 23

3 Refuge Resources 25
Ecoregion Setting 25
Flyway Setting 25
Natural/Historic Conditions 25
Geographic and Physical Setting 26
Topography 26
Geology 26
Soils 28
Climate 28
Air Quality 28

Contaminants and Water Quality 30
Hydrology 34
Water Supply 35
Biological Resources 36
Plant Communities 36
Wildlife 40
Special Status Species 46
Visitor Services 50
Ecoregion Scale 50
Local Scale 51
Socioeconomic Resources 53
Cultural Resources 54
Cultural Resources 54
Historic Setting 54
Archeology 55
Land Use 56
Wilderness and Other Special Management Areas 56
Current Management Practices 56
Wetlands 56
Mosquito Control 58
Riparian 58
Grasslands 59
Weed Control 60
Farming Program 60
Monitoring and Surveys 61

4 Challenges 63
Invasive Species 63
Basin Hydrology and Water Quality 64
Floodplain Conditions 64
Flood Control Projects 65
Water Quality 66
Land Use Changes 67
Urbanization and Vineyard Conversion 67
Other Human Impacts 67
Air Quality 67
Illegal Activity 67
Mosquito Management 68
Avian Bird Flu 68

5 Refuge Vision, Goals, and Objectives 71
Vision Statement 71
Goals 72

6 Implementation and Monitoring 93
Step-Down Management Plans 93
Funding and Staffing 93
Compliance Requirements 94
Partnership Opportunities 94
Adaptive Management 94
Plan Amendment and Revision 95

References 99

Figures

Figure 1. Ecoregion and Watershed Map 6
Figure 2. Land Status 9
Figure 3. Core and Cooperative WM Areas 10
Figure 4. Refuge Roads and Units 27
Figure 5. Vegetation Map 37
Figure 6. Proposed Habitat Management 73
Figure 7. Proposed Visitor Services Management 74

Tables

Table 1. Invasive Plant Species Targeted for Control on the Stone Lakes NWR 64
Table 2. Step-down Management Plans 93
Table 3. Estimated Initial Capital Outlay to Implement the CCP 96
Table 4. Estimated Annual Cost to Implement the CCP 97

Appendices 107

Appendix A. Compatibility Determinations 109
Fishing 109
Wildlife Observation and Photography 114
Environmental Education and Interpretation 119
High-speed Boating 124
Recreational Boating 130
Research 137
Plant Gathering 141
Mosquito Monitoring and Control 145
Grazing 162
Appendix B. Environmental Assessment 171
Appendix C. Fire Management Plan 213
Appendix D. Wildlife Species Found on Stone Lakes NWR 301
Appendix E. Fish Species Found on Stone Lakes NWR 311
Appendix F. Wilderness Review 313
Appendix G. Budget Requests: RONS and MMS 315
Appendix H. Endangered Species Act, Section 7 Consultation 317
Appendix I. Response to Comments 319
Appendix J. Plant Species Found on Stone Lakes NWR 321
Appendix K. Glossary 333
Appendix L. Summary of Public Involvement/Comments and Consultation/Coordination 341
Appendix M. Mailing List 343
Appendix N. List of Preparers 345
Appendix 0. Integrated Pest Management Plan for Mosquito-Associated Threats 347

Acronyms

California Department of Boating and Waterways	DBW
California Department of Fish and Game	DFG
California Department of Water Resources	DWR
California Endangered Species Act	CESA
Comprehensive Conservation Plan	CCP
California Department of Transportation	Caltrans
California Department of Parks and Recreation	DPR
California Native Plant Society	CNPS
Endangered Species Act	ESA
Environmental Assessment	EA
Environmental Impact Statement	EIS
Global positioning system	GPS
Memorandum of Agreement	MOA
Memorandum of Understanding	MOU
National Wildlife Refuge	Refuge
National Wildlife Refuge System	Refuge System
National Wildlife Refuge System Improvement Act of 1977	Improvement Act
Natural Resources Conservation Service	NRCS
National Environmental Policy Act	NEPA
Native American Grave Protection and Repatriation Act	NAGPRA
Sacramento-San Joaquin Delta	Delta
Stone Lakes National Wildlife Refuge	Refuge
Sacramento Regional County Sanitation District	SRCSD
State Water Resources Control Board	SWRCB
Sacramento Regional Wastewater Treatment Plant	SRWTP
Sacramento-Yolo Mosquito and Vector Control District	SYMVCD
University of California	UC
U.S. Army Corps of Engineers	USACE
U.S. Environmental Protection Agency	USEPA
U.S. Fish and Wildlife Service	Service
U.S. Department of Agriculture	USDA
U. S. Geological Survey	USGS

1 Introduction

Introduction

Stone Lakes National Wildlife Refuge (Refuge) was established in 1994, becoming the 505th refuge in the National Wildlife Refuge System (NWRS). The Refuge boundary encompasses about 17,640 acres; this includes a core Refuge area of about 9,000 acres and a 9,000 acre "Cooperative Wildlife Management Area" where the Service first seeks to enter into cooperative agreements and memoranda of understanding with landowners or purchase conservation easements.. The Service actively manages about 6,200 acres. The Refuge is located in the Beach-Stone Lakes Basin within the Sacramento Valley in southwestern Sacramento County; it lies about ten miles south of the city of Sacramento, straddling Interstate-5 from the town of Freeport south to Lost Slough.

Purpose and Need for the Comprehensive Conservation Plan (CCP)

The Service prepared this draft CCP to guide management of fish, wildlife, plants, other natural resources and visitor use on the Refuge for the next 15 years. The Comprehensive Conservation Plan (CCP) is flexible; it will be revised periodically to ensure that its goals, objectives, implementation strategies and timetables remain valid and appropriate. Major revisions require and provide a process for public involvement and National Environmental Policy Act (NEPA) review, if needed.

The NWRS Improvement Act of 1997 requires that the Service develop a CCP for each refuge by 2012, and that refuges be managed in a way that ensures the long-term conservation of fish, wildlife, plants, and their habitats and provides for compatible wildlife-dependent recreation. The purposes for developing a CCP are:

- Provide a clear statement of direction for the future management
- Provide long-term continuity in Refuge Complex management;
- Communicate the U.S. Fish and Wildlife Service's management priorities for the Refuges to their conservation partners, neighbors, visitors, and the general public;
- Provide an opportunity for the public to help shape the future management of the Refuges;
- Ensure that management programs on the Refuges are consistent with the mandates of the National Wildlife Refuge System (Refuge System) and the purposes for which each Refuge was established;
- Ensure that the management of the Refuges fully considers resource priorities and management strategies identified in other Federal, State, and local plans;
- Provide a basis for budget requests to support the Refuge's needs staffing, operations, maintenance, and capital improvements; and
- Evaluate existing and proposed uses of each refuge to ensure that they are compatible with the refuge purpose(s) as well as the maintenance of biological integrity, diversity, and environmental health.

U.S. Fish and Wildlife Service and National Wildlife Refuge System

U.S. Fish and Wildlife Service Responsibilities

The U.S. Fish and Wildlife Service (Service) is the primary Federal agency responsible for conserving and enhancing the nation's fish and wildlife populations and their habitats. Although this responsibility is shared with other Federal, State, Tribal, local, and private entities, the Service

has specific responsibilities for migratory birds, threatened and endangered species, inter-jurisdictional fish and certain marine mammals. The Service has similar responsibilities for the lands and waters it administers to support the conservation and enhancement of fish and wildlife.

The National Wildlife Refuge System

The National Wildlife Refuge System (NWRS) is the largest system of lands in the world dedicated to the conservation of fish and wildlife. Operated and managed by the Service, it currently includes 545 refuges with a combined area of more than 94 million acres. The majority of refuge lands (over 77 million acres) are located in Alaska. The remaining acreage is scattered across the other 49 states and several island territories. About 20.6 million acres are managed as wilderness under the Wilderness Act of 1964.

The Service has specific responsibilities for migratory birds such as this great egret.
Photo by Tom Harvey, USFWS

The NWRS started in 1903, when President Theodore Roosevelt protected an island with nesting pelicans, herons, ibis, and roseate spoonbills in Florida's Indian River from feather collectors decimating their colonies. He established Pelican Island as the nation's first bird sanctuary and went on to establish many other sanctuaries for wildlife during his tenure. This small network of sanctuaries continued to expand, later becoming the NWRS. In contrast to other public lands, which are managed for multiple uses, refuges are specifically managed for fish and wildlife conservation.

The mission of the NWRS, established by the NWRS Improvement Act of 1997, is:

"To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

The goals of the NWRS, as established by the Draft Policy on the NWRS (January 16, 2001), are:

- To fulfill our statutory duty to achieve refuge purpose(s) and further the System mission.
- Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate migratory bird, interjurisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife, and plants.
- Conserve and restore where appropriate representative ecosystems of the United States, including ecological processes characteristic of those ecosystems.
- Foster understanding and instill appreciation of native fish, wildlife, and plants and their conservation by providing the public with safe, high-quality, and compatible wildlife-dependent visitor use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

Legal and Policy Guidance

Legal mandates and Service policies govern the Service's planning and management of the NWRS. A list and brief description can be found at the "Division of Congressional and Legislative Affairs, USFWS" Web site (http://laws.fws.gov). In addition, the Service has developed draft or final policies to guide NWRS planning and management. These policies can be found at the "NWRS Policies" Web site (http://www.fws.gov/refuges/policymakers/nwrpolicies.html). The main sources of legal and policy guidance for the CCP and EA are described below.

National Wildlife Refuge System Improvement Act of 1997

Statutory authority for Service management and associated habitat management planning on units of the NWRS is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), which was significantly amended by the National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act, 16 U.S.C. 668dd-668ee). Section 4(a)(3) of the Refuge Improvement Act states, "With respect to the National Wildlife System [NWRS], it is the policy of the United States that – (A) each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was established…" The Refuge Improvement Act also states that the "…purposes of the refuge and purposes for each refuge mean the purposes specified in or derived from law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit."

The Refuge Administration Act, as amended, clearly establishes wildlife conservation as the core NWRS mission. House Report 105-106, accompanying the Refuge Improvement Act, states "…the fundamental mission of our System is wildlife conservation: "… wildlife and wildlife conservation must come first." In contrast to some other systems of federal lands which are managed on a sustained-yield basis for multiple uses, the NWRS is a primary-use network of lands and waters. First and foremost, refuges are managed for fish, wildlife, plants, and their habitats. In addition, units of the NWRS are legally closed to all public access and use, including economic uses, unless and until they are officially opened through an analytical, public process called the refuge compatibility process. With the exception of refuge management activities which are not economic in nature, all other uses are subservient to the NWRS' primary wildlife management responsibility and they must be determined compatible before being authorized.

The Refuge Improvement Act provides clear standards for management, use, planning, and growth of the NWRS. Its passage followed the promulgation of Executive Order 12996 (April 1996), "Management of Public Uses on National Wildlife Refuges", reflecting the importance of conserving natural resources for the benefit of present and future generations of people. The Refuge Improvement Act recognizes that wildlife-dependent recreational uses including hunting, fishing, wildlife observation and photography, and environmental education and interpretation, when determined to be compatible with the mission of the System and purposes of the Refuge, are legitimate and appropriate public uses of the Refuge System. Section 5 (C) and (D) of the Refuge Improvement Act states "compatible wildlife-dependent recreational uses are the priority general public uses of the Refuge System and shall receive priority consideration in planning and management; and when the Secretary determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated, subject to such restrictions or regulations as may be necessary, reasonable, and appropriate."

The Refuge Improvement Act also directs the Service to maintain adequate water quantity and quality to fulfill the NWRS mission and refuge purposes, and to acquire, under state law, water rights that are needed for refuge purposes.

Compatibility Policy

Lands within the NWRS are different from other multiple use public lands in that they are closed to all visitor uses unless specifically and legally opened. The Improvement Act states ". . . the Secretary shall not initiate or permit a new use of a Refuge or expand, renew, or extend an existing use of a Refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety." The Improvement Act also states that ". . . compatible wildlife-dependent recreational uses (hunting, fishing, wildlife observation

and photography, or environmental education and interpretation) are the priority general public uses of the System and shall receive priority consideration in Refuge planning and management."

In accordance with the Improvement Act, the Service has adopted a Compatibility Policy (603 FW 2) that includes guidelines for determining if a use proposed on a national wildlife refuge is compatible with the purposes for which the refuge was established. A compatible use is defined in the policy as a proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the NWRS mission or the purposes for which the Refuge was established and contributes to the maintenance of biological integrity, diversity, and environmental health. The Policy also includes procedures for documentation and periodic review of existing refuge uses.

When a determination is made as to whether a proposed use is compatible or not, this determination is provided in writing and is referred to as a compatibility determination. An opportunity for public review and comment is required for all compatibility determinations. For compatibility determinations prepared concurrently with a CCP or step-down management plan, the opportunity for public review and comment is provided during the public review period for the draft plan and associated NEPA document. The Refuge has completed draft compatibility determinations for fishing, wildlife observation and photography, environmental education and interpretation, high speed boating, recreational boating, research, grazing, plant collecting, and mosquito monitoring and control. These compatibility determinations will be finalized with the CCP. The compatibility determinations prepared in association with this draft CCP/EA are provided in Appendix A.

Biological Integrity, Diversity, and Environmental Health Policy

Section 4(a)(4)(B) of the Refuge Improvement Act states, "In administering the System, the Secretary shall…ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans…" This legislative mandate represents an additional directive to be followed while achieving refuge purposes and the NWRS mission. The Act requires the consideration and protection of a broad spectrum of fish, wildlife, plant, and habitat resources found on a refuge. Service policy guiding implementation of this statutory requirement provides a refuge manager with an evaluation process to analyze his/her refuge and recommend the best management direction to prevent further degradation of environmental conditions; and, where appropriate, and in concert with refuge purposes and NWRS mission, to restore lost or severely degraded resource components. Within the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3[3.7B]), the relationships among biological integrity, diversity, and environmental health; NWRS mission; and refuge purposes are explained as follows, "…each refuge will be managed to fulfill refuge purpose(s) as well as to help fulfill the System mission, and we will accomplish these purpose(s) and our mission by ensuring that the biological integrity, diversity, and environmental health of each refuge are maintained and where appropriate, restored."

When evaluating the appropriate management direction for refuges, Refuge Managers will use sound professional judgment to determine their refuge's contribution to biological integrity, diversity, and environmental health at multiple landscape scales. Sound professional judgment incorporates field experience, an understanding of the refuge's role within an ecosystem, and the knowledge of refuge resources, applicable laws and best available

science, including consultation with resource experts both inside and outside of the Service.

The priority visitor uses of the NWRS are not in conflict with this policy when they have been determined to be compatible. The directives of this policy do not envision or necessitate the exclusion of visitors or the elimination of visitor use structures from refuges; however, maintenance and/or restoration of biological integrity, diversity, and environmental health may require spatial or temporal zoning of visitor use programs and associated infrastructures. General success in maintaining or restoring biological integrity, diversity, and environmental health will produce higher quality opportunities for providing wildlife-dependent recreational uses.

Draft Wilderness Stewardship Policy Pursuant to the Wilderness Act of 1964
This policy updates guidance on administrative and public activities on wilderness and proposed wilderness within the NWRS. The purpose of the policy is to prescribe how the Service:
"preserves the character and qualities of designated wilderness while managing for the refuge establishing purpose(s), maintains outstanding opportunities for solitude and primitive and unconfined type of recreation, and conducts minimum requirements analyses before taking any action that may impact wilderness character."

The policy emphasizes recreational uses that are compatible and wilderness-dependent. The policy clarifies conditions upon which generally prohibited uses (motor vehicles, motorized equipment, mechanical transport, structures, and installations) may be necessary for wilderness protection. It confirms that:
"we will generally not modify habitat, species population levels, or natural ecological processes in refuge wilderness unless doing so maintains or restores ecological integrity that has been degraded by human influence or is necessary to protect or recover threatened or endangered species."

National Environmental Policy Act of 1969
This Draft CCP and associated National Environmental Policy Act (NEPA) document has been prepared consistent with the requirements of NEPA, the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR Secs. 1500 et seq.), and the Department of Interior's NEPA procedures (Department Manual, Part 516).

Stone Lakes National Wildlife Refuge

Location

The Refuge is located in southern Sacramento County, west of the city of Elk Grove. It lies within the Morrison Creek, Cosumnes River and Mokelumne River watersheds as well as the Sacramento-San Joaquin Delta (Delta) (Figure 1. Ecoregion and Watershed Map). The approved Refuge boundary is roughly defined by Morrison Creek to the north, Franklin Boulevard and Interstate-5 to the east, the former Southern Pacific Railroad to the west and Lost Slough to the south.

Refuge Setting

Before European settlement, the Beach-Stone Lakes Basin was a magnet for wildlife, such as elk (*Cervus elaphus*), pronghorn (*Antilocapra americana*) and grizzly bear (*Ursus arctos horribilis*). During winter storms, the flooded basin could stretch from lower Morrison Creek to the Mokelumne River, expanding lakes and seasonal wetlands that supported tens of thousands of migratory birds. The land destined to become a national wildlife refuge teemed with wildlife.

The Plains Miwok relied on the land, its plants and its abundant wildlife for survival. These American Indians camped, hunted and fished along the shores of the area's lakes. Historic Beach Lake once covered nearly 1,000 acres and North and South Stone Lakes were also extensive. Located in the heart of the Refuge, the lakes received their names in the mid 1800s from a former landowner, a Sacramento merchant named Rockwell Stone. The Stone family held about 1,000 acres until 1891.

Oregon
Pacific Flyway
Area Enlarged
MODOC NWR
Redding
SACRAMENTO RIVER NWR
SACRAMENTO NWR
DELEVAN NWR
COLUSA NWR
SUTTER NWR
SAN PABLO BAY NWR
MARIN ISLANDS NWR
Sacramento
Stone Lakes National Wildlife Refuge
Morrison Creek
Sacramento/ San Joaquin Delta
Cosumnes River
Local Watersheds
San Francisco
SAN JOAQUIN RIVER NWR
Modesto
SAN LUIS NWR
MERCED NWR
DON EDWARDS SAN FRANCISCO BAY NWR
ANTIOCH DUNES NWR
Fresno
BLUE RIDGE NWR
KERN NWR
PIXLEY NWR
Bakersfield
BITTER CREEK NWR
Nevada
California
Pacific Ocean
Los Angeles
101
99
80
5
580
Figure 1. Watershed and Ecosystem Setting
Stone Lakes
National Wildlife Refuge
Sacramento River Watershed
Central Valley-San Francisco Bay Ecoregion
0 Miles 100
0 Kilometers 100

Changes began in the mid 1800s. Levees were constructed along the Sacramento River and around Delta islands so the land could be farmed. The Southern Pacific Railroad was built, bisecting the basin, allowing nearly complete drainage of its lakes. Finally, Interstate-5 was constructed, ushering in tremendous pressure for urban development.

As Sacramento grew in the mid 1960s, the U.S. Army Corps of Engineers (USACE) suggested building channels in the area to hold floodwaters. Conservation organizations also became interested in the basin in late 1960s, hoping to avoid a major flood control project and keep the area natural. During the same period, a local landowner proposed build a new town for 50,000 people around North Stone Lake.

In response to these pressures and in recognition of the importance of the Stone Lakes Basin floodplain, the State of California and County of Sacramento purchased about 2,600 acres in the 1970s, turning the land over to their respective park departments to manage.

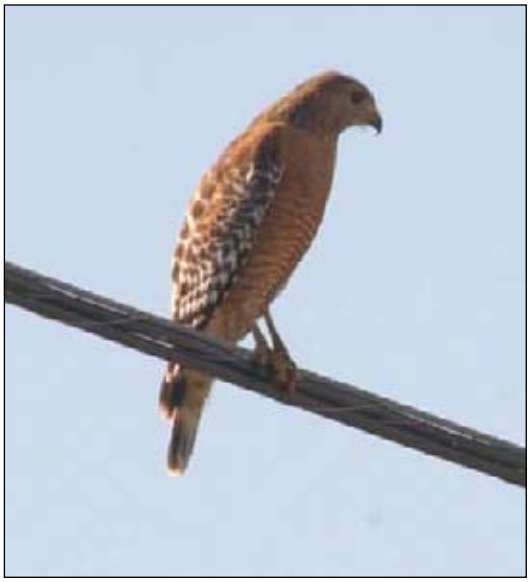
By the late 1980s the idea of further protecting the Stone Lakes Basin by establishing a national wildlife refuge took hold. Support for the Refuge derived partly from the fact that the unique lakes and waterways of the basin lie entirely within the 100-year floodplain. The basin also occupies a strategic location for buffering the effects of urban encroachment into the Delta. Additionally, a national wildlife refuge could potentially provide a link with ongoing nearby land conservation efforts such as the Cosumnes River Preserve.

Several local legislators supported protecting the land from development and were in a position to help move the process forward.

History of Refuge Establishment and Acquisition

In July 1992, the Service completed a complex two year public planning process resulting in finalization of an Environmental Impact Statement (EIS). The EIS (USFWS 1992) defined the present 18,000 acre approved Refuge boundary.

During circulation of the draft EIS, , the Service received written and verbal input from over 6,000 citizens about potential effects a refuge could have on the landscape and the EIS' adequacy in addressing these issues. Despite litigation under NEPA over the adequacy of the EIS , the Service successfully defended its Record of Decision and with a broad base of local support, established the Refuge in 1992.



With a broad base of local support the Refuge was established in 1992, protecting habitat for native species like this red-shouldered hawk.
Photo by Tom Harvey, USFWS

With acquisition of the first property in 1994, the Refuge was officially established as the 505th unit in the National Wildlife Refuge System. It joined the ranks of other local land conservation and management projects, including the Cosumnes River Preserve to the southeast and the Vic Fazio Yolo Bypass Wildlife Area to the west, which have similar goals of protecting and enhancing vital Central Valley fish and wildlife habitats.

Land Protection

The approved boundary for the Refuge--the area within which the Service is authorized to work with willing landowners to acquire and/or manage land is 17,640.7 acres (Figure 2. Land Status). The Refuge consists of a 9,146 acre core area (Figure 3. Core and Cooperative Wildlife Management Areas), encompassing Upper and Lower Beach Lakes and North and South Stone Lakes and a 9,066 acre Cooperative Wildlife Management Area (CWMA), encompassing lands to the east and south of the core area. Within the approved Refuge Boundary, the Service may pursue a number of approaches

to conserve and manage lands, depending on the preferences of willing landowners. These may include: technical assistance, cooperative agreements, memoranda of understanding and acquisition of conservation or agricultural easements and fee title interest. In the EIS (USFWS 1992), the Service agreed to use fee title acquisition within the CWMA only on a case by case basis and after seeking approval by the Sacramento County Board of Supervisors. The preferred approaches to conserve lands within the CWMA are: cooperative agreements, memoranda of understanding, and purchase of conservation or agricultural easements. According to the August 1992 Land Protection Plan for The Refuge, a primary objective of the CWMA is to maintain lands in private ownership and continue agricultural production (Land Protection Plan, Appendix B).

To date, the Service manages about 6,200 acres within the approved project boundary including: 2,933 acres under cooperative agreement; 1,740 acres in fee title ownership; and 1,533 acres under agricultural easement.

The Service is also exploring cooperative management of an additional 2,210 acres within the approved boundary that are owned by two other agencies: (1) Sacramento Regional Sanitation District (1,800 acres); and (2) California Department of Water Resources (410 acres).

Land Conservation Methods

Working with willing landowners and local and state agencies, the Service may use various means to conserve or manage fish and wildlife and their habitats within the approved Refuge boundary. These may include: fee title acquisition, conservation easements, memoranda of understanding and cooperative agreements, financial incentives and technical assistance and education and outreach. It is the established policy of the Service to seek the minimum degree of interest in property needed to accomplish refuge land conservation objectives.

In fee title acquisitions, the Service acquires full ownership of property through fee simple purchase, donation, exchange, or transfer from another Federal agency. Land acquired in fee title by the Service is removed from county tax roles. To partially offset this loss, the Service provides annual payments to counties as authorized by the Refuge Revenue Sharing Act (Public Law 95-469). The Service is required under the U.S. Constitution to pay fair market value for property and purchases are dependent on the availability of funds.

In acquiring a conservation easement, the Service purchases the minimum rights needed to conserve fish and wildlife habitat, while allowing the existing landowner to retain title to the land. Easements may include wetland or waterfowl habitat easements, upland easements, agricultural practices easements and non-development easements. The easement interest acquired by the Service becomes part of the Refuge and is subject to applicable laws and regulations pertaining to refuges. The easement is a permanent interest in the property that runs with the land and the landowner remains responsible for all property taxes About 5,000 acres within the approved Refuge boundary and CWMA are currently publicly owned and managed for conservation purposes by five local and State agencies. A majority of these lands are or will be jointly managed with the Service through memoranda of understanding and cooperative agreements.

The Service may also assist in securing financial incentives for landowners who are not willing to sell an interest in their property but wish to explore conservation or enhancement of fish and wildlife habitats on their property. For example, through the Partners for Fish and Wildlife program, landowners may apply for financial assistance from the Service to protect, enhance, or restore wetland, riparian, or native grassland habitats on their property. In addition, the Service could assist a landowner to secure funds from Farm Bill programs available from the U.S. Department of Agriculture/Natural

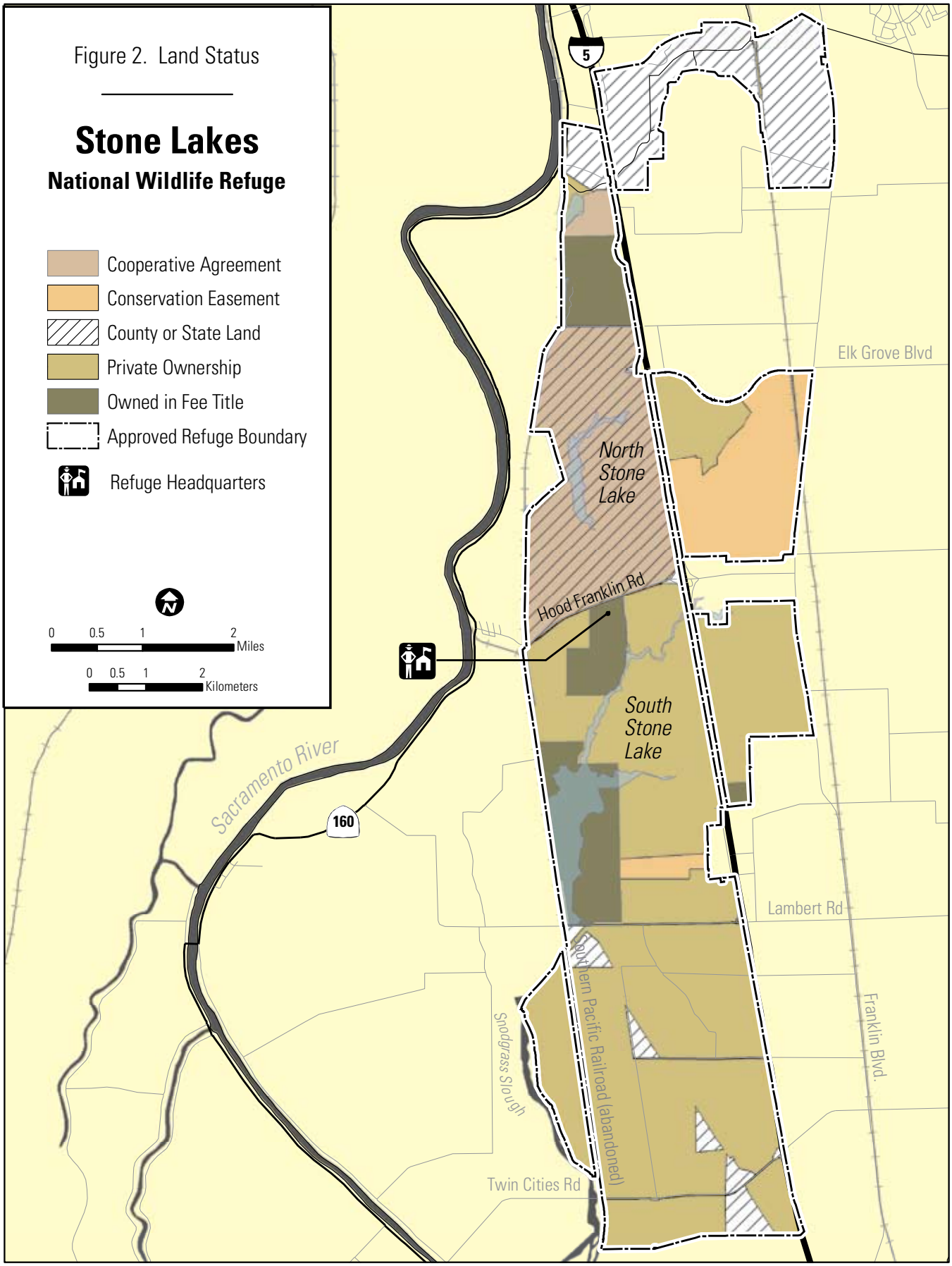


Figure 2. Land Status
Stone Lakes
National Wildlife Refuge
Cooperative Agreement
Conservation Easement
County or State Land
Private Ownership
Owned in Fee Title
Approved Refuge Boundary
Refuge Headquarters
0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
5
Elk Grove Blvd
North Stone Lake
Hood Franklin Rd
South Stone Lake
Sacramento River
160
Lambert Rd
Southern Pacific Railroad (abandoned)
Snodgrass Slough
Franklin Blvd.
Twin Cities Rd

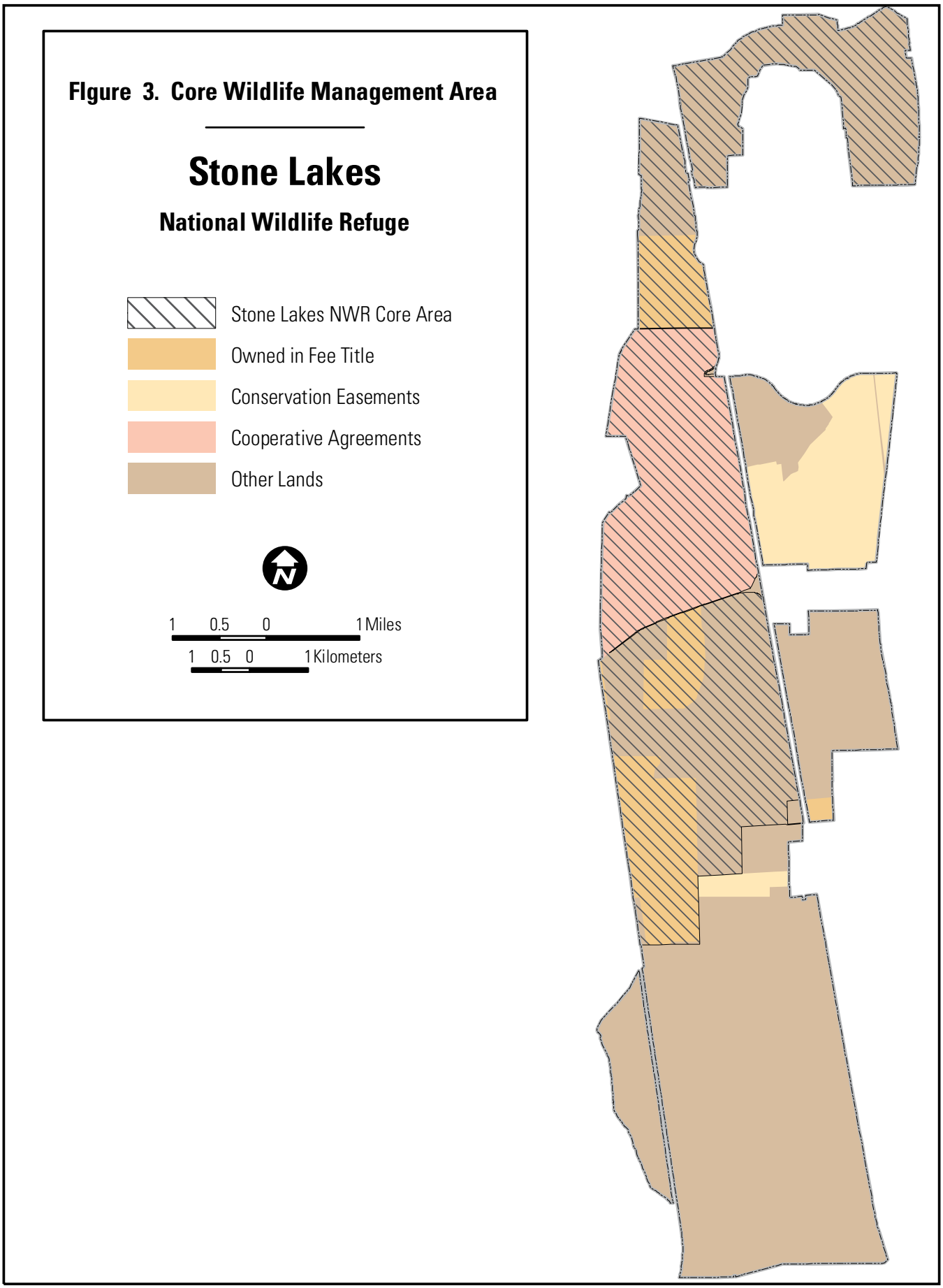


Figure 3. Core Wildlife Management Area
Stone Lakes
National Wildlife Refuge
Stone Lakes NWR Core Area
Owned in Fee Title
Conservation Easements
Cooperative Agreements
Other Lands
N
1 0.5 0 1 Miles
1 0.5 0 1 Kilometers

Resources Conservation Service (NRCS). Potential NRCS programs that could benefit landowners and further Refuge land conservation objectives include the: Conservation of Private Grazing Land Program, Environmental Quality Incentives Program, Farmland Protection Program, Wetlands Reserve Program and Wildlife Habitat Incentives Program. Finally, Service staff is available to provide technical assistance and education and outreach information to willing landowners who are interested in conserving fish and wildlife habitats on their lands.

The Refuge has financed most of its land acquisition and restoration efforts with grants from a wide range of state and federal agencies and private organizations. These sources have played a vital role in advancing the Refuge's land conservation and management programs. Grants have been provided by: City of Sacramento, County of Sacramento, California Wildlife Conservation Board, California Environmental Enhancement Mitigation Fund, California Environmental License Plate Fund, Cigarette and Tobacco Product Surtax, Department of Transportation-TEA 21 Fund, CALFED Bay Delta Program, North American Wetlands Conservation Act, Land and Water Conservation Fund, Central Valley Project Improvement Act, National Fish and Wildlife Foundation, David and Lucille Packard Foundation, The Trust for Public Land and other private donations.

Partnerships

Partnerships have been a cornerstone of Refuge development and management. A consortium of public and private organizations strongly supported the designation of Stone Lakes as a national wildlife refuge and has since been joined by many others as the Refuge has expanded. The Refuge's urban location and the local and state agencies that own land within the Refuge boundary have provided numerous opportunities for partnerships from the Refuge's inception.

The Refuge staff routinely discusses and coordinates restoration activities, jointly applies for grants and discusses other management issues with the Sacramento County Department of Regional Parks, Recreation and Open Space (North Stone Lake Unit), the Sacramento Regional County Sanitation District (Bufferlands) and the California Departments of Transportation (Caltrans) (Beach Lake Mitigation Bank), California Department of Parks and Recreation (DPR) (North Stone Lake Unit) and California Department of Water Resources (DWR) . The Service has finalized a cooperative agreement with Sacramento County Department of Regional Parks, Recreation and Open Space over management of the North Stone Lake unit and partners closely with Sacramento Regional County Sanitation District on the annual event, Walk on the Wildside, and the water hyacinth control program. .

Controlling water hyacinth a nonnative, invasive aquatic plant, has been a prime motivation for formation of an important partnership, the Stone Lakes Water Hyacinth Working Group, in which the Refuge plays a central role. This group includes more than a dozen local and state agencies, organizations, and private individuals who own or manage land in the Stone Lakes Basin, affected by this noxious weed. Recent partners in the group have included: the Refuge, California Department of Boating and Waterways (DBW), Sacramento Regional County Sanitation District (SRCSD), Sacramento County Supervisor Don Notolli, Sacramento County Department of Water Resources, Sacramento County Agricultural Commission, Sacramento-Yolo Mosquito and Vector Control District (SYMVCD), Florin Resource Conservation District, Caltrans, Vino Farms, the Whitney Family, LaRue Schock and the San Francisco Estuary Institute. The working group cooperates on eradication, has applied for and received grants and has produced educational materials to reduce the spread of water hyacinth in local waterways.

Controlling and eliminating invasive water hyacinth, shown here being removed from Lambert Ditch by volunteers, was the prime motivation for another important partnership: the Stone Lakes Water Hyacinth Working Group.
Photo by USFWS

The Refuge also coordinates with California Departments of Fish and Game (DFG) and DBW , Resource Conservation District #813 and Sacramento County Department of Environmental Review on issues of mutual management concern. Much of the restoration that has occurred on Refuge managed land occurred through partnerships with a variety of private organization, including Ducks Unlimited, California Waterfowl Association, Wildlands, Inc., Stone Lakes National Wildlife Refuge Association, American Lands Conservancy, Sacramento Tree Foundation, Safari Club, and Trust for Public Land.

The Service entered into a Memorandum of Understanding (MOU) with SYMVCD in 1993 to address concerns regarding potential effects the Refuge may have on mosquito populations. According to the MOU, the Service agreed to consult with SYMVCD on the design and management of Refuge wetlands and provide access to SYMVCD to monitor the mosquito population on the Refuge. The Service also agreed to submit Pesticide Use Proposals for pesticides SYMVCD may wish to use on the Refuge, if thresholds for larval or adult control are exceeded. SYMVCD and the Service rely on a full range of integrated pest management techniques to manage mosquito populations, including water and vegetation management, biological control (e.g., planting of mosquito fish [*Gambusia affinis*]) and if necessary, chemical control of larval or adult mosquitos. As a result, mosquito larval control activities since 1994 have been largely limited to localized (less than five acres) applications of larvicides and until 2005, and only three applications of an adulticides.

In 2005, West Nile Virus (WNV) became established in Sacramento and Yolo counties, triggering aggressive and widespread mosquito control efforts. In August of 2005 the number of human WNV cases and rate of infected adult mosquitos were so high that SYMVCD conducted aerial applications of pyrethrin over a major portion of Sacramento County (Sacramento County 2006). During 2005, the Refuge received ultra-low volume (ULV) ground treatments of pyrethrin on 18 occasions from September 28 through October 12. As of July 2006, the Refuge has been adulticided six times between June 27 and July 21.

The Service also cooperates with SYMVCD in the monitoring of landbird populations on the Refuge, primarily to evaluate the role of wild bird populations as reservoirs of mosquito-borne diseases, such as western equine encephalitis, St. Louis encephalitis, and West Nile Virus. The landbird monitoring program began in 1995 and involves mist netting and banding of a wide variety of birds. A small blood sample (0.10 cc) is taken from some species for disease analysis. In addition to contributing to the goals of mosquito management, the program has provided valuable information regarding bird use on the Refuge, timing of migration, reproductive ecology and reproductive success.

In addition to those already mentioned, several programs and nongovernmental organizations (NGOs) provide vital support for Refuge land conservation, restoration and visitor services programs, including the CALFED Bay Delta Authority Ecological Restoration Program, Central Valley Project Improvement Act, North American Wetlands Conservation Act, Audubon California, California Native Plant Society, California Waterfowl Association, The Nature Conservancy and Sacramento

Open Space. These groups routinely assist with grant writing and fundraising, coordinate research or census efforts, help with planning programs and activities and provide coverage of Refuge activities in their publications or events.

Refuge Purposes

Lands within the Refuge System are acquired and managed under a variety of legislative acts and administrative orders and authorities. The official purpose or purposes for a refuge are specified in or derived from the law, proclamation, executive order, agreement, public land order, funding source, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit. The purpose of a refuge is defined when it is established or when new land is added to an existing refuge. When an addition to a refuge is acquired under an authority different from the authority used to establish the original refuge, the addition takes on the purposes of the original refuge, but the original refuge does not take on the purposes of the addition. Refuge managers must consider all of the purposes. However, purposes that deal with the conservation, management, and restoration of fish, wildlife and plants and their habitats take precedent over other purposes in the management and administration of a refuge.

The Refuge System Improvement Act directs the Service to manage each refuge to fulfill the mission of the Refuge System, as well as the specific purposes for which that refuge was established. Refuge purposes are the driving force in developing refuge vision statements, goals, objectives and strategies in the CCP. Refuge purposes are also critical to determining the compatibility of all existing and proposed refuge uses.

Stone Lakes National Wildlife Refuge was established under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, The Migratory Bird Conservation Act and The Endangered Species Act of 1973.

According to these authorities, the primary Refuge-wide purposes are:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. §§ 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. §§ 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. §§ 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. §§ 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. §§ 1534 (Endangered Species Act of 1973)

Related Projects and Studies in the Area

U.S. Fish and Wildlife Service

Final Environmental Impact Statement Stone Lakes National Wildlife Refuge (EIS). In 1972, Jones and Stokes Associates prepared an EIS for the Refuge. The purpose of the EIS was to evaluate the effects of various Service alternatives to acquire and protect lands in southwestern Sacramento County to establish the Refuge. The EIS includes interim Refuge management goals and proposed habitat restoration areas.

The interim Refuge management goals are as follows:

- Preserve, enhance, and restore a diverse assemblage of native Central Valley plant communities and their associated fish, wildlife and plants;
- Preserve, enhance, and restore habitat to maintain and assist in the recovery of rare, threatened, and endangered plants and animals;
- Preserve, enhance, and restore wetlands and adjacent agricultural lands to provide foraging and sanctuary habitat needed to achieve the distribution and population levels of migratory waterfowl and other water birds consistent with the goals and objectives of the North American Waterfowl Management Plan and Central Valley Habitat Joint Venture;
- Create linkages between refuge habitats and habitats on adjacent lands to reverse past impacts of habitat fragmentation on wildlife and plants;
- Coordinate refuge land acquisition and management activities with other agencies and organizations to maximize the effectiveness of refuge contributions to regional habitat needs;
- Provide for environmental education, interpretation and fish and wildlife oriented recreation in an urban setting accessible to large populations; and
- Manage riverine wetlands and adjacent floodplain lands in a manner consistent with local, State and Federal flood management; sediment and erosion control, and water quality objectives.

Draft North Stone Lake Management and Restoration Plan. The 2,791 acre North Stone Lake Unit consists of two adjacent parcels owned by the DPR (1,224 acres) and Sacramento County (1,567 acres). The goal of the Service is to cooperatively manage both these properties with the County and the State, as a unit of the Refuge. The Service currently has a cooperative agreement with Sacramento County for management of their property and is drafting an agreement with DPR that addresses the State-owned land. Since Sacramento County has managed both parcels collectively as the North Stone Lake Wildlife Refuge, they drafted a management and restoration plan in 1992. The plan has now been revised and updated by the Service. Some wetland restoration elements in the 1992 plan that were not considered to have neutral effects on floodplain storage were removed or modified in the revision but the plan has not been adopted by Sacramento County. . Under the revised draft plan, the North Stone Lake Unit would be managed for a diversity of native animal and plant species by enhancing and restoring a diversity of wetland and grassland habitats. Once completed, many of the restoration projects will require little management. Other restored habitats, such as seasonal marshes and grasslands, will require intensive management and manipulation.

Other Agencies and Projects

Sacramento Regional Wastewater Treatment Plant and Bufferlands. The Sacramento Regional County Sanitation District (SRCSD) constructed the Sacramento Regional Wastewater Treatment Plant (SRWTP) to treat wastewater for the urbanized area of Sacramento. In addition to constructing the plant, SRCSD purchased 2,650 acres surrounding the treatment plant to serve as a buffer between the plant and surrounding planned and existing residential communities. This land is known as the Bufferlands. Approximately 1,800 acres of the Bufferlands lie within the approved Refuge boundary The Service and SRCSD have drafted a cooperative management agreement for the Bufferlands to be managed a unit of the Refuge. SRCSD restores native habitats such as wetlands, riparian forest, and native grasslands and actively manages the Bufferlands as wildlife habitat. They also provide opportunities for; environmental education, interpretation, wildlife observation and fishing; oversee a volunteer program and partner with the Service and others on the annual Refuge event, Walk on the Wildside.

Vic Fazio Yolo Basin Wildlife Area. The Vic Fazio Yolo Wildlife Area is managed by the California Department of Fish and Game and located along Interstate-80 where

16,000 acres in the Yolo Bypass floodway have been restored to wetlands or support agricultural lands managed for the benefit of fish and wildlife. . The Wildlife Area lies approximately 15 miles northwest of the Refuge and was created through the cooperative efforts of an array of private, State and Federal partners. It covers approximately six square miles and provides visitor opportunities such as bird watching, outdoor educational programs and waterfowl hunting.

Cosumnes River Preserve. The Cosumnes River Preserve is located adjacent to and southeast of the Refuge's approved boundary and just upstream from the confluence of the Cosumnes and Mokelumne rivers. The Preserve was established through the cooperative efforts of a private/public partnership that includes The Nature Conservancy, Ducks Unlimited, U.S. Bureau of Land Management, Sacramento County and California Department of Water Resources. The project strives to conserve and enhance nearly 20,000 acres of riparian forest, wetlands and grasslands along the Cosumnes River, which is the only remaining un-dammed tributary of the Sacramento River.

The Cosumnes River floodplain provides habitat for tens of thousands of migratory waterfowl, songbirds and birds of prey; a large portion of the Central Valley's population of greater sandhill cranes (*Grus canadensis tabida*); and rare reptiles and mammals, such as the endangered giant garter snake (*Thamnophis gigas*). Chinook salmon (*Oncorhynchus tshawytscha*) and Pacific lamprey (*Lampetra tridentate*) spawn and native Delta fish breed and rear their young in the shallow waters of the wetlands.

The Central Valley Joint Venture. The Central Valley Joint Venture (CVJV) is a partnership of private conservation organizations and State and Federal agencies whose goal is to protect, maintain and restore habitat to increase Central Valley waterfowl populations to levels comparable to the 1970s and consistent with other objectives of the North American Waterfowl Management Plan. The Central Valley of California is the most important waterfowl wintering area in the Pacific Flyway, supporting 60 percent of the flyway's duck and goose population. It is especially important that 65 percent of all pintails (*Anas acuta*) in the United States use the Central Valley.

The Cosumnes River floodplain provides habitat for tens of thousands of migratory waterfowl, songbirds, and birds of prey; a large portion of the Central Valley's population of greater sandhill cranes; and uncommon reptiles and mammals, such as these river otters.
Photo by USFWS

CALFED Bay-Delta Authority (CALFED). CALFED, a consortium of stakeholders and State and Federal agencies, is attempting to develop a plan to address water supply and flood control concerns, as well as restoration of fish and wildlife populations of the Sacramento-San Joaquin Delta (Delta). Under CALFED's ecological restoration program funding was made available to purchase the Sun River portion of the South Stone Lake Unit.

Central Valley Project Improvement Act (CVPIA).
The CVPIA was adopted to incorporate conservation and enhancement of fish and wildlife populations into operation of the Central Valley Project by the U.S. Bureau of Reclamation. It provides for the allocation of water supplies for the recovery of native fishes and for State and Federal wildlife management areas. Funding available through the program assisted the Refuge with acquisition of the Headquarters Unit.

2 The Planning Process

The Planning Process

The Refuge Planning Chapter of the Fish and Wildlife Service Manual (Part 602 FW 2.1, November 1996) and evolving policy related to the Refuge System Improvement Act of 1997 help to guide the process followed for developing this Comprehensive Conservation Plan (CCP). Key steps include:

- Gathering information;
- Initiating public involvement;
- Analyzing resource relationships;
- Identifying issues and developing vision and goals;
- Developing alternatives and assessing environmental effects;
- Identifying a preferred alternative;
- Publishing the draft CCP and NEPA document;
- Documenting public comments on the draft CCP;
- Revising the draft CCP and preparing the final CCP;
- Securing approval of the California/ Nevada Operations; and
- Implementing the CCP.

The CCP may be amended at any time, as necessary, under an adaptive management strategy. Public involvement and NEPA review will be required if major revisions are needed.

The Stone Lakes CCP Process

In a Federal Register Notice, dated August 26, 2002, the Service announced that it was preparing a CCP for the Refuge. The first Refuge planning update, distributed in July 2002, provided the public with background about the Refuge and the National Wildlife Refuge System and explained how CCP development fits into the overall picture of refuge management.

The second planning update, released in September 2002, announced a series of the public meetings and explained how the public could become involved in the planning process. The purpose of the meetings was to solicit public involvement in the CCP process and help Service staff identify issues and gather information to help develop the CCP.

This draft CCP and Environmental Assessment (EA) (Appendix C) are being distributed to Refuge cooperators, nearby landowners, State and Federal government agencies, local jurisdictions, private organizations, community groups and private citizens. The public has 30 days from the draft's release to provide comments. A final planning update will be issued at the same time as the final CCP. The draft CCP and EA can also be viewed at the following internet sites: http://stonelakes.fws.gov/publicreview.htm and http://library.fws.gov/ccps.htm.

The CCP will assist Refuge staff with preparation of annual work plans and updating the Refuge Operational Needs System (RONS) database. The RONS database describes the unfunded budget needs for each refuge and is the basis upon which funding increases are allocated for operational needs. The plan may also be reviewed during routine inspections or programmatic evaluations. Results of the reviews may indicate a need to modify the plan. Periodic review of the objectives and strategies is an integral part of the plan, and management activities may be modified if the desired results are not achieved. Depending on the degree that changes may be required, the appropriate level of public involvement and NEPA documentation will be determined by the Refuge Manager. The CCP will be formally revised every 15 years.

Issues Identified by the Public

During the CCP public scoping process, issues, concerns, and opportunities were identified through public meetings, discussions with planning team members and other key contacts. The public had an opportunity to attend four scoping meetings, in Elk Grove, Davis, Walnut Grove and Sacramento, where their comments were recorded. More than 135 people attended these meetings. Over 250 people also provided written comments by mail and email and through personal conversations with the Refuge and planning staffs. During the planning process, the Service has received numerous comments and suggestions regarding the potential for public hunting on the Refuge. Due to opportunities related to recent conveyance of the Sun River property to the Refuge and commitments by the Service to maintain hunting opportunities in the South Stone Lake area, the Refuge opted to establish a public waterfowl hunting program during 2005-2006 through a separate planning process, independently of this CCP. All comments, issues, concerns, and opportunities compiled by the Service are summarized in the following narrative which has been organized by several broad topics.

Public comments, on Comprehensive Conservation Planning for the Refuge, were received in writing, via e-mail, via postal mail and during four public meetings.
Photo by USFWS

Management

Several meeting attendees observed that the future of Refuge wildlife will rely on establishing sanctuary areas separate from visitor use areas, or establishing times within use areas when wildlife are not disturbed. They asked that visitor uses be compatible with Refuge conservation purposes and that management decisions be based on resource values. One group asked the Service to assess the negative impacts of waterfowl management on other native plants and animals and asked the Service to mitigate the impacts of recreational activities. The same group also requested that the Service assess the effects of predator management strategies to protect sensitive, threatened and endangered species. Some hope to see Refuge staff work with the city of Elk Grove and Cosumnes River Preserve to develop an open space greenbelt to contain development.

A number asked about the Refuge land acquisition priorities and plans for potential acquisitions, hoping to see site specific plans developed for each property that is purchased. Others felt the Refuge needs more conservation easements and other land protection strategies. Specific reference was made to the areas east of Interstate-5 and North of Hood-Franklin Road and also South of Lambert Road as places to favor easements over fee title acquisition.

Some local landowners would like to see a balance between historic land uses, such as agriculture, and expanded recreation opportunities. They suggested that the Refuge establish a 500-foot buffer zone for agricultural spraying and other historic farming activities to avoid problems between existing arming activities and Refuge activities and between privately owned lands and Refuge restoration activities.

There were several comments about the Refuge's floodplain location, the need to maintain its floodplain capabilities and concern regarding how proposed activities and landscape modifications would impact flooding. Refuge plans should leave room for Sacramento County or the State to deal

with the Morrison Creek flood problem. They should also recognize that surrounding agricultural lands are on higher ground, providing a natural escape for animals during flooding. Because one of the Refuge's goals is to expand or enhance threatened and endangered species, some neighboring landowners feel they need an incidental take provision that would allow them to continue their farming operations should flooding and endangered species displacement occur.

Along the same lines, concern was expressed about mosquito-related problems and the existing MOU with the Sacramento-Yolo Mosquito and Vector Control District. If an emergency occurs and action is required, there is concern that the bureaucracy will cause unnecessary delays that could impact neighboring private lands. They would like to see some sort of pre-approved plan established for such emergencies.

Some people commented that the Refuge must be a good neighbor and responsible landowner and help pay overhead costs, just as other private landowners. This means that the Refuge should pay water usage fees to the North Delta Water Agency and reclamation districts and pay mosquito abatement costs and other fees. Some feel this has been a source of frustration for ten years and that private landowners cannot subsidize public ownership

A few people asked how the Refuge acquires water rights. One attendee suggested that the Refuge should use treated wastewater because a pipe conveying treated water already passes through the Refuge. People would like to see water quality and groundwater monitored/tested. They would also like assurance that Elk Grove and Sacramento meet clean water standards before their runoff reaches the Refuge. An additional concern regarding waterways relates to the spread of water hyacinth (*Eichhornia crassipes*). A request was made for the Refuge to continue its cooperative program to manage/control water hyacinth and other noxious weeds.

There was a general recognition that Refuge management is labor intensive and that it should be a high priority for the Refuge to have adequate staffing and funding. A suggestion was made to charge day use fees for all activities to help cover management, expansion, fish stocking, etc.

The Delta Protection Commission acknowledged the Refuge's outreach efforts to invite comments during the CCP process. The Commission's comment reflected their mission of keeping as much land in private ownership as is possible within the primary zone of the Delta and working with the habitat values associated with agriculture. The Refuge Staff was also extended an invitation to brief the Commission about CCP progress.

General Access

Many comments expressed concern about the current lack of, or very limited access to the Refuge. There were numerous requests that the Refuge allow many more types of recreational activities and that these expanded opportunities occur soon.

Many types of recreational uses were mentioned. Hunting received the greatest number of requests, from both individuals and hunting organizations. Horseback riders and a water ski group have accessed portions of the Refuge from private lands since prior to its establishment and they asked for continued access. Comments asked for many other types of uses, including fishing, photography, hiking, birdwatching, small boat launching facilities, bicycle trails, dog trials, environmental education, wildlife observation areas and facilities, picnic and day use facilities and a visitor center. They also requested restrooms. They suggested that the Refuge may want to consider camping or rustic lodging facilities.

Some said that the Refuge should obtain the needed funding to fully staff daily operations to allow improved open access. Several meeting attendees expressed the belief that since this is Federal land, it is their right to have opportunities for these activities. And several offered to support these activities by helping to build facilities, patrol the Refuge, or perform other needed work.

Several comments asked that recreational uses be balanced, specifically requesting that hunting be balanced with other uses. They asked that recreational opportunities be allowed in a way that protects wildlife. They suggested that some activities, such as hunting and wildlife viewing, be restricted to specific areas or times to avoid conflicts.

To support their requests, several made comparisons to Yolo Basin Wildlife Area, observing that it originally had less land under management but supported more types and amount of usage, and to the American River Parkway, which allows considerable recreational usage. They suggested thinking about obtaining funding from other sources for these types of programs. A few attendees hoped that the Refuge would remain rustic and unimproved, calling this "symbolic."

Many asked questions about or commented on the waterways as part of the public trust. They wanted to know if the Refuge's waterways were considered navigable and what the Refuge policy would be regarding their use. Historic use of waterways was cited several times, as well as the belief that use of waterways should not be restricted.

Boating/Waterskiing

Several comments asked that the Refuge provide opportunities for sculling, canoeing, and non-motorized boating or boating with trolling motors only; they also requested a ban on jetskis.

Comments fell on both sides of whether to allow waterskiing. Some felt it was inappropriate. Several members of the local water ski club that has used Beach Lake for many years asked the Refuge to allow this historic use to continue, citing that it is a very seasonal, limited use and does not conflict with other uses or wildlife. They suggested creating a designated waterski area. Several waterskiers offered to help the Refuge by picking up trash or acting as docents of the waterways.

The California Canoe and Kayak School, a paddling school and retail center in Northern California, asked if there would be an opportunity to open a commercial operation with docent led activities.

Horseback Riding

Several horseback riders who had accessed the Refuge through the privately owned Beach Lake Stables said there has been historical, "prescriptive" use of the Refuge for horseback riding since 1970. They would like to continue to ride on the Refuge, saying that there are only ten to 15 regular riders who ride seasonally.

Some horseback riders attending the meetings asked that the Refuge be opened to riding, with designated areas for riding and other uses. They commented that riding is low impact and can coexist with wildlife and the six priority visitor uses. They would like the opportunity to show it is compatible and requested restrictions on horseback riding if there is a conflict with hunting. Several riders spoke of their willingness to respect the sensitivity of the ecosystem and remain on trails. They offered to organize a volunteer horse patrol, similar to the Folsom Lake patrol and help maintain trails and report poachers, vandalism, fires, etc.

Others expressed concern as to whether horseback riding and hunting would be compatible with each other. One commenter was concerned about the environmental effects of horseback riding, particularly erosion.

Fishing

Several comments asked about the Refuge's plans regarding fishing. Some said they used to fish at Stone Lakes prior to its designation as a national wildlife refuge and would like the opportunity again. They would like year-round fishing, especially bass fishing.

Comments suggested that fishing and hunting should be separated to avoid conflicts. One comment was that if hunting and fishing are allowed, the hunt area should be closed to fishing on hunt days. Another comment suggested that the Refuge should stock fish to provide good family experiences. The Refuge offers a

great opportunity for reintroduction of Sacramento perch.

Hunting

There is strong support for a hunting program that includes waterfowl and upland birds, including pheasant, dove, and quail. Many people mentioned that hunting has occurred historically at Lodi Gun Club and other parts of the Refuge both to support their request and as rationale for allowing interim hunting on some of these existing Refuge properties. A few attendees asked to include big game hunting, such as deer (with a shotgun) and small game, such as rabbit.

They also pointed out that hunting exists on other refuges. They feel that if the top third of the Refuge is closed to hunting due to County regulations and the bottom third is closed due to agricultural use, then the middle area south of Hood-Franklin Road should be developed for hunting, not as wildlife sanctuaries. They asked whether hunting could be allowed on the State and County properties that the Refuge manages.

Several specifically requested that the Refuge establish an interim compatibility determination to allow hunting now. A few felt that a hunting program should be developed when suitable property and adequate staffing are available.

In terms of access, some feel that nonconsumptive uses, such as wildlife viewing and photography, are being given and will continue to be given precedence over hunting and fishing. They would like to see a balanced program between hunting and non-hunting areas.

Several asked how the Refuge will manage hunting. Some suggested that the Refuge explore how the California Department of Fish and Game (DFG) manages hunting at other Central Valley refuges. They wondered if there is a general agreement between DFG and the Service, or if each refuge establishes their own arrangement.

Several attendees said that hunting is sustainable and supported by numerous organizations. Hunting related purchases can help local businesses. Hunters have a long tradition of helping with conservation, funding and facilities. There were numerous references to fees hunters pay to acquire and manage habitat through the Duck Stamp and Federal excise taxes on hunting equipment. Several want to see if some of these funds could be earmarked for a hunting program or to purchase land for hunting at Stone Lakes. They feel the Refuge should expand wetlands and increase ponds available for hunting. There were offers from many hunters to help fund, develop, build and monitor hunting facilities. There were requests that the Refuge develop interpretive materials explaining the role of hunters in conservation.

A number of people expressed concern over a hunting program. A few mentioned hunting related accidents as a cause for concern. Some moved to the area to get away from places that allow hunting and are opposed to it on the Refuge. They would like to see the Refuge advance, but not at the expense of wildlife. They questioned whether hunting is compatible with conservation goals and other uses, such as education and wildlife viewing. They felt that if it is allowed, hunting should not occur at the same time as these other uses. One group was opposed to both hunting and trapping on the Refuge.

Conversely, some said they bought property close to the Refuge because of the potential public access and the prospect of being able to hunt close to home. Many look to the Stone Lakes Refuge as the potential sole opportunity for public hunting in Sacramento County. They want a place where they can hunt locally, without having to drive a long distance. They expressed a need for a hunting program for hunters who do not belong to a duck club.

Others were concerned whether there are adequate bird populations to support observations and hunting and whether hunting causes too much disturbance.

Hunters expressed their hope that the Refuge would not be like Cosumnes River

Preserve, which they feel promised hunting programs and has failed to provide them.

There was strong consensus on developing a junior hunt program; some suggested it could be supported by volunteers with dogs, time and experience. Several people said that a Refuge hunting program should not be just exclusively for junior hunters. It should also be for adult hunters, both beginners and experienced.

The Refuge received many suggestions regarding the proportion of land to be used for hunting, but most felt that from 40 to 50 percent of the Refuge should be hunted. There was strong interest in splitting access between free roam and blind hunting, including floating blinds and two to four person blinds. There were many requests to carefully locate hunt and sanctuary areas. Blinds should be accessible to those with disabilities.

People also had suggestions regarding how hunting access should occur. Some felt that the Refuge should use a lottery/reservation system and both monitor and limit the number of hunters to assure a quality hunt. Many cited hunting programs at Sacramento, Colusa, Delevan and Gray Lodge as models. They would like to see adequate facilities, such as good land and water access with boat ramps, parking, restrooms and other amenities. A request was made to allow hunting from scull boats and to provide boats to hunters who do no have them.

One commenter was concerned that the Refuge would serve as a sanctuary and draw birds from Yolo (Bypass), negatively affecting hunting in Yolo.

Education/Interpretation

Numerous people commented on the value of the Refuge's educational resources. Several programs were noted, such as school field trips, events and special projects at local schools. Some felt that the primary focus of use for the Refuge should be educational. They would like to see more education programs, including college level research projects. The Refuge should work with teachers to develop a curriculum and teacher/docent training to enhance the Refuge visitation experience. It should also have a field trip coordinator.

The current limited access and Refuge facilities were noted. Comments asked that the Refuge develop trails and facilities for family use and school field trips. A visitor center and signs along trails would help students learn about the unique features of the Refuge. Having greater access to more areas of the Refuge would allow more community involvement. The Refuge should also consider other outreach sites and centers and do what it can to keep these activities free.

Several visitor improvements were suggested, from a visitor center to new interpretive trails. It was suggested that the money for these improvements would not likely come from Refuge funding, but from private fundraising efforts and other organizations.

Wildlife Observation

Several comments supported wildlife viewing, but stated that the priority must be to maintain habitat for wildlife. The Refuge should control access to prevent an impact on wildlife. They also want to be sure that there are no conflicts between wildlife observation, hunting and other uses.

There were several requests for more trails, good interpretive signing and specific suggestions regarding auto tour routes. The Vic Fazio Yolo Basin Wildlife Area auto tour route was cited as an example for avoiding congestion.

An observation was made that birdwatching lacks a funding base. Birdwatchers should pay a use fee to help cover the costs of facilities. A suggestion was made to see if money from DFG fines could be used to build Refuge facilities.

A specific comment was made that the State Railroad Museum is considering an excursion train for wildlife viewing between

the museum and Hood-Franklin Road. We should consider a cooperative venture with them where our interests overlap.

Other Comments

Comments requested other forms of recreational access, such as areas for gun dog training and field trials, bicycle access on existing roads and trapping fur bearing mammals to help reduce the need for a predator control program.

General

A comment was made that the waterways need docents to serve as an extra set of eyes. Two comments were very supportive of the expansion of open space land held by public trust agencies and organizations. This is particularly so for projects involving natural and native habitats, restoration and preservation.

Resource issues and opportunities were also identified during the scoping process. The results of this effort are described in Chapter 4, Problems and Opportunities.

3 Refuge Resources

Ecoregion Setting

Stone Lakes National Wildlife Refuge is located in the Central Valley/San Francisco Bay Ecoregion. This Ecoregion encompasses the Sacramento-San Joaquin Delta located within the San Francisco Bay-Delta Watershed, with an estuary that encompasses roughly 1,600 square miles and drains more then 60,000 square miles of California's runoff (SFEP 2000). The Delta is composed of 57 leveed islands and over 700 miles of sloughs (DWR 2006). The Delta includes the confluence of the two longest rivers in California, the Sacramento and San Joaquin rivers. Following winter rains and Sierra snow melt, the Sacramento River and its tributaries would historically rise above the natural levees and inundate the floodplain. This system was dynamic, depositing rich alluvium, creating and cutting streambanks, providing conditions necessary the growth of riparian forests, changing the river's course and creating oxbow lakes and backwaters, clearing debris and streambeds, exposing and depositing gravel and sand, and creating salmonid spawning habitat. Toward the Delta, with the greater influx of sediment, more substantial natural levees were deposited where larger, more diverse riparian forests occurred (Katibah 1984).

Flyway Setting

The Refuge is located within the Pacific Flyway. The Pacific Flyway is used by millions of waterfowl and shorebirds for migration to wintering and breeding grounds. This Refuge is an important stopover area for migrating shorebirds in the fall and spring and provides important wintering habitat for waterfowl, supporting approximately 60 percent of the total population (CVJV 1990).

Natural/Historic Conditions

Historically the Central Valley supported about four million acres of wetlands with associated grasslands and riparian areas (CVJV 1990). Permanent and seasonal wetlands provided wintering and breeding habitat for waterbirds and other wildlife that flourished through the region. Prior to large scale disturbance, natural processes dominated the area. The Stone Lakes Basin is located within the 100-year floodplain. Historically, periodic floods would sweep through the area changing the course of the rivers and waterways and resetting natural community succession in the area. In addition, fire was a regular component of the area's ecosystem, sweeping through the area every three years.

The 1992 EIS (USFWS 1992) identified the location and extent of historic wetlands in the Refuge planning area, based on U.S. Geological Survey (USGS) atlas sheets of the Sacramento Valley surveyed in 1903-1910. Before 1903, activities related to flood control, water conveyance, and agricultural conversion had already reduced the extent of wetlands prior to the survey. The NRCS, formerly the Soil Conservation Service, mapped locations of hydric soils in 1990 that are generally assumed to correspond to the locations of historic wetlands.

Most of the open water, wetland, and riparian areas present on the Refuge in 1910 have since been drained and converted to agricultural uses. Today, over 95 percent of the riparian habitat in the Central Valley has been destroyed due to agricultural expansion and urbanization. Beach Lake and its associated wetland and riparian vegetation covered a much larger area before it was drained and farmed as recently as the 1960s (Figure 4) (USFWS 1992).

North Stone Lake, which is similar in size to its historic extent, had been drained, cleared and farmed prior to World War II. South Stone Lake was originally about three times its present size extending well west of the former Southern Pacific Railroad levee that now forms its western boundary.

An extensive area of freshwater wetlands 1.0 - 1.5 miles wide, was present in overflow areas east of Snodgrass Slough and between Snodgrass Slough and the Mokelumne River. Bear Lake, a narrow lake more than two miles long located between Lambert Road, Twin Cities Road, Snodgrass Slough and the railroad, no longer exists.

Overflow areas of the Cosumnes River supported extensive freshwater wetlands, about 1 mile wide, upstream of Grizzly Slough and downstream of Twin Cities Road. An unnamed lake about 1.5 miles long and 1,000 feet wide located east of Bruceville and west of the Cosumnes River, was drained and converted to agricultural land.

Little historical data is available that describes waterfowl use of the Refuge. However, maps of the Refuge developed by USGS prior to 1910 indicate that large, tidally influenced, permanent and seasonal wetlands existed, especially in the southern portion of the Refuge toward the Cosumnes River and at Beach, North Stone and South Stone lakes. These wetlands undoubtedly attracted large numbers of swans, geese, ducks and other waterbirds. Levee construction and channelization of rivers, creeks and other natural drainages and conversion of floodplains to agriculture have largely reduced the numbers of breeding and wintering waterfowl the Refuge can support. Historically, ducks were likely more abundant on the Refuge than they are at present (USFWS 1992). Local residents reported successful private duck hunting at South Stone Lake and the farmlands near Hood-Franklin and Lambert Roads from the 1940s until the early 1960s (USFWS 1992). Duck hunting at South Stone Lake was marginal by the early 1960s and has continued to decline during the last three decades (USFWS 1992).

Geographic and Physical Setting

Topography

The Refuge is part of a fairly level, but undulating, ancient alluvial plain incised by Morrison Creek, the Cosumnes River and several small creeks. Morrison Creek traverses the northern portion of the Refuge. The land slopes west to the Sacramento River. Elevations on the Refuge range from near mean sea level to 25 feet above mean sea level. Several small creeks traverse the western and northwestern portions of the Refuge.

While much of the Refuge was laser leveled in the past for agriculture, portions of it, particularly in the North Stone Lake area, still have their native undulating topography.

Geology

The Refuge is within the Great Valley Physiographic Province. The dominant geologic structure is the northwest to southeast-trending asymmetrical syncline that underlies the valley. A syncline is a fold in the rocks of the Earth's crust in which the layers or beds dip inwards, thus forming a trough like structure with a sag in the middle.

The Refuge is underlain by materials comprised of quaternary alluvial and intertidal depositions. Most of the Refuge is underlain by the Victor formation. The Victor alluvial formation was deposited in the late Pleistocene (about one million years ago) by materials washed from the Sierra Nevada. During the mid-Holocene era, about 5,000 years ago, basin, intertidal, levee and channel deposits accumulated along the Sacramento and Cosumnes rivers. The Victor formation consists of poorly sorted alluvial materials that vary in size from clays to boulders. Erosion of the Victor Formation has led to accumulation of finer grained basin deposits along the Sacramento and Cosumnes rivers near the Delta. Intertidal deposits of soft mud and peat accumulated west of Snodgrass Slough at the margin of the Delta. More recently, natural levee and channel deposits have accumulated along the Sacramento and Cosumnes rivers.

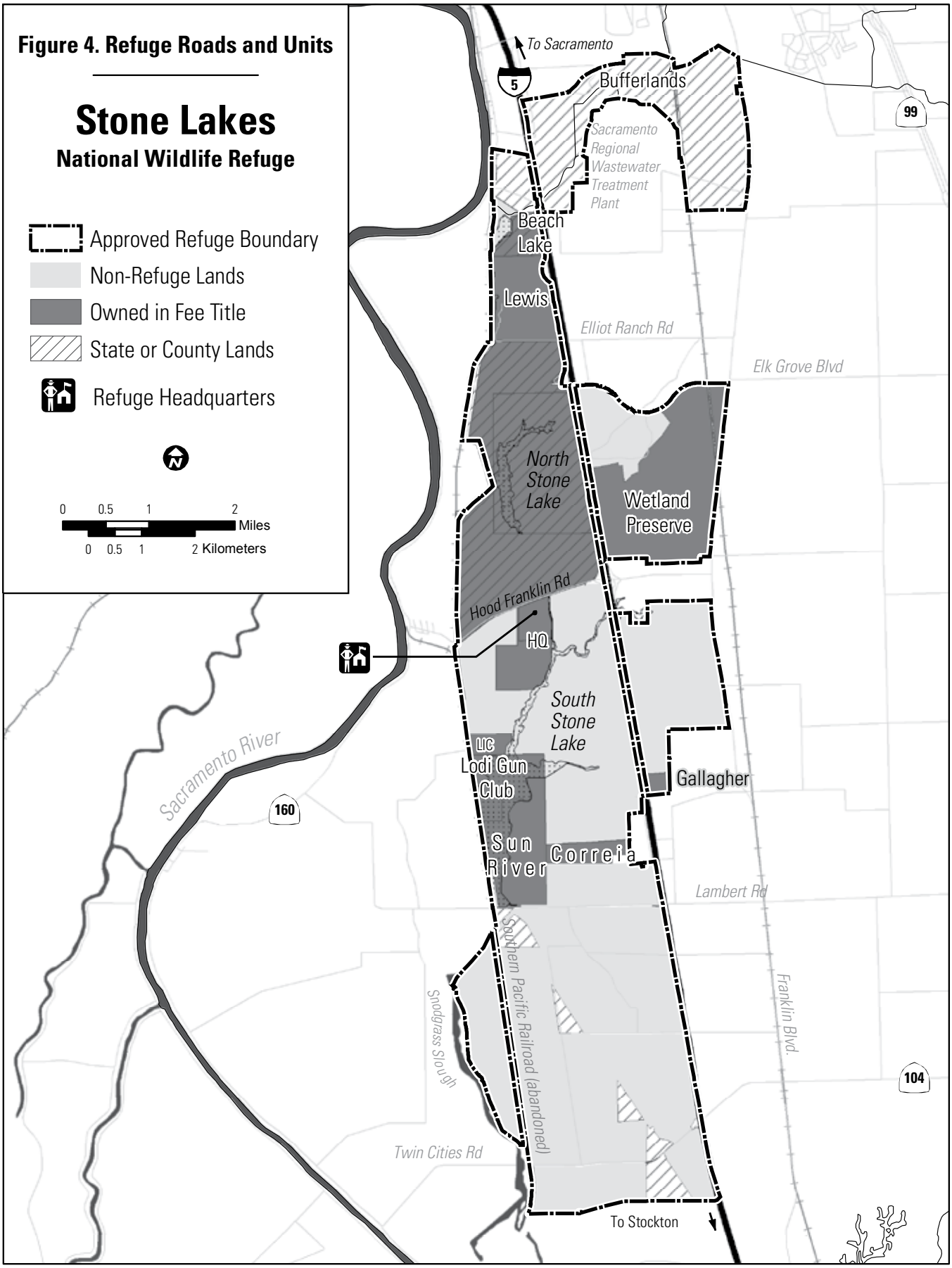


Figure 4. Refuge Roads and Units
Stone Lakes
National Wildlife Refuge
Approved Refuge Boundary
Non-Refuge Lands
Owned in Fee Title
State or County Lands
Refuge Headquarters
0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
To Sacramento
5
Bufferlands
99
Sacramento Regional Wastewater Treatment Plant
Beach Lake
Lewis
Elliot Ranch Rd
Elk Grove Blvd
North Stone Lake
Wetland Preserve
Hood Franklin Rd
HQ
South Stone Lake
LIC
Lodi Gun Club
Gallagher
Sacramento River
160
Sun River
Correia
Lambert Rd
Southern Pacific Railroad (abandoned)
Snodgrass Slough
Franklin Blvd.
104
Twin Cities Rd
To Stockton

Soils

Two systems are used by the NRCS to describe the Refuge soils: general soil map units and detailed soil series. The general soil map units represent broad patterns of the soil, topographic relief and drainage classes. Typically, each general soil map unit consists of one or more soil series. The general soil map can be used to compare the suitability of large areas for general land use (USFWS 1992). Soil series maps provide the finer level of detail necessary for site specific planning.

Refuge soils can be classified into three general soil types.

- Egbert Clays and Valpac Loams
- Dierssen sandy clay loams and clay loams
- Clear Lake Clays

Along the Sacramento River, the soils are characteristically very deep and nearly level. These soils are in the floodplain and originally supported extensive wetland and riparian habitats. The Egbert-Valpac general soil type forms a continuous one mile wide strip along the Sacramento River and Snodgrass Slough. It is comprised of somewhat poorly drained soils in areas with a high water table either throughout the year or seasonally. Prime farmland soils with high fertility are generally found in Egbert-Valpac general soil units.

The dominant general soil on the Refuge is Dierssen. Dierssen map units are comprised of somewhat poorly drained soils in areas with a perched water table and are moderately deep to deep over a cemented hardpan. Clear Lake soils, which are present in small areas east of the Dierssen soil unit, are also somewhat poorly drained and underlain by a shallow cemented hardpan. They have a seasonally high water table perched above the hardpan. Both the Dierssen and Clear Lake general soil map units are nearly level and are found in basins and on basin rims. Both areas are protected by flood control levees.

Clays are the most dominant soil particle on the Refuge; thus soils tend to be hydric. Hydric soils correspond to historic locations of wetlands and open water bodies, forming under frequent water saturation and the resulting anaerobic soil conditions. Silty and/or sandy soil belts are interspersed and are identifiable by the associated vegetation. Soils on the Refuge have been divided into soil mapping units. A total of 30 soil map units are found on the Refuge. These map units were used in the EIS (USFWS 1992) to predict the best areas for restoration.

Climate

The Refuge lies between the Coast and Diablo Ranges to the west and the Sierra Nevada to the east. The Carquinez Strait provides a sea-level gap between the Coast Ranges and the Diablo Range. The Carquinez Strait is about 55 miles southwest of the Refuge and the intervening terrain is mainly flat with rolling hills. The prevailing winds blow from the south, primarily due to marine breezes through the Carquinez Strait. During winter, the sea breezes diminish and winds from the north occur more frequently. However, winds from the south still predominate. The climate in the Refuge area is temperate and semiarid, with hot, dry summers and cool, damp winters. Annual temperatures in the area average highs of 52 degrees Fahrenheit in January to about 93 degrees Fahrenheit in July and lows of 38 degrees Fahrenheit in January to 58 degrees Fahrenheit in July. Annual precipitation averages about 17 inches. Dense "tule" fog is common in winter (USFWS 1992).

Air Quality

Air Pollution Control Agencies. The Federal Clean Air Act (42 U.S.C. §§ 7401, as amended) mandates the establishment of ambient air quality standards and requires areas that violate these standards to prepare and implement plans to achieve the standards by certain deadlines. The deadline for attaining both the ozone and carbon monoxide (CO) standards was August 31, 1988. Areas that do not meet Federal primary air quality standards are designated as "nonattainment" areas. Areas that comply with Federal air quality standards are designated as "attainment" areas. Attainment and nonattainment

designations are pollutant specific. Thus, while Sacramento County is a nonattainment area for particulate matter less than 10 microns in diameter (PM10) and ozone it is an attainment area for carbon monoxide (CO), nitrogen oxide (NO_x), sulfur dioxide (SO_2) and lead.

Many agencies are involved in air pollution control, including the U.S. Environmental Protection Agency (USEPA 2006), California Air Resources Board (ARB), Sacramento Metropolitan Air Quality Management District (SMAQMD) and other air quality management districts (AQMDs).

In California, all agricultural burning is regulated jointly by the ARB and local AQMDs. Each day the ARB determines, based on recent and anticipated weather conditions, whether the following day will be a permissible burn day or a no-burn day. Each ARB's primary objective in making this determination is to control the amount of smoke from agricultural burning that reaches urban areas. On permissible burn days, few restrictions are placed on the amount of land that may be burned in the region. On no-burn days, fields may be burned only if a special permit has been issued by the local AQMD. Such burn permits are allocated based on an estimated allowable acreage for the entire region.

Ambient Air Quality Standards and Existing Air Quality in Sacramento County

Both the State of California and the Federal government have established a variety of ambient air quality standards. The following discussion focuses on the ambient standards and existing concentrations for PM10, ozone and CO for two reasons: Sacramento County's air quality currently exceeds the allowable ambient standards for PM10 and ozone and these pollutants, together with CO, are the primary pollutants that could be affected by the Refuge.

PM10. Health concerns associated with suspended particles focus on those particles small enough to reach the lungs when inhaled. Few particles larger than 10 microns in diameter reach the lungs. Consequently, both the Federal and State air quality standards for particulate matter have been recently revised to apply only to these small particles (designated as PM10).

The entire Sacramento Valley, including Sacramento County, is classified as a PM10 moderate nonattainment area (USEPA 2006). Both the 24 hour and annual California PM10 standards are violated on a regular basis in the Sacramento area (USFWS 1992). Sacramento County PM10 emissions are generated by a variety of sources, primarily entrained road dust, construction and demolition activities. Farming operations and agricultural waste burning are also important sources of PM10 in Sacramento County.

Ozone. Ozone is a respiratory irritant that also increases susceptibility to respiratory infections. Ozone causes substantial damage to leaf tissues of crops, natural vegetation and damages many materials by acting as a chemical oxidizing agent.

The Federal air quality standard for ozone is exceeded several times a year at monitoring stations in Sacramento County. As a consequence of the recorded violations of the Federal ozone standard, the entire Sacramento Valley Air Basin, including Sacramento County, has been designated a serious nonattainment area of ozone (USEPA 2006). This indicates that the ozone levels in the Sacramento Valley air basin are a potential threat to public health. Human health effects of ozone can include difficulty breathing and lung tissue damage (ARB 2006).

Ozone, the main component of photochemical smog, is primarily a summer and fall pollution problem. Ozone is not emitted directly into the air but is formed through a complex series of chemical reactions involving other compounds that are directly emitted. These directly emitted pollutants, also known as ozone precursors, include reactive organic gases (ROG) and NO_x (ARB 2006). The period required for ozone formation allows the reacting compounds

to be spread over a large area, producing a regional pollution problem. Ozone problems are the cumulative result of regional development patterns, rather than the result of a few significant emission sources. Motor vehicles are the primary source of NOx and ROG in Sacramento County and therefore, are primary contributors to regional ozone concentrations.

Carbon Monoxide (CO). CO combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. Relatively low concentrations of CO can meaningfully affect the amount of oxygen in the bloodstream because CO binds to hemoglobin 220-245 times more strongly than oxygen. Both the cardiovascular system and the central nervous system can be affected when 2.5 percent to 4.0 percent of the hemoglobin in the bloodstream is bound to CO rather than to oxygen. State and Federal ambient air quality standards for CO have been set at levels intended to keep CO from combining with more than 1.5 percent of the blood's hemoglobin (U.S. EPA 1978, California ARB 1982).

Sacramento County has been designated as a nonattainment area for CO in the past, but is no longer considered a nonattainment area (USEPA 2006). Motor vehicle emissions are the dominant source of CO in most areas. As a directly emitted pollutant, CO disperses as it is transported away from the emission source, reducing pollutant concentration. Consequently, CO problems are usually localized, often the result of a combination of high traffic volumes and traffic congestion. Data from previous studies suggest that CO problems occur primarily near major traffic arteries having large amounts of commercial development. The Refuge is located on either side of Interstate-5 adjacent to and within the Sacramento urban area.

CO is primarily a winter problem. High CO levels develop primarily during winter when periods of light winds or calm conditions combine with the formation of ground level temperature inversions (typically in the evening through early morning period). These conditions result in reduced dispersion of vehicle emissions, allowing CO problems to develop and persist during hours when traffic volumes are declining from peak levels. It is unknown how elevated CO levels affect Refuge resources. Motor vehicles also exhibit increased CO emission rates at low air temperatures (USFWS 1992).

Contaminants and Water Quality

Water sources within the Refuge boundary include Morrison and Laguna creeks, Upper and Lower Beach lakes, urban runoff and agricultural drainage, Southern Pacific Cut (SP Cut), North and South Stone lakes and groundwater. Water quality monitoring by the SRCSD and the Service have been completed to date on the Refuge and in the surrounding area.

Water quality in North and South Stone Lakes is affected by limited Delta and San Joaquin River daily tidal flows moving up Snodgrass Slough through the Lambert Road bridge water control structure. Agricultural activities upstream of lakes may influence water quality from direct drainage into the lakes and the SP Cut. Groundwater discharge/recharge and Mokelumne River upflow via Snodgrass Slough to and from the lakes may also influence water quality in the lakes. The SRWTP does not discharge effluent into the Morrison Creek watershed. Instead, the treated effluent is dechlorinated and discharged directly to the Sacramento River near the community of Freeport.

The Refuge has many drainages that originate in urban and agricultural areas and empty into Refuge wetlands and lakes. In addition, a significant portion of land within the approved Refuge boundary is currently in agriculture. These areas are likely sources of nonpoint source contaminants, however they also provide important habitat for fish, aquatic invertebrates and foraging areas for birds that feed on these resources. Monitoring of aquatic habitats for nonpoint pollution is important, especially on this Refuge which is surrounded by urban development and actively managed agriculture.

The Sacramento Regional Wastewater Treatment Plant conducts ongoing quarterly water sampling for certain trace elements at several locations along Morrison Creek, Laguna Creek, and Meadowlark and Black Crown lakes. Furthermore, the USACE sampled water from the Morrison Creek watershed from 1982 to 1984. Concentrations of cadmium (Cd), copper (Cu) and lead (Pb) exceeded the USEPA acute toxicity criterion for aquatic life in all samples. The DFG and SWRCB collected and analyzed largemouth bass (*Micropterus salmoides*) from Meadowlark Lake from 1985 – 1987 and analyzed for heavy metals and organochlorine pesticides (OCs). Elevated levels of mercury (Hg), Cu, chlordane, dacthal, total DDT and total polychlorinated biphenyls (PCBs) were detected. Environmental contaminants are clearly present in the Stone Lakes area, but have been poorly delineated.

Baseline sampling on the Refuge and in nearby areas was conducted by the Service in 1997. The Service collected water, sediments, crayfish, fish, and waterbird eggs and analyzed them for OCs, PCBs and trace elements. Generally low levels of trace elements were found in water and biota, and generally low levels of organic compounds were present in sediments and biota. Concentrations of certain trace elements exceeded the USEPA's threshold effects level in sediments. Concentrations of trace elements were consistently higher (relative to other sites) in sediments from Lower Beach Lake. Lower Beach Lake is the terminus of Morrison Creek and may accumulate contaminants that originate in the greater Sacramento metropolitan area. Further sampling and toxicity tests of water and sediments are needed to identify the source of the contamination in Lower Beach Lake and other nearby areas (USFWS 2003a).

Water, sediment and biota samples were collected from eight locations (three sites in Morrison Creek, two sites in North Stone Lake and three sites in South Stone Lake) in spring on 1997 (Thomas 1997). Samples were analyzed for dissolved oxygen, temperature, heavy metals (arsenic, cadmium, copper, lead, mercury, selenium and zinc), salts (sodium chloride, calcium ion and magnesium), Nitrate NO_3 and pH. Results indicate that levels of heavy metals, although present, were not sufficient to cause deleterious impacts to wildlife; concentrations of selenium in all five waterbodies tested are above levels recommended for the protection of aquatic life.

Additional sampling was conducted from December 1998 to January 2000 on stormwater runoff onto the Refuge. The water quality of the Refuge and surrounding areas is continuously being degraded by irrigation drainwater and urban drainage in the summer, and the flushing of accumulated pollutants via urban stormwater runoff in the winter. Water samples and water quality data (temperature, dissolved oxygen, conductivity and pH) were collected from 11 sites on the Refuge during four storm events from December 1998 to January 2000. Temperature, pH, dissolved oxygen and conductivity were within normal limits for all sites, except for dissolved oxygen at Morrison Creek, which was at or below 3.0 milligrams/liter (mg/L) during two of the storm events. Overall, trace element concentrations in stormwater entering the Refuge were relatively low. Seven of 16 trace element samples collected during the two storm events had copper concentrations above the hardness adjusted chronic criterion and of those, three were also above the acute criterion. Four of 16 samples had lead concentrations above chronic criterion. Only one sample out of 16 had a concentration of cadmium that would be considered significantly elevated above the hardness adjusted chronic criterion (3.75 times the criterion). Nearly all sites had Diazinon levels above DFG's proposed 50 mg/L chronic criterion; however, they did not all produce measurable toxicity when daphne (*Ceriodaphnia dubia*) were exposed to the samples. Two sites, one on the Lower Beach Lake Unit and another that flows into Lower Beach Lake, consistently showed levels of Diazinon that produced toxicity to *Ceriodaphnia* along with detectable levels

of chlorpyrifos. Concentrations of Diazinon at these sites ranged from 101 to 1,488 mg/L with measured toxicity units ranging from 3.2 to 3.5 (USFWS 2003b).

Sacramento County's National Pollutant Discharge Elimination System (NPDES) Municipal Permit requires that pollutants found in urban stormwater runoff be reduced to the maximum extent possible. Dry detention stormwater runoff treatment facilities were constructed as part of the 3,000-acre development east of the Refuge identified in the East Franklin Specific Plan and would likely be included in other projects as well. These detention basins are effective in reducing pollutants by 30 to 90 percent.

Discharge Water Quality Monitoring
The Central Valley Regional Water Quality Control Board (Regional Board) issued order No. R5-2006-0054, regulating discharges from irrigated lands, effective beginning July 1, 2006 and ending June 30, 2011 (CVRWQCB-CVR 2006). The order detailed an individual discharger conditional waiver of waste discharge requirements. The order states that individual dischargers can seek coverage under the Individual Discharger Conditional Waiver or under the Coalition Group Conditional Waiver, by joining a coalition group. The conditional waiver requires Dischargers to pay a fee to the State Water Board. The Water Quality Control Plan for the Central Valley Region designates beneficial uses and establishes water quality objectives (CRWQCB-CVR 2004).

During the development of the irrigated lands waiver the Regional Board included discharges from "managed wetlands" in the definition of irrigated lands (USFWS 2004). However, the term "managed wetlands" is not defined by the Regional Board. There is a broad range of management activities that occur on Refuge wetlands. Some forms of management are relatively passive while others are very intensive due to enhance habitat for endangered and threatened species as well as migratory birds.

During the development of the waiver, the Service objected to being included under the waiver and recommended that a separate waiver be developed for managed wetlands. The Regional Board recognized that wetland discharges were sufficiently different than agriculture and a separate waiver would be appropriate but they did not have sufficient funds and staff to develop a separate waiver at the time. Thus the Regional Board's irrigated lands waiver and its requisite monitoring programs are primarily designed to address pesticide discharges from agriculture and does not take into consideration the differences and uniqueness of wetlands.

Meeting the waiver requirements is at best awkward for wetland managers, including the Refuge, because the irrigated lands waiver is designed to address discharges from irrigated agriculture. In evaluating the irrigated lands waiver requirements, the Service believes that the monitoring requirements for an individual discharger under the waiver are more appropriate for wetland discharges. They require monitoring of pesticides and toxicity only if certain chemicals or pollutants of concern are discharged, whereas the primary monitoring program for coalitions requires monitoring of all pollutants of concern since a coalition is more likely to represent a large variety of pesticide uses and discharge types.

The Refuge manages seasonal and permanent wetlands on the South Stone Lake, Headquarters and Beach Lake Units totaling approximately 335 acres. Periodic draw downs of the permanent wetland impoundments on the Lewis and Beach Lake units are done when vegetation, such as cattails, covers more than 75 percent of the wetland and to control weeds and undesirable fish species, such as carp. During years with no restrictions on water use, flood ups of seasonal wetlands begin in early to mid-September and continue through late fall depending on rainfall. Drawdowns commence in early April and continue through mid-June. Seasonal wetland drawdowns are accomplished

through a combination of evaporation and opening of water control structures. Depending on annual rainfall, flood waters are pumped out of the Sun River property of the South Stone Lake Unit to minimize damage to infrastructure and facilitate draw downs. Supplemental summer irrigation of seasonal wetlands to stimulate desirable plant growth for migrating waterfowl is done in late July and early August to a maximum depth of 12 inches for 24 hours and then drawndown by opening water control structures within a few days.

Only one type of discharge to waters of the State, as defined in Regional Board order No. R5-2006-0054, occurs on the Refuge: storm water runoff from the Refuge during flooding events. Discharge to waters of the State is defined by order No. R5-2006-0054 as "Surface discharges, such as irrigation return flows, tailwater, drainage water, subsurface drainage generated by irrigating crop land or by installing and operating drainage systems to lower the water table below irrigated lands (tile drains), stormwater runoff flowing from irrigated lands, stormwater runoff conveyed in channels or canals resulting from the discharge from irrigated lands, and/or operational spills containing waste" (CVRWQCB-CVR 2006). See "Current Management Practices: Wetlands" in Chapter 3 for a detailed discussion of Refuge wetland management practices.

Pesticide Use and Toxicity Testing

The Service does not propose to do toxicity testing of its wetland discharges. All pesticide use on the Refuge, is part of an Integrated Pest Management (IPM) plan and adheres to pesticide label instructions, Intra-Service Section 7 Consultations under the Endangered Species Act, Sacramento County pesticide bulletin protective measures for threatened and endangered species, buffer requirements and other appropriate best management practices.

Since the mid-1990s, the Refuge has collaborated with a number of private, local and state entities as a participant in the Stone Lakes Basin Water Hyacinth Control Group (SLBWHCG). As a result of water hyacinth control efforts to date, the extent of plant infestations has been reduced to an estimated 30 to 35 acres. With continued applications, it is anticipated that beyond 2006, control efforts may be scaled back to occasional treatments (two to three per week) during the hyacinth growing season to spot-treat small infestations.

The Stone Lakes Basin water hyacinth control program is permitted under a Statewide National Pollution Discharge Elimination System (NPDES) General Permit (No. CAG990005) for discharge of aquatic pesticides. Field crews with the Service and the SRCSD conduct chemical control of water hyacinth on approximately 670 acres of open water habitats on Lower Beach Lake, SP CUT (the borrow channel for the former Southern Pacific Railroad), North Stone Lake and South Stone Lake and its tributaries. Control activities occur in natural lakes and sloughs as well as man-made irrigation or drainage ditches and channels. Treated waterways lie within lands owned by the Service, the State of California, Sacramento County and a number of private landowners. Since infestations of water hyacinth within the Basin have been greatly reduced due to past efforts, it is anticipated that a steadily decreasing quantity of herbicide will be needed as the program becomes more of a maintenance operation. To comply with the monitoring and reporting requirements of the NPDES General Permit, the Refuge and SRCSD provide an annual report to the California Regional Water Quality Control Board summarizing aquatic pesticide applications and the results of water quality monitoring for the water hyacinth control program.

The Refuge also cooperates with Sacramento-Yolo Mosquito Vector Control District (SYMVCD) to mitigate the risk of mosquito borne diseases. See Appendix A, Compatibility Determination for Monitoring and Control of Mosquitos for detailed information. The SYMVCD and the Service rely on a full range of IPM techniques to manage mosquito

populations, including wetland design features, water and vegetation management, biological control and chemical control of larval or adult mosquitos. As a result of IPM practices larvicide applications on the Refuge have been limited to small acreages and adulticides have historically been used infrequently (i.e., three ground ultra-low volume applications during 10 years). Largely due to the 2005 detection of West Nile Virus, the Refuge received ground ultra-low volume applications of the adulticide pyrethrin on 18 occasions in 2005 and six applications to date in 2006. Additional applications of adulticides are likely during the remainder of the 2006 season. .

Since the majority of Refuge uplands are not irrigated they do not technically fall under the irrigated lands waiver. The IPM methods that the Refuge uses to control weeds include burning, mowing, discing and application of herbicides including Roundup (glyphosphate) and 2, 4-D. Multiple treatments on the same acreage in one year are rare and are usually spot applications. Also, since these are Refuge uplands, virtually all areas where applications occur have vegetated buffers between applications and any waterbodies.

While irrigated agriculture is conducted within the approved Refuge boundary, it is not conducted on lands under the control (i.e., fee title ownership, cooperative management agreement, conservation easement) of the Refuge. While participating in a watershed monitoring coalition group with adjacent irrigated agricultural producers is a possible option, discharge from adjacent agricultural lands is ultimately the responsibility of the discharger.

The Refuge, by policy and mandate, is managed utilizing many of the best management practices to reduce pesticide and fertilizer runoff, they are considered the basic elements of good refuge habitat management. Refuge policy mandates limited use of pesticides only after physical or other means (e.g., controlled burns, grazing, mowing) are used and after review and approval by management. Most herbicide treatments are a part of long-term habitat restoration and management plans on uplands where treated areas are being restored to native habitat. Except for approximately 490 acres of irrigated pastureland, Refuge uplands are not irrigated.

All applications of herbicides on Refuge uplands occur where there are natural vegetated buffers from aquatic habitats. Many riparian areas have understory vegetation that minimizes potential drift into waterbodies. Also, aerial applications are not utilized on the Refuge. Applications for upland weeds are typically spot treatments of discrete stands of plants and multiple applications on the same acreage in one year are rare . For these reasons the Service does not propose to do toxicity testing of its wetland discharges.

Pesticide Monitoring

The Refuge and SRCSD will continue monitoring of water quality required under the NPDES General Permit for the application of aquatic herbicides for the water hyacinth control program. Given that minimal discharge, if any, occurs from the Refuge and that water quality monitoring is already occurring, the Refuge intends to file as an individual discharger, under the Central Valley Regional Water Quality Control Board's, Irrigated Lands Conditional Waiver for water dischargers.

Water Quality is further discussed in Chapter 4.

Hydrology

The Refuge lies within the Beach-Stone Lakes Basin in the northeast portion of the Sacramento-San Joaquin Delta. This Basin is within the lower watershed of the Morrison Creek drainage, with the Sacramento River to the west and the Mokelumne and Cosumnes rivers nearby to the southeast (Figure 1). The lower Morrison Creek watershed governs the surface water flow patterns over the Refuge. This 180-square-mile system of streams and

floodplain originates in eastern Sacramento County and includes portions of the City of Sacramento, Morrison, Unionhouse, Laguna, Elk Grove and Elder creeks. Streamflows in these channels are affected by storm runoff, springs, urban drainage, groundwater pumping for irrigation, water supply and diversions and surface storage ponds located throughout the watershed. Waters on the Refuge are also influenced by the Cosumnes and Mokelumne rivers, especially during floods when water from the two rivers backs up the Southern Pacific Railroad borrow canal (SP Cut).

The Morrison Creek stream group drains a large urban and agricultural watershed that includes Laguna and, Morrison creeks and Beach Lake. Many commercial and industrial sources contribute runoff to Morrison Creek. Most streams are intermittent and historically dry during the summer. Today, urbanization and agricultural practices in this watershed have resulted in low summer flows consisting of runoff from irrigation, wastewater flows and agricultural return flows (USFWS 1992).

Elevations in the Morrison Creek watershed range from 300 feet above mean sea level (MSL) in the northeast and slope gently down to sea level in the Beach-Stone Lakes Basin in the southwest. Construction of a reclamation district levee before the turn of the century divides Upper Beach Lake, which extends northeastward under Interstate-5, from Lower Beach Lake. This levee directs water draining down Morrison Creek from Upper Beach Lake to an electric pump (City Sump 90) that discharges it directly into the Sacramento River near the town of Freeport.

During winter high-flow periods when Upper Beach Lake rises 3 feet above MSL, water overtops the dike dividing Upper and Lower Beach Lake and spills into Lower Beach Lake and the Southern Pacific railroad borrow ditch (SP Cut). Water then continues south to North Stone Lake, Hood-Franklin Road and South Stone Lake; passes through the Lambert Road Bridge flood control structure; and then enters Snodgrass Slough. Snodgrass Slough provides a surface hydrologic connection for the Basin and the Sacramento-San Joaquin Delta near the town of Locke (Jones and Stokes Associates 1989). Nearly all the lands within the approved Refuge boundary are within the 100-year floodplain.

Also see Chapter 4, Hydrology.

Water Supply

Water sources available for maintenance and management of Refuge fish and wildlife habitats and irrigation include: runoff from local sources such as the Morrison Creek drainage, shallow groundwater and surface flows from Snodgrass Sough. Surface flows from direct precipitation and surplus irrigation returns within the Beach-Stone Lakes Basin provide water sources for habitats and farming operations adjacent to the SP Cut. The Basin and SP Cut are also used as a tailwater and stormwater runoff drain for reclamation districts lying to the west.

Interception of shallow groundwater is used to sustain habitats and agricultural lands within the Refuge and the Beach-Stone Lakes Basin. Due to irrigation withdrawals, there is a groundwater depression in the water table south and east of the Refuge area. This groundwater depression creates a gradient away from the Sacramento River and locally induces flow from the river across the Refuge area toward the center of the depression. Therefore, groundwater that is intercepted by channels and wells within the Beach-Stone Lakes Basin is likely seeping from the river.

In response to the daily tidal cycle, water levels in Snodgrass Slough and the SP Cut are influenced by operation of a slide gate and flap gates on the Lambert Road Bridge flood control structure; diversion of water by various upstream users, including the Refuge and operation of the Delta Cross Channel by the California Department of Water Resources for the State Water Project. South to north flows of surface water occur through the Lambert Road Bridge flood control structure and these

reverse flows play a substantial role in sustaining the water supply in the Beach-Stone Lakes Basin.

Biological Resources

Plant Communities

Vegetation communities are categorized below as grassland, riparian, woodland or wetland (Figure 5. Vegetation Map). Agricultural crops, vineyards, and urban developments are only addressed on the Vegetation Map.

Grasslands. Grasslands on the Refuge are broken into three categories: annual grassland, perennial grassland and irrigated pastures. Grasslands are open habitats supporting grasses and forbs with little or no woody vegetation. The gently rolling terrain surrounding North Stone Lake is covered with large areas of annual grasslands mixed with seasonal wetlands.

Annual. Most of the grasslands in California are dominated by annual, nonnative grasses and forbs as a result of cultivation, livestock grazing, changes in fire regimes and other disturbances (Heady 1988). Characteristic species include the dominant species, wild rye (*Elymus* spp.), as well as wild oats (*Avena fatua*), bromes (*Bromus* spp.) and filarees (*Erodium* spp.). Some annual grasslands are interspersed with native perennial grasses and forbs. Restoration and management are a focal part of grassland management for native grasses and forbs, such as creeping wild rye and California poppy (*Eschscholzia californica*), as well as many other species. The grazing regime is the primary tool, used by managers, to enhance native grassland species; however, prescribed burning (see Appendix D. Fire Management Plan), water manipulations, mowing and discing are also utilized. See the section on "Grasslands" under "Current Management" later in this chapter for more information.

Perennial. Before Euroamerican settlement, most of the Central Valley grassland was dominated by native purple needlegrass (*Nassella pulchra*). Open areas between the tussocks of this perennial bunchgrass supported many wildflowers, including owl's clover (*Orthocarpus purpurascens*), lupine (*Lupinus* spp.), brodiaea (*Brodiaea* spp.) and many others. This native grassland community, known as valley needlegrass grassland, has been almost completely replaced by annual grassland. Remnants of valley needlegrass grassland occur as small patches, usually in marginal habitats, such as undisturbed moist sites and areas protected from grazing or only lightly grazed. Valley needlegrass grassland may occur on the Refuge, although no occurrence has been identified. Another native perennial grassland that was once common is the valley wild rye grassland, dominated by creeping wild rye and associated with California mugwort (*Artemisia* spp.) and stinging nettle (*Urtica dioica*). Patches of this grassland occur on the Refuge and are being actively restored.

Irrigated Pasture. Irrigated pastures on the Refuge are irrigated and optimally grazed in the summer months (June through August) to promote and enhance native vegetation. Grazing is monitored to provide a mosaic of habitats, thus increasing biodiversity. Monitoring consists of visual calibration and measuring residual dry matter in pounds per acre. These pastures support a good ratio of forbs (eg., clovers, lupines, poppies and succulent grasses) to grasses, which provide valuable forage for white-faced ibis (*Plegadis chihi*), geese, black-bellied plovers (*Pluvialis squatarola*) and others. Currently, irrigated pastures, found on the North Stone Lakes and Gallagher properties, play a valuable role in habitat and wildlife management.

Grassland Wildlife. Grassland habitats are important foraging areas for many species. Less than 1 percent of California's native grassland remains due mainly to advances in large-scale irrigation in the 1930s; therefore, grassland management plays a vital role in contributing to the Refuge System's biological integrity, diversity and environmental health. Refuge grassland management promotes grasslands at varying heights and densities in order to create a mosaic of grassland habitats at the

Figure 5. Land Cover

Stone Lakes National Wildlife Refuge

1 0.5 0 1 Miles

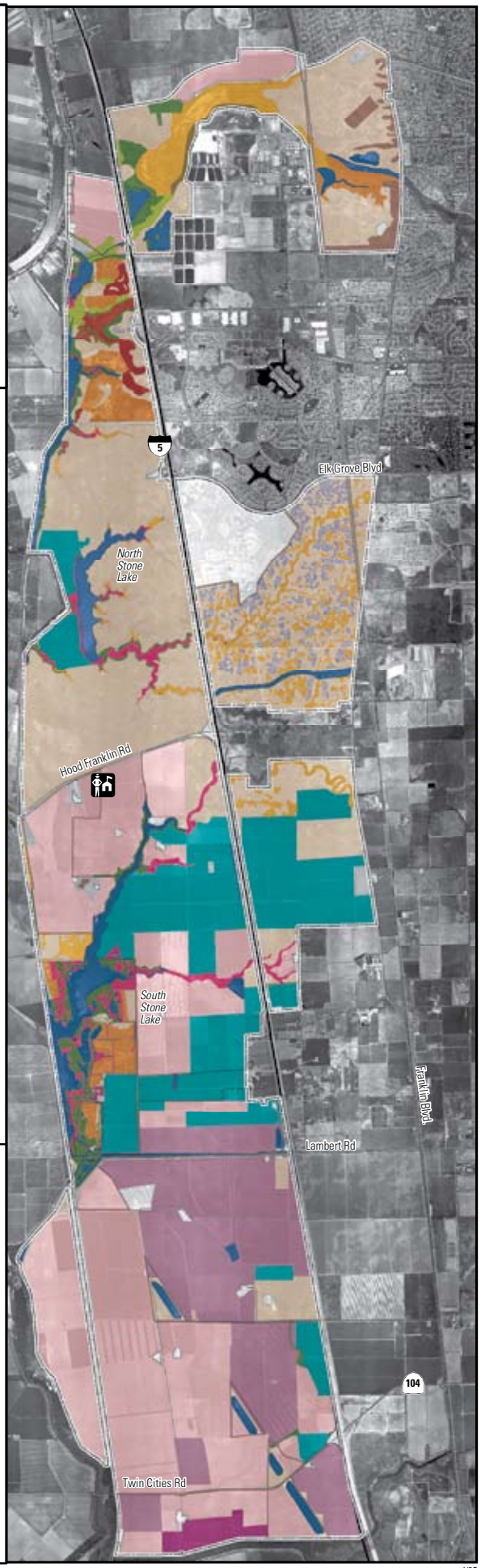
1 0.5 0 1 Kilometers

Land Cover

- Approved Refuge Boundary
- Agricultural Croplands
- Open Water / Aquatic Bed
- Perennial Marsh
- Cottonwood Willow Riparian
- Developed
- Disturbed/Fallow/Bare Land
- Grasslands
- Irrigated Pasture/ Wet Meadow
- Managed Permanent Wetland
- Managed Seasonal Wetland
- Mixed Riparian
- Orchards
- Riparian Scrub
- Passive Seasonal Wetland
- Upland Forest
- Valley Oak Riparian
- Vernal Pools
- Vineyard

Land Status

- Cooperative Agreement
- Conservation Easement
- Non-Refuge Lands
- Owned in Fee Title



1/05

ecosystem level. Species utilizing grasslands dominated by shorter grasses include birds of prey such as northern harriers (*Circus cyaneus*), white-tailed kites (*Elanus leucurus*), red-shouldered hawks (*Buteo lineatus*) and Swainson's hawks; shorebirds such as the black-bellied plover; wading birds such as white-faced ibis, great blue herons (*Ardea herodias*) and great egrets (*Ardea alba*); tree swallows (*Tachycineta bicolor*), cliff swallows (*Petrochelidon pyrrhonota*), barn swallows (*Hirundo rustica*) and other species of birds. Species utilizing taller grass habitats include savannah and white-crowned sparrows (*Passerculus sandwichensis, Zonotrichia leucophrys*) , western meadowlarks (*Sturnella neglecta*), California horned larks (*Eremophila alpestris*), loggerhead shrikes (*Lanius ludovicianus*) as well as mammals such as coyote (*Canis latrans*), deer mice (*Peromyscus maniculatus*), pocket gophers (*Thomomys bottae*), black tailed hares (*Lepus californicus*), California voles (*Microtus californicus*) and California ground squirrels (*Spermophilus beecheyi*). Since species often utilize more than one habitat type, the aforementioned habitats and their associated species are generalizations.

Riparian Forest. Riparian forests support the densest and most diverse wildlife communities in the Sacramento Valley. The diversity of plant species and growth forms provide a variety of food and microhabitat conditions for wildlife. The unique combination of surface water and groundwater, fertile soils, high nutrient availability and layered vegetation provide diverse conditions for wildlife. North and South Stone Lakes support riparian scrub and forest habitats along with marshes dominated by cattail (*Typha* sp.), tule (*Schoenoplectus acutus* var. *occidentalis*), smartweed (*Polygonum* sp.) and season wetlands. Riparian habitat is also supported along some of the ephemeral swales and stream courses found in the Refuge.

Riparian areas are particularly important to migratory wildlife as they provide corridors along migration routes. It is important to maintain the integrity and continuity of riparian corridors which provide nesting and foraging habitat and shelter from inclement weather and predation. For these reasons, riparian restoration and management is a vital part of the Refuge's habitat and wildlife management. Three types of riparian forests occur on the Refuge: cottonwood, mixed, and valley oak (*Quercus lobata*). Mature riparian forests are diverse, multilayered communities associated with occasional to frequent flooding and perennial subsurface water.

Riparian forests support the densest and most diverse wildlife communities in the Sacramento Valley.
Photo by USFWS

Cottonwood Riparian Forest. Cottonwood riparian forests occur along perennial streams where inundation occurs every spring. The forest canopy is dominated by Fremont cottonwood (*Populus fremontii*) and Goodding's willow (*Salix gooddingii*) typically draped with California grape vines (*Vitis californica*). The understory often supports California box elder (*Acer negundo* var. *californicum*), California blackberry (*Rubus ursinus*), white-stemmed raspberry (*Rubus leucodermis*), buttonbush (*Cephalanthus occidentalis*) and blue elderberry (*Sambucus mexicana*).

Mixed Riparian Forest. Mixed riparian forests occur in areas where the floodwater inundation occurs more often and for longer periods of time than valley oak and less often

and for shorter duration than cottonwood. Canopy dominants include Fremont cottonwood, valley oak, Goodding's willow, red willow (*Salix laevigata*), yellow willow (*Salix lucida*), California black walnut (*Juglans hindsii*) and California sycamore (*Platanus racemosa*). Common understory dominants include California box elder, Oregon ash (*Fraxinus latifolia*), poison oak (*Toxicodendron diversilobum*) and buttonbush. California grape envelops trees and shrubs in this area, giving this forest a jungle-like appearance.

Valley Oak Riparian Forest. The highest portion of the floodplain with the least frequent inundation supports the valley oak riparian forest. Valley oak riparian forest persists in well-drained soils which are not extensive within the Refuge boundary. The dense forest canopy is dominated by valley oak with associated tree species of Oregon ash, California sycamore, and California black walnut. The understory typically supports annual grasses, however, moister soils support vines and shrubs, such as poison oak, California blackberry and wild rose (*Rosa californica*).

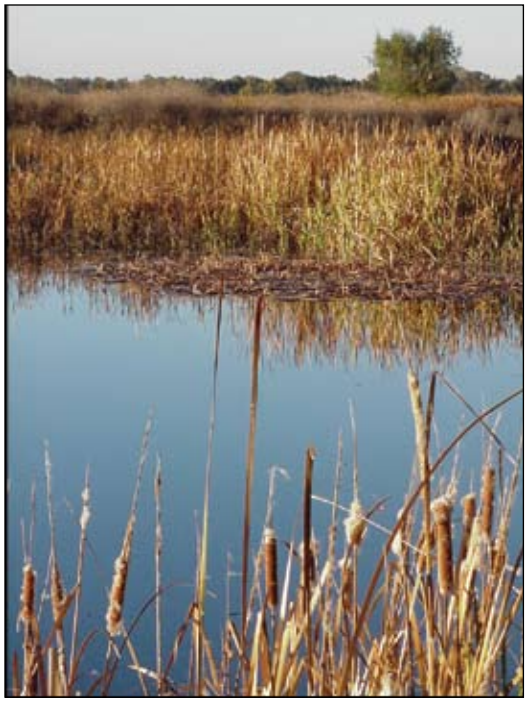
Valley Oak Woodland. Scattered valley oaks form woodland and savanna habitats on deep, well-drained alluvial soils. Typically the valley oak is the only tree found in this community. The understory is usually annual grassland, but moister sites support shrubs, such as poison oak and wild rose. Valley oak woodland is often transitional between valley oak riparian forest and valley oak savanna. Valley oak woodlands are not prominent on the Refuge because of a lack of appropriate soils and elevations to support their growth; however, valley oak woodland can be found on the Lewis Unit.

Wetlands. Two wetland vegetation types occur on the Refuge: perennial and seasonal. Seasonal vegetation can be divided into two categories, vernal pools and seasonal vegetation in actively managed wetland units or cells. Refuge wetlands are managed to maintain and enhance biodiversity, particularly for waterbirds, reptiles, amphibians and invertebrates. North and South Stone Lakes support wetlands dominated by cattail, tule and smartweed along with seasonal wetlands. The most extensive areas of freshwater marsh and aquatic bed vegetations in southern Sacramento County are at South Stone Lake.

The highest portion of the floodplain with the least frequent inundation supports valley oak dominated riparian forest, shown being restored above with the active support of volunteers from the Sacramento Tree Foundation.
Photo by USFWS

Perennial. Shallow, perennial wetland vegetation consists primarily of cattails, tules, cottonwood, willow, sedges (*Carex* spp.) and rushes (*Juncus* spp., *Scirpus* spp.). The vegetation varies in regards to the presence of tules and cattails, both of which require more saturated conditions than most seasonal wetlands provide. Conversely, wetlands also vary in regards to watergrass (*Echinochloa crus-galli*), swamp timothy (*Crypsis schoenoides*) and annual smartweed (indicative of seasonal wetlands), which require seasonal irrigation, as opposed to frequent or constant inundation.

Seasonal. Seasonal wetland vegetation on the Refuge is usually considered transitional between perennial wetlands and vernal pools. Seasonal wetland vegetation consists primarily of watergrass, swamp timothy, annual smartweed, curly dock (*Rumex crispus*), cocklebur (*Xanthium strumarium*), sedges and rushes. Seasonal wetlands are managed to promote vegetation that has relatively higher food



The most extensive areas of freshwater marsh and aquatic bed vegetations in southern Sacramento County are at South Stone Lake, on the Refuge.
Photo by USFWS

value for migratory waterbirds, as well as to provide cover and substrate for birds, mammals, reptiles, amphibians and invertebrates.

Vernal Pools. Vernal pools are ephemeral or seasonal shallow pools with an underlying impervious layer. The pools fill with rain water in the winter and retain water through the spring until they evaporate due to the Central Valley's intense summer heat. There are over 150 plant species associated with similar vernal pool habitat on the nearby Cosumnes River Preserve and 90 percent of the plants are native with more than half of them being endemic. Plants and animals associated with vernal pools are adapted to the unique environment of vernal pools. For example, orcutt grasses (*Orcuttia* spp.) have a submergent vegetative phase with floating leaves. As the pools dry, a terrestrial phase emerges. Typical vernal pool species include downingia (*Downingia* spp.), Sacramento and pilose orcutt grass (*Orcuttia viscida*, *Orcuttia pilosa*), popcorn flower (*Plagiobothrys* spp.), goldfield (*Lasthenia* spp.), vernal pool tadpole shrimp (*Lepidurus packardi*), fairy shrimp (*Branchinecta lynchi*), California tiger salamander (*Ambystoma californiense*), western toad (*Bufo boreas*) and the western spadefoot toad (*Spea hammondii*), although some of these species can also be found in some of the seasonal wetland units. The majority (98 percent) of the Refuge vernal pools can be found on the Wetland Preserve Unit, with the rest found on the Lewis Unit. Barely 12 percent of the vernal pools located on the Refuge are naturally occurring; the remainder have been created over the last 14 years as mitigation for vernal pool losses due to development. The Wetland Preserve Unit is owned in fee title by AKT Development Corporation and managed by the Refuge under a conservation easement.

Cattle grazing and prescribed fire are the primary management tools for maintaining and enhancing vernal pools with grazing considered most beneficial for vernal pool plants, invertebrates and amphibians (J. Marty, TNC, pers. comm.). Primary benefits of grazing come from phytomass removal and trampling of nonnative invasive annual grasses and other weeds in the pool margins and surrounding uplands. If left unchecked, these non-native plant species competitively exclude native vernal pool plants, especially around pool margins; reduce the inundation period of the pool which increases evapotranspiration; promote the grow of algae, which appears to negatively affect vernal pool crustaceans; and can inhibit the overland migration of vernal pool-breeding amphibians (Robins 2002). In addition to discouraging nonnative grasses, cattle also compact the soil to where grazed vernal pools hold water an average of 50 days longer than un-grazed vernal pools. This enhanced water retention capability also provides benefits for plant and wildlife species. The Wetland Preserve Unit of the Refuge is managed by the Service under conservation easement. Refuge staff are in the process of developing a grazing management plan in cooperation with the landowner that will protect vernal pool and other seasonal wetland habitats on the unit.

Wildlife

The diverse vegetation of the Beach-Stone Lakes Basin provides habitat for a range of mammals, birds, reptiles, amphibians and invertebrates. Wildlife can be found on all units of the Refuge. North and South Stone Lakes are especially important wildlife habitat areas because of the combination of grasslands, extensive riparian forest, seasonal and perennial wetlands and open water they support. A survey of North Stone Lake reported sightings of three amphibian species, eight reptile species, 101 bird species and 23 mammal species (USFWS 1992). The same survey also

reported finding active nesting sites of 52 great egrets, 49 great blue herons, 61 black-crowned night-herons (*Nycticorax nycticorax*), 20 snowy egrets (*Egretta thula*), and 17 double-crested cormorants (*Phalacrocorax auritus*).

South Stone Lake is rich in riparian and wetland habitats supporting a diversity of amphibian, reptile, bird and mammal species. Two waterfowl hunt clubs were operated on the lake for many years prior to establishment as a refuge. However, hunting success has declined substantially during the last three decades. The primary waterfowl species likely to be encountered at South Stone Lake are mallard (*Anas platyrhynchos*), American wigeon (*Anas americana*), green-winged teal (*Anas crecca*) and occasionally, northern pintail (USFWS 1992).

Mammals. Grassland habitats support small prey species, such as deer mice, California voles, pocket gophers, California ground squirrels, desert cottontails (*Sylvilagus auduboni*) and black-tailed hares. Ungrazed grasslands with dense cover typically support more wildlife species than do grazed pastures or disturbed grasslands and some species prefer ungrazed pastures, such as badgers (*Taxidea taxus*), black-tailed hares, coyotes and California ground squirrels.

Valley oak woodlands supply acorns for western gray squirrels (*Sciurus griseus*) and black tailed deer (*Odocoileus hemionus*), which depend on the acorns as a critical autumn food source. Riparian forest and scrub provide habitats for many of the same species as the valley oak woodlands. Mature cottonwood, Goodding's willow and valley oak trees provide habitat for cavity-nesting species, such as bats, western gray squirrels, raccoons (*Procyon lotor*) and ringtails (*Bassariscus astutus*). Riparian understory plants, such as California grape, blackberry and elderberry, supply food sources for Virginia opossum (*Didelphis virginiana*), raccoon, striped skunk (*Mephitis mephitis*) and gray fox (*Urocyon cinereoargenteus*). As with birds, narrow and discontinuous riparian areas favor wildlife that forage near, in or over water, such as beavers (*Castor canadensisis*), river otters (*Lutra canadensis*) and bats. Riparian scrub provides cover and forage for California ground squirrels. Beavers preferentially feed on young cottonwood shoots and many small mammals feed on willow seeds. Bramble thickets offer escape cover to desert cottontails and black-tailed hares. Aquatic areas near riparian scrub habitats provide foraging habitats for carnivores and omnivores, such as river otters and gray foxes. Ground insectivores that inhabit riparian scrub include broad-footed moles (*Scapanus latimanus*). Striped skunks also prey on other small animals using the riparian scrub.

Perennial wetlands support river otters, muskrats (*Ondatra zibethicus*) and beavers. Upland species, such as black-tailed hares and desert cottontails, take cover and forage at the margins of wetland habitats.

Birds. Over 200 bird species have been sighted at in the Beach-Stone Lakes Basin (USFWS 2003a). About 90 species are confirmed to have nested on the Refuge. These species include numerous waterbirds, songbirds, and raptors. For a detailed list of birds see Appendix E.

Refuge grasslands are important foraging areas for many birds of prey, such as black-shouldered (white-tailed) kites, red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks, red-shouldered hawks, northern harriers, golden eagles (*Aquila chrysaetos*), American kestrels (*Falco sparverius*), prairie falcons (*Falco mexicanus*), great horned owls (*Bubo virginianus*) and barn owls (*Tyto alba*). Songbirds forage in grassland habitats, including loggerhead shrikes, yellow-billed magpies (*Pica nuttalli*), horned larks, water pipits (*Anthus rubescens*), western bluebirds (*Sialia mexicana*), savannah sparrows and a variety of swallow species. A few birds nest in grasslands, such as killdeer (*Charadrius vociferous*), ring-necked pheasants (*Phasianus colchicus*), northern harriers, western kingbirds (*Tyrannus*

Pastures on the Refuge and nearby farmland may represent an important stopover point for geese during spring migration; Canada, snow, white-fronted, and Ross' geese are regularly observed on Refuge pastures and waterbodies during spring.
Photo by USFWS

verticalis) and western meadowlarks. Ungrazed grasslands with dense cover typically support more wildlife species than do grazed pastures or disturbed grasslands. However, some bird species prefer grazed pastures, such as burrowing owls (*Athene cunicularia*), mourning doves (*Zenaida macroura*), Brewer's blackbirds (*Euphagus cyanocephalus*), turkey vultures (*Cathartes aura*), red-tailed hawks, black-shouldered kites, ring-necked pheasants and yellow-billed magpies. Pastures on the Refuge and nearby farmland may represent an important stopover point for geese during spring migration; more than 1,500 white-fronted geese (*Anser albifrons*) were observed on pasture near Hood-Franklin Road in the late 1970s (USFWS 1992) and large numbers continue to use grasslands adjacent to North Stone Lake. Canada (*Branta canadensis*), snow (*Chen caerulescens*) and Ross' (*Chen rossii*) geese are also observed on Refuge pastures and waterbodies regularly during spring. Except for some species such as robins, blackbirds, and mourning doves, vineyards provide virtually no suitable bird habitat, while orchards can provide some nesting habitat for birds of prey and food and cover for other birds and mammals.

The mature Fremont cottonwood, willow (*Salix* spp.) and valley oak trees of riparian vegetation provide nesting support for large birds, such as hawks, owls, American crows (*Corvus brachyrhynchos*), great egrets and great blue herons. Cavity nesting birds, such as woodpecker species and wood ducks (*Aix sponsa*), require mature stands. Dense understory consisting of blackberry (*Rubus* spp.), raspberry (*Rubus* spp.), California grape and elderberry produce important food for wildlife. Common birds that depend on the nectar, fruits, and seeds of riparian plants include California towhees (*Pipilo crissalis*), spotted towhees (*Pipilo maculatus*), Anna's hummingbirds (*Calypte anna*) and black-headed grosbeaks (*Pheucticus melanocephalus*).

The high quality riparian vegetation on the Refuge provides excellent habitat for neotropical migrants. The riparian and valley oak woodland vegetation supports an abundance of insect prey that sustain a high diversity and density of migratory and resident birds, including western flycatchers (*Empidonax difficilis*), yellow warblers (*Dendroica petechia*), MacGillivray's warblers (*Oporornis tolmiei*) and song sparrows (*Melospiza melodia*). Habitat destruction and nest parasitism by nonnative brown-headed cowbirds (*Molothrus ater*) may be primary causes of bird decline on the Refuge (USFWS 1992). Insectivorous species that have dramatically declined or been eliminated from the Central Valley's nesting avifauna, but have been seen on the Refuge, include: yellow-billed cuckoos (*Coccyzus americanus*), willow

flycatchers (*Empidonax* spp.), yellow warblers, yellow-breasted chats (*Icteria virens*) and blue grosbeaks (*Passerina caerulea*). Some riparian areas are narrow and discontinuous and favor wildlife species that forage in adjacent grassland or agricultural fields, including black-shouldered kites, American kestrels and western kingbirds. Riparian areas also provide perches and cover for species that forage in or over water, such as double-crested cormorants, green-backed herons (*Butorides virescens*), belted kingfishers (*Ceryle alcyon*), black phoebes (*Sayornis nigricans*) and violet-green swallows (*Tachycineta thalassina*). Riparian scrub provides cover and forage for California (valley) quail (*Callipepla californica*), ring-necked pheasants, American goldfinches (*Carduelis tristis*), lesser goldfinches (*Carduelis psaltria*) and California towhees. Bramble thickets provide potential nesting habitat for tri-colored blackbirds (*Agelaius tricolor*). Aquatic areas near riparian scrub habitats provide foraging habitats for ground insectivores, such as killdeer, spotted sandpipers (*Actitis macularius*) and western kingbirds.

Valley oak woodlands provide shade, shelter and nesting habitat for many bird species, including various woodpecker species and other cavity-nesting birds, such as American kestrels, western screech owls (*Megascops kennicottii*), white-breasted nuthatches (*Sitta carolinensis*) and western bluebirds. Acorns are an important food source for many species, including acorn woodpeckers (*Melanerpes formicivorus*), valley quail, northern flickers (*Colaptes auratus*) and scrub jays (*Aphelocoma californica*). Valley oak foliage and bark attract insects that are eaten by ash-throated flycatchers (*Myiarchus cinerascens*), plain titmice (*Baeolophus inornatus*), white-breasted nuthatches and northern orioles (*Icterus galbula*). Valley oak woodlands provide the best habitat on the Refuge for aerial-foraging species, such as acorn woodpeckers, ash-throated flycatchers and western wood-pewees (*Contopus sordidulus*). This habitat also offers perch sites for ground foraging species, such as western bluebirds and northern flickers. Swainson's hawks, red-tailed hawks and black-shouldered kites use valley oak woodlands as habitat because they require sturdy nesting sites with open canopy for easy access. Great blue heron and great egret maintain important rookeries in the valley oak woodlands near North Stone Lake and near Black Crown Lake on the Bufferlands Unit.

Perennial wetlands provide habitat for a variety of species, including pied-billed grebe (*Podilymbus podiceps*), American bitterns (*Botaurus lentiginosus*), American coots (*Fulica Americana*) and Virginia rails (*Rallus limicola*). Upland species, such as ring-necked pheasants and California quail, take cover and forage at the margins of wetland habitats. Diving and dabbling ducks and other aquatic birds also use the perennial wetlands of North and South Stone Lakes and the Bufferlands; however, most wintering waterbirds depend on the seasonal wetlands.

Waterbirds that make extensive use of the managed wetlands at North Stone Lake and the Bufferlands include grebes, herons, egrets, pelicans, cormorants, rails, cranes, plovers and other waterbird species (USFWS 1992). Flooded pastures and croplands and other seasonal wetlands provide foraging and roosting habitat for thousands of shorebirds migrating along the Pacific Flyway. For example, 4,090 shorebirds and 4,440 waterbirds were observed at Upper Beach Lake in a single survey on April 28, 1990 (USFWS 1992). A DFG aerial survey conducted in February 1972 recorded 5,750 waterfowl in the Beach-Stone Lakes basin. As many as 15,000 waterfowl were observed on other surveys (USFWS 1992). Dominant waterfowl species included tundra swans (*Cygnus columbianus*), snow geese, white-fronted geese, Canada geese, mallards, northern pintails, northern shovelers (*Anas clypeata*), cinnamon teal (*Anas cyanoptera*), green-winged teal, wood ducks and ruddy ducks (*Oxyura jamaicensis*). The Service also collected data on waterbird abundance in the Beach-Stone Lakes basin during January through March in 1982 and 1983.

Refuge grassland habitats commonly support reptiles like this rehabilitated gopher snake, shown being released onto the Refuge.
Photo by USFWS

The basin supported two million annual bird use days (one bird present for one day); of these 1.2 million were waterfowl (USFWS 1992). Based on the observations of local landowners and data collected by the Service, DFG and Ducks Unlimited, the Refuge appears to be most important as a feeding and resting area for waterfowl in the early spring rather than an important overwintering area. North and South Stone Lakes have the potential to be managed as waterfowl breeding and nesting areas during the spring and summer (USFWS 1992). Other wetland obligate bird species include common yellowthroats (*Geothlypis trichas*), red-winged blackbirds (*Agelaius phoeniceus*) and marsh wrens (*Cistothorus palustris*).

Open water portions of the Refuge's lakes, ponds and sloughs offer roosting habitat for waterbirds, such as pied-billed grebes, eared grebes (*Podiceps nigricollis*), common moorhens (*Gallinula chloropus*), American coots and a variety of waterfowl species. Diving and dabbling ducks and other water birds forage on submerged aquatic plants and associated invertebrates in aquatic beds associated with open water. Fisheries in open waters of Beach Lake, and North and South Stone Lakes provide an important food source for fish eating species, including American white pelicans (*Pelecanus erythrorhynchos*) and double-crested cormorants. In addition, double-crested cormorants nest at North Stone Lake (USFWS 1992).

Reptiles and Amphibians. Reptiles and amphibians can be found among the various habitat types on the Refuge. Common reptiles and amphibians on the Refuge include Pacific treefrogs (*Hyla regilla*), bullfrogs (*Rana catesbeiana*), western pond turtles (*Clemmys marmorata*), pond slider turtles (*Trachemys scripta*), western fence lizards (*Sceloporus occidentalis*), western terrestrial garter snakes (*Thamnophis elegans elegans*) and gopher snakes (*Pituophis catenifer*). Suitable habitat exists for the federally-threatened giant garter snake along sparsely vegetated lakes, sloughs and wetlands. Refuge grassland habitats commonly support gopher snakes, common garter snakes (*Thamnophis sirtalis*), California kingsnakes (*Lampropeltis getulus californiae*), western fence lizards and western toads. Valley oak woodland reptiles observed at North Stone Lake include western fence lizards, California alligator lizards (*Elgaria multicarinata multicarinata*), western yellow-bellied racers (*Coluber mormon*), Pacific gopher snakes, California kingsnakes and common garter snakes. Amphibians have also been seen in the valley oak woodlands at North Stone Lake, including bullfrogs, western toads and Pacific treefrogs. Reptiles seen in the riparian scrub include the ground insectivorous western fence lizard and the predatory gopher snake. Perennial wetland habitat provides breeding and foraging habitat for common garter snakes, Pacific treefrogs and bullfrogs. This habitat also has the potential to provide habitat for the giant garter snake. When standing water is available, amphibians such as California tiger salamanders, western toads and Pacific

treefrogs use vernal pools for egg laying and for the development of their young.

Fish. Fish are found in all bodies of water on the Refuge, including North and South Stone Lakes. Various surveys done from 1992 to present have yielded 30 species on the Refuge (See Appendix F, Fish List). Only five of the species observed, Sacramento blackfish (*Orthodon microlepidotus*), prickly sculpin (*Cottus asper*), hardhead minnow (*Mylopharodon conocephalus*), California roach (*Hesperoleucus symmetricus*) and sculpin are California natives. Common fish on the Refuge include mosquito fish, threadfin shad (*Dorosoma petenense*), black crappie (*Pomoxis nigromaculatus*), redear sunfish (*Lepomis microlophus*), catfish (*Ictalurus* spp.), largemouth bass, carp (*Cyprinus carpio*) and common bluegill (*Lepomis macrochirus*) (D. Vanicek , CSUS, 1999, B. Treiterer, USFWS, pers. comm.). Other introduced species include silverside (*Menidia beryllina*) and shrimp species. While many problems are associated with introduced fishes, they have a value for sportfishing (largemouth bass, catfish, etc.), controlling mosquitos (*Gambusia* spp.), and as forage for other fish and wildlife.

North and South Stone Lakes are best described as shallow and eutrophic, characterized by enriched dissolved nutrient levels (such as phosphates) that stimulate growth of aquatic plants and algae. As the abundant plants and algae decay the dissolved oxygen levels are reduced by microbial blooms. Due to the abundant plankton, these lakes are dominated by planktivorous (plankton-eating) fish. The food chain is stimulated by nutrients from abundant bird use, which helps produce the dense phytoplankton population. The phytoplankton in turn support a large zooplankton population, which supports the fish. Piscivorous (fish-eating) fish are not abundant in the lakes. The SP cut is less turbid than the lakes and contains fewer planktivorous fish.

Aquatic habitats occurring on the Bufferlands of the SRWTP consist of Laguna and Morrison creeks and five lakes. A total of 22 fish species have been documented from Bufferlands waterbodies. Meadowlark Lake comprises 19 acres of permanent water and was created as a borrow pit for construction of Interstate-5. It is filled each winter from overflows of Morrison and Laguna creeks and has steep banks with almost no vegetation. Black Crown Lake covers 28 acres and is very similar in nature and origin to Meadowlark Lake. However, it has some vegetation for cover and shade, is connected to Morrison Creek, and has a more stable water level in summer. Nineteen and 21 species of fish have been documented from Meadowlark and Black Crown lakes, respectively. Nicolaus Pond is an 8 acre pond, fed with water from the Captein Dairy and Laguna Creek Fish Farm. The banks are gradual and contain some grassy areas and some emergent vegetation. Five species of fish have been found in this pond. Fishhead Lake was created as part of a wetland mitigation project. The lake consists of 13.5 acres of permanent water with an additional 30.5 acres of seasonal water. Tailwater from Laguna Creek Fish Farm feeds the lake almost year round. The banks are steep, but stable water levels have allowed emergent vegetation to become established. The lake contains 18 species of fish. The 6.2-acre Lost Lake was formed from an abandoned gravel mining operation. Most of the lake is about ten feet deep and steep sided. Five species have been found in Lost Lake.

About 16,000 lineal feet of Laguna Creek passes through the Bufferlands. It is not channelized and appears to be high quality fish habitat. The upper sections have gentle slopes and large patches of emergent vegetation while the lower sections are lined with mature riparian trees. A total of 14 species of fish have been found in the creek. A 15,000 lineal foot section of Morrison Creek runs through the Bufferlands and receives most of its summer water from Sacramento storm drains. Fish kills have been observed here in the past, possibly a consequence of impaired water quality. Above its confluence with Laguna Creek, Morrison Creek is highly channelized

and appears to have little high quality fish habitat. Some stretches of bank are vegetated; however, most banks are steep and bare when water levels recede during the summer. In summer, large patches of floating water primrose (*Ludwigia peploides*) sometimes cover the entire surface of the creek. Past the confluence, the banks are lined with riparian trees offering a higher degree of cover. Ten species of fish have been found in Morrison Creek.

Invertebrates. There has been no comprehensive invertebrate survey conducted at the Refuge. However, some surveys occasionally conducted by SYVCMD and refuge staff have found that aquatic vertebrates, such as grass shrimp, Louisiana swamp crayfish, clam shrimp (*Cyzicus californicus*), Odonata larvae (dragon and damselfly), Notonectiday larvae (backswimmers), cladocerans, copepods and water beetles (Corixidae larvae), inhabit seasonal and permanent wetlands and also the vernal pools.

Vernal pools are located on the Wetland Preserve, North Stone Lake and Beach Lake units of the Refuge. Please see the description of vernal pool fairy shrimp and vernal pool tadpole shrimp below. Two species of fairy shrimp, the vernal pool fairy shrimp and the vernal pool tadpole shrimp, have been identified in the pools.

Special Status Species

Stone Lakes provides or has the potential to provide habitat for Federal Endangered Species Act (ESA) and California Endangered Species Act (CESA) threatened and endangered species.

Federally-listed Species

Vernal pool fairy shrimp (*Branchinecta lynchi*). The vernal pool fairy shrimp is an ESA listed threatened species and is a small (0.4 inches to 1.0 inch long) crustacean with a delicate elongate body, large stalked compound eyes and 11 pairs of swimming legs. This species is endemic to vernal pool habitats in California and southwestern Oregon (USFWS 1994).

Vernal pool fairy shrimp typically inhabit vernal pools with clear to tea-colored water, most commonly in grass or mud-bottomed swales, or basalt flow depression pools in unplowed grasslands. They also may exist in alkaline vernal pools. The water in pools inhabited by this species has low total dissolved solids, low conductivity, low alkalinity and low chloride. Fairy shrimp feed on algae, bacteria, protozoa, rotifers and bits of detritus (USFWS 1994).

The primary threats to vernal pool fairy shrimp are the loss and alteration of habitat due to urban and agricultural development and random extinction by virtue of the small isolated nature of the remaining population.

Vernal pools are found on the Wetland Preserve and Lewis Units. Vernal pool fairy shrimp have been documented within vernal pools on the Wetland Preserve Unit.

Vernal pool tadpole shrimp (*Lepidurus packardi*). The vernal pool tadpole shrimp is an ESA listed endangered species. Vernal pool tadpole shrimp are primarily benthic (living on the bottoms of the pools) animals that swim with their legs down. Vernal pool tadpole shrimp climb or scramble over objects, and plow along bottom sediments as they forage for food. Their diet consists of organic detritus and living organisms, such as fairy shrimp and other invertebrates (USFWS 2003c). Females disperse fully developed cysts into the pool, where the cysts are then deposited into the sediment. Vernal pool tadpole shrimp pass the summer months as dormant cysts in the soil. Some of the cysts hatch as the vernal pools are filled with rainwater in the next or subsequent seasons, while other cysts may remain dormant in the soil for many years. When winter rains refill inhabited pools, tadpole shrimp reestablish from dormant cysts and can become sexually mature within three to four weeks of hatching (Ahl 1991; Helm 1998). The tadpole shrimp will continue to grow as long as their vernal pool habitat remains inundated, in some cases for six months or longer. They periodically shed their shells, which can often be found along the edges of vernal pools where vernal pool

tadpole shrimp occur. Mature vernal pool tadpole shrimp range from 0.6 to 3.4 inches in length. Mature adults may be present in pools until the habitats dry up in the spring (USFWS 2003c).

Tadpole shrimp can be found in California's Central Valley and the San Francisco Bay area. The geographic range of this species includes disjunct occurrences in the Central Valley, from Shasta County to northern Tulare County and in the Central Coast Range from Solano County to Alameda County. The primary threats to vernal pool tadpole shrimp are the same as for the vernal pool fairy shrimp.

Vernal pools can be found on the Wetland Preserve and Lewis units. Vernal pool tadpole shrimp have been documented within vernal pools on the Wetland Preserve Unit.

Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*, VELB). The valley elderberry longhorn beetle is an ESA listed threatened species. The VELB is a medium-sized beetle, typically about two cm long.

The VELB is associated with elderberry trees (*Sambucus* spp.) during its entire life cycle. The adults emerge from pupation inside the wood of these trees in the spring as their flowers begin to open. The exit holes made by the emerging adults are distinctive small oval openings. Often these holes are the only detectable clue that the beetles occur in an area. The adults feed on elderberry foliage until about June, when they mate. The females lay eggs in crevices in the bark. Upon hatching, the larvae begin to tunnel into the tree where they will spend one to two years eating the interior wood, which is their sole food source.

The elderberry tree is associated with riparian forests which occur along rivers and streams. Historically the VELB ranged throughout the Central Valley; however, recent surveys have revealed the VELB to persist only in scattered localities along the Sacramento, American, San Joaquin, Kings, Kaweah and Tule rivers and their tributaries. Over 95 percent of our riparian forests have been cleared in the past century for agricultural, as well as urban and suburban, and development uses (Smithsonian Zoological Park). The wood from these forests has also been used extensively as fuel and building materials. Additionally, extensive use of pesticides, grazing and other mismanagement have severely degraded otherwise undisturbed patches of riparian habitat.

There are no documented sightings of the VELB or of any exit holes on the Refuge. However, elderberry trees of appropriate size can be found on the Lewis Unit. New elderberry shrubs planted for mitigation on the South Stone Lake Unit are expected to reach the appropriate size for VELB habitat in the future.

Giant garter snake (*Thamnophis gigas*). The giant garter snake is an ESA listed threatened species. Historically, the range of this snake was the San Joaquin Valley from the vicinity of Sacramento and Antioch southward to Buena Vista and the Tulare Lake Basin (CDFG 2000). The current distribution extends from near Chico to Fresno County. This species is one of the most aquatic garter snakes and is usually found in areas of freshwater marsh and low gradient streams. Permanent wetlands are especially important as they provide habitat over the summer and early fall when seasonal wetlands are dry. Although the snake is absent from larger rivers (such as the Sacramento River), it has adapted to human made habitats, such as drainage canals and irrigation ditches, especially those associated with rice farming. Riparian woodlands do not provide suitable habitat because of excessive shade and inadequate prey resources (USFWS 1993).

Generally quite aquatic, these garter snakes forage primarily in and along streams, taking fish, amphibians and amphibian larvae (Fitch 1941). Most current food sources may be introduced species, such as carp, mosquito fish, and bullfrogs, because the native prey such as blackfish, thick-tailed

chub (*Gila crassicauda*) and red-legged frog (*Rana aurora draytoni*) are no longer available (Rossman et al. 1996). Courtship and mating normally occur soon after spring emergence. Young are born alive between mid-July and early September, usually in secluded sites, such as under the loose bark of rotting logs or in dense vegetation near pond or stream margins.

The giant garter snake is now very scarce throughout its range in the Central Valley. Populations have been eliminated or decimated by the elimination of natural sloughs and marshy areas. Heavy use of pesticides is also suspected as a contributing factor in the decline of this once abundant garter snake. Fortunately, protection of waterfowl habitat may allow it to survive in a small portion of its original range.

The giant garter snake was last documented on the Refuge 14 years ago in 1992 at Beach Lake. The species is presumed to be present throughout the Refuge where suitable habitat exists (Wylie 1997). The Refuge lies within the Sacramento Basin subpopulation of the giant garter snake.

Bald eagle (*Haliaeetus leucocephalus*). The bald eagle has suffered from habitat destruction and degradation, illegal shooting and contamination of its food source, most notably due to the pesticide DDT. The bald eagle is listed as an ESA threatened and CESA endangered species. Although there have been no documented sightings of the bald eagle on the Refuge, (DFG 2004) habitat exists for them on the Refuge.

State-Listed Species

Greater sandhill crane. The greater sandhill crane is a CESA listed threatened species. The Refuge and adjacent public and private lands provide habitat for greater and lesser sandhill (*Grus canadensis canadensis*) cranes. The California Central Valley provides wintering habitat for 6,000 – 6,800 cranes, nearly 14 percent of the world's total population of greater sandhill cranes (Pacific Flyway Council 1997). The San Joaquin-Sacramento Delta is one of the two most important winter use areas for the Central Valley population of greater sandhill cranes; over 61 percent of the Central Valley population has been recorded on the Delta (Ivey and Herziger 2001).

Historically, greater sandhill cranes were fairly common breeders on California's northeastern plateau (Grinnell and Miller 1944). The greater sandhill crane is now reduced greatly in numbers and breeds only in Siskiyou, Modoc, Lassen, Plumas and Sierra counties (James 1977; Remsen 1978; McCaskie et al. 1979). The subspecies winters primarily in the Sacramento and San Joaquin Valleys (Grinnell and Miller 1944) but can also be found near Brawley in Imperial County and Blythe, in Riverside County (Garrett and Dunn 1981), along with lesser sandhill cranes. Greater sandhill cranes formerly wintered more commonly in Southern California, but have declined greatly there and throughout their range. They are extremely rare outside of their known wintering grounds except while migrating over interior California. There have been a few coastal sightings from Marin County southward, but there are no records from offshore islands.

The Refuge's wintering cranes migrate southward from the northeast in September and October and northward in March and April. Cranes travel in great flocks, both day and night, with stops only for short periods to feed and rest. Migration is rapid and direct. In winter, cranes frequent dry grasslands and croplands especially near open and emergent wetlands (Grinnell and Miller 1944), although they may also feeds on dry plains far from water. When foraging, cranes prefer open treeless short grass plains, grain fields and open wetlands where predators can be easily seen (Grinnell and Miller 1944, Cogswell 1977). They feed mostly on cereal crops (e.g., newly planted or harvested) and will also consume grasses and forbs. Cranes also use their long bills to probe in soil for roots, tubers, seeds, grains, earthworms and insects. Larger prey, such as mice, small birds, snakes, frogs, and crayfish, are also taken (Terres 1980; Eckert and Karalus 1981). Fruits and berries are eaten if available (Eckert and Karalus 1981).

Grazing can be detrimental to sandhill crane, when they are nesting and fledging (Littlefield and Ivey 2002), however nesting is not known to occur on the Refuge.

Cranes roost at night in flocks standing in moist fields or in shallow water (Terres 1980). They also roost in expansive, dry grasslands, island sites, and wide sandbars (Johnsgard 1975; Eckert and Karalus 1981).

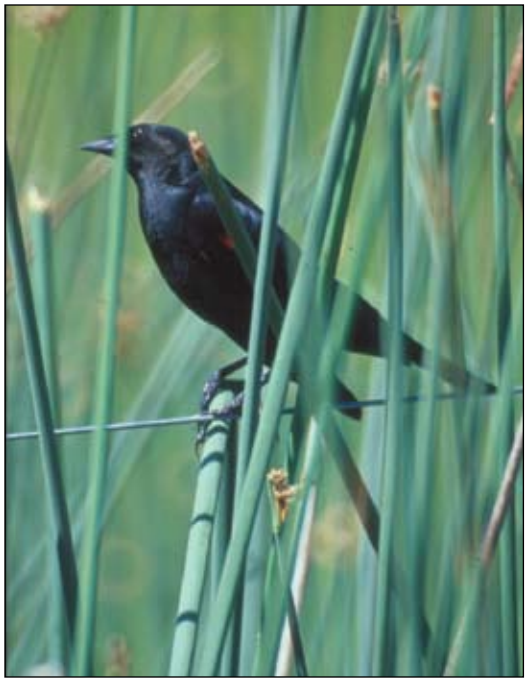
In California, sandhill cranes establish nesting territories in wet meadows that are often interspersed with emergent marsh habitat. The last statewide breeding population study in California was conducted in 1988. The breeding population in California was estimated to be 276 pairs. Favorable roost sites and an abundance of cereal grain crops characterize the cranes' preferred Central Valley wintering ground. Rice is used extensively by cranes near the Butte Sink area of Butte County and corn is the principal food source at most other Central Valley wintering areas, particularly in the Sacramento-San Joaquin Delta near Lodi in San Joaquin County. Irrigated pastures are chosen for resting sites throughout the wintering ground. A key requirement of wintering habitat is a communal roost site consisting of an open expanse of shallow water (CDFG 2000).

Currently, the estimate for greater sandhill cranes within their Pacific Flyway range is between 5,000 and 6,000 individuals. This species continues to experience threats on both wintering and breeding grounds by agricultural and residential conversion of habitat, predation, human disturbance and collisions with power lines (CDFG 2000).

Surveys indicate 300-350 greater sandhill cranes feed, roost and loaf on the Refuge during the winter season. The cranes roost and forage in managed impoundments, pastureland, and other agricultural land throughout and adjacent to the Refuge. Cranes are commonly seen on irrigated pastures on the South Stone Lake Unit and on the grasslands of North Stone Lake and the Wetland Preserve Unit. They can also be found on the Whitney (in the southeast corner) and Zacharias Island properties, lands that are not managed by the Refuge but are within the approved refuge boundary. In general, a mix of greater and lesser sandhill cranes can be found south of Hood-Franklin Road, with only greater sandhill cranes occurring north of Hood-Franklin Road.

When foraging, greater sandhill cranes prefer open treeless short grass plains, grain fields and open wetlands where predators can be easily seen.
Photo by USFWS

Swainson's hawk (*Buteo swainsoni*).
The Swainson's hawk is a State-listed threatened species. The Swainson's hawk is an uncommon breeding resident in the Central Valley (Polite 2000). Swainson's hawks breeding in the Central Valley appear to winter in Mexico and Columbia (CDFG 2001). Bloom (1980) estimated 110 nesting pairs, and a total of 375 pairs in California (Polite 2000). The diet of the Swainson's hawk is varied, although its staple in the Central Valley is the California vole, augmented with a variety of bird and insect species. Over 85 percent of Swainson's hawk territories in the Central Valley are in riparian systems adjacent to suitable foraging habitats. Swainson's hawks often nest peripherally to riparian systems of the valley, as well as within lone trees or groves of trees in agricultural fields. Valley oak, Fremont cottonwood, walnut and large willow are the most commonly used nest trees in the Central Valley, each with an



Many species of concern have been seen on the Refuge including this tricolored blackbird.
Photo by USFWS

average mature height of about 58 feet, and ranging from 41 to 82 feet tall. Swainson's hawks require large, open grasslands with abundant prey in association with suitable nest trees. Suitable foraging areas include native grasslands or lightly grazed pastures, alfalfa and other hay crops and certain grain and row croplands. Unsuitable foraging habitat includes crops, such as vineyards, orchards, certain row crops, rice, corn and cotton crops. Suitable nest sites may be found in mature riparian forests, lone trees or groves of oaks, other trees in agricultural fields and mature roadside trees.

Wildlife viewing is the most popular wildlife-dependent activity among ecoregion residents with 56 percent of outdoor recreators participating.
Photo by USFWS

Declining numbers of Swainson's hawks are, in part, caused by loss of nesting habitat (Polite 2000). Converting compatible agricultural lands to residential and commercial developments and noncompatible agricultural activities are a serious threat to Swainson's hawks throughout California (CDFG 2000). Swainson's hawks have been seen on nearly the entire Refuge (B. Treiterer, USFWS, pers. comm.).

Other species that have been seen on the Refuge include the following State or Federal species of concern: white-faced ibis, tri-colored blackbird, western burrowing owl, oak titmouse (*Baeolophus inornatus*), white-tailed kite, loggerhead shrike, rufous hummingbird (*Selasphorus rufus*), lamprey (*Lampetra ayresii*), Pacific lamprey, small-footed bat (*Myotis ciliolabrum*) and Yuma myotis bat (*Myotis yumanensis*).

Visitor Services

Ecoregion Scale

Wildlife viewing is the most popular wildlife-dependent activity among ecoregion residents with 56 percent of outdoor recreationists participating. About 41 percent of residents participate in freshwater fishing, 19 percent in saltwater fishing and 9 percent in hunting.

The population in the ecoregion is expected to rise by 47 percent between the year 2000 and the year 2020. Unmet demand appears to be highest in the region for wildlife viewing, trail hiking, picnicking, camping and freshwater fishing with this trend expected to continue. Outdoor recreationists in the Central Valley/San Francisco Bay Ecoregion tend to be mostly white (78 percent) with growing participation by the Hispanic and Asian-American communities. In general, residents of moderate or high family incomes have the greatest interest in wildlife-dependent recreation, both consumptive and non-consumptive types.

The nearest other national wildlife refuges are Antioch Dunes, San Pablo Bay, Sutter and San Joaquin River. Of these, only Sutter

is open to unsupervised visitor use. Other nearby public lands offering similar wildlife-dependent recreational activities include the Yolo Basin Wildlife Area, Cosumnes River Preserve and the American River Parkway. The U.S. Forest Service and Bureau of Land Management have considerable land holdings in the ecoregion and all wildlife-dependent priority recreational uses are accommodated on various portions of their lands. There are 16 State Wildlife Areas or Ecological Areas operated by DFG within an hour's drive of the Refuge. These 16 areas provide opportunities for wildlife observation, interpretation, hunting and/or fishing. In addition, there are five State Parks within approximately one hour's drive that offer fishing, wildlife observation and/or interpretation.

Local Scale

More than 50 percent of lands within the Refuge's approved boundary are privately-owned and the Service has no authority to provide for visitor use of those lands. However, limited visitor use is available on Refuge lands that are owned by or over which the Service has management authority.

Wildlife-Dependent Recreation.
In the Refuge System Improvement Act of 1997, Congress recognized six wildlife-dependent priority recreational uses of refuges: hunting, fishing, wildlife observation and photography, interpretation and environmental education. More than 6,000 people per year visit the Refuge to participate in a variety of wildlife dependent recreational and educational activities. Currently, the Refuge accommodates waterfowl hunting, wildlife observation and photography, interpretation and environmental education.

Hunting. In 2004, the Service began a planning process for a public waterfowl hunt program on the South Stone Lake Unit of the Refuge. The first Refuge-managed hunt occurred during the 2005-2006 hunt season. The program consists of spaced-blinds accessible by foot and boat and emphasizes opportunities for youth and hunters in wheelchairs. Prior to acquisition by the Service, waterfowl hunting had occurred on the South Stone Lake Unit on the Sun River and Lodi Gun Club properties while they were private duck hunting clubs. Some illegal waterfowl hunting also occurs occasionally in the Beach Lake, North Stone Lake, and South Stone Lake units due to limitations in Refuge law enforcement capability and opportunities to gain illegal access via private property and by boat.

Wildlife Observation and Photography. The Refuge, with its proximal location to a major urban center, wildlife diversity and mosaic of habitats, is steadily increasing in popularity with the surrounding community. The North Stone and Beach Lake units of the Refuge are open every second and fourth Saturday of each month (except during July and August) from 7:30 a.m. to 2:00 p.m. and 9:00 a.m. to 3:00 p.m., respectively. Visitors access the Refuge from the trailhead at the Elk Grove Boulevard entrance, west of Interstate-5. Refuge staff and/or volunteers greet visitors who may take a 3-mile round trip self-guided walk through grasslands on the North Stone Lake unit, past seasonal and permanent wetlands, and along riparian habitat to an observation platform overlooking Lower Beach Lake and wetland impoundments. Visitors in wheelchairs or with small children may drive directly to the universally accessible trail leading to the

The first Refuge-managed hunt occurred in the 2005/2006 hunt season, including this wheelchair accessible hunting blind on the Sun River Unit.
Photo by USFWS

Since the establishment of the Refuge, educators and youth care professionals from Sacramento, San Joaquin and Yolo counties have been using the Refuge as an outdoor classroom to enhance course curricula.
Photo by USFWS

viewing platform. Visitors typically spend between two and four hours per visit and there is no daily entrance fee.

Environmental Education. Since the establishment of the Refuge, educators and youth care professionals from Sacramento, San Joaquin and Yolo counties have been using the Refuge as an outdoor classroom to enhance course curricula. Educators include teachers, professors and outdoor education leaders. Youth care professionals include leaders for Scouts, 4H, Campfire and church groups. Most of the educators and youth care professionals who are served by the Refuge's environmental education program work with kindergarten through college age students. Currently, most educational field trips are guided by Refuge volunteers or staff on the Beach Lake Unit, with occasional classroom visits. These programs are available by special arrangement.

Interpretation. Current Refuge interpretation consists of interpretative panels on the wildlife viewing platform, Refuge brochures, special guided tours by Refuge volunteers and staff, Refuge website and special events such as the Refuge's annual Walk on the Wildside event.

Fishing. The Refuge does not currently have a formal fishing program open to the public, although several points of illegal entry exist and are regularly used by shore and boat anglers.

Non-Priority Wildlife-Dependent Visitor Uses. Before its establishment as a national wildlife refuge, a number of visitor uses occurred on the Refuge. The EIS (USFWS 1992) described recreational resources and uses that were cited in "public comments on the draft EIS, staff of land management organizations and agencies in the study area, representatives of recreation and conservation groups, marina operators, Sacramento County Sheriff's Department boat patrol members and boaters who regularly recreate on the waterways in the study area." Many of these historic uses continue in addition a number of other authorized and unauthorized non-priority wildlife dependent visitor uses occur on the Refuge including: bird-watching and nature study (e.g., National Audubon Society annual "Christmas bird counts"); target

Refuge visitors may take a 3-mile round trip, self-guided walk through managed grasslands and along a riparian zone to an observation platform overlooking a managed wetland.
Photo by USFWS

shooting/firearm discharging; hunting (mostly pheasant and waterfowl); trapping (to control populations of burrowing animals, such as beaver, muskrat and mink to control levee damage); hiking and walking; water-oriented recreation such as motorized boating, canoeing, kayaking, waterskiing, house-boating, fishing and swimming/ sunbathing; horseback riding; jogging; bicycling; ultralight flying; helicopter training; fruit and nut gathering; picnicking and camping; and natural history plant collecting.

Socioeconomic Demographics

The Refuge is located within Sacramento County, bounded by the city of Elk Grove on the east, and 15 miles south of downtown Sacramento. Sacramento County's population was estimated at over 1.36 million in 2005 (USCB 2006) and is projected to grow by almost 0.5 million by 2025 (SACOG 2000). Sacramento is by far the biggest city in the county; and even though the Greater Sacramento Region includes portions of five other counties, 65 percent of the city's population lives within Sacramento County. By percentage, Elk Grove was the fastest growing large U.S. city, between 2004 and 2005 (USDOC 2006). Elk Grove incorporated in 2000 with a population of 81,400 (SACOG 2000) and had reached 112,338 by July, 2005 (USDOC 2006).

In 2004, there were an estimated 649,782 citizens in the labor force in Sacramento County (ACS 2004). In 2005 unemployment averaged 4.8 percent and is projected to decline in 2006 to 4.6 percent (SFP 2006). The sectors of the economy accounting for the largest numbers of jobs in the county in 2004 were: management, professional and related occupations (35 percent); sales and office occupations (31 percent) and service occupations (15 percent) (ACS 2004). In 2004 Sacramento County per-capita income averaged $23,589 and median family income averaged $57,488 (ACS 2004). Of people over the age of 25, 16 percent did not have a high school diploma, 23 percent had a high school diploma or equivalency, 19 percent attained a bachelor's degree and 8 percent attained a graduate or professional degree (ACS 2004). In 2004, approximately 10 percent of Sacramento County residents were living in poverty (ACS 2004).

The largest age group distributions in Sacramento county are: between 25 and 44 years old (30 percent); under 18 (28 percent) and between 45 and 64 (22 percent) (ACS 2004). The racial compositions of Sacramento County and the city of Elk Grove are relatively diverse. Sacramento County's population is composed of 54.4 percent Caucasians, 16.1 percent Hispanics, 12.9 percent Asians and 10.4 percent African Americans (ACS 2004). The most recent statistics available for Elk Grove, from 2000, show that Elk Grove has a slightly higher percentage of Asian people (17.6 percent) and slightly less African Americans, Hispanics and Caucasians when compared to Sacramento County in the aggregate (USCB 2000). In Sacramento County there was an estimated 181,077 households with one or more people under the age of 18, in 2004 (ACS 2004).

Despite increasing urbanization, agriculture continues to be an important economic sector in Sacramento County. Sacramento County ranked 27th, out of 58 counties, in the State for gross value of agricultural production for 2002-2003 (CASS 2004). The county's top ten farm commodities in 2002 were grapes, milk, nursery stock, pears, poultry, vegetable crops, rice, cattle, corn and livestock (CASS 2004). While agriculture continued to be an important sector of the economy, 0.92 percent of prime farmland and 5.05 percent of agricultural land was converted to urban and build-up uses between 1988 and 1998 (Kuminoff et al. 2000).

The median home price in Sacramento County jumped to $287,672 by 2004 (ACS 2004) and has continued to rise, reaching $360,000 by April of 2006 (CLMI 2006). Housing units in the county are projected to increase from 473,211 in 2000 to 662,004 in 2025 (SACOG 2000). Of the increase, 45 percent will occur in unincorporated areas, and 25 percent in the city of Sacramento, but fully 20 percent of the increase is projected

to occur in Elk Grove where housing units increased from 24,817 in 2000 (SACOG 2000) to 66,733 in 2005 (CEG 2006).

Cultural Resources

Cultural Resources and Ethnographic Background

Cultural resources include a variety of links to past cultures, such as physical remains, sites, objects, records, oral histories and traditional culture, but can also include landscapes, plants, animals, sacred locations and traditional cultural properties that play a role in the traditional community. Other historic sites represent a wide variety of activities, including homesteading and settlement, trade, transportation, agriculture and ranching.

Most of the recorded cultural resources at the Refuge are archaeological sites linked with American Indian occupation that include large village sites, small seasonally occupied camps, sites with burials and sites considered sacred. The material remains of historic activities within the project boundary may include standing structures and foundations, still-occupied dwellings, abandoned trails, ferry sites, extant roadways and railroad lines.

The Plains Miwok formerly occupied the lands now within the approved Refuge boundary. The Refuge contains a rich array of Plains Miwok cultural history because its abundant flora and fauna made it a suitable place for humans. Before the area was settled by Euroamericans, the Plains Miwok territory extended from north of the lower reaches of the Cosumnes River to south of the lower reach of the Mokelumne River, along both sides of the Sacramento River and southwest to the vicinity of Mt Diablo in Contra Costa County. The eastern boundary of their territory was the foothills of the Sierra Nevada, which they shared with the Central Sierra Miwok (Levy 1978, Service 1992).

Typical of the surrounding Central California groups, the political organization of the Plains Miwok is believed to have centered around small tribelets. Each tribelet was essentially sedentary and occupied a place more or less continuously for generations. Resources were variably controlled with acorn and hunting lands considered communal, while seed tracts and fishing stations could be individually allocated in accordance with inherited use rights for one or more seasons. The tribelets also used seasonal camps to exploit seasonal resources, such as salmon, acorns, etc. (Tremaine 1997, Kroeber 1932, Bennyhoff 1977).

Numerous Plains Miwok village locations were identified during the waning years of traditional American Indian inhabitation of the region. Major village sites are plotted along the Sacramento, Mokelumne and Cosumnes rivers. Additionally, several locations in Sacramento County have been identified as sacred by the Native American Heritage Commission. The “Hulpoomne” appears to be the nearest known “tribe” associated with the north portion of the Refuge, being associated with a principal village in the area where the town of Freeport now stands (Merriam 1907).

Today, descendants of the Plains Miwok continue to have ties to their ancestral lands. Known cultural sites on and off Refuge lands have been identified and efforts have been made to work with tribal representatives to restore native habitats while preserving these sites. In some cases and at the request of tribal representatives, previously-disturbed archeological sites have been capped with layers of soil and vegetation to help prevent human remains and other objects from being exposed on the surface. The comprehensive conservation planning process gives us the opportunity to plan for the future of the Refuge, working to protect these important resources and providing a link to the past for current generations of Plains Miwok.

Historic Setting

Spanish explorers arriving in the 1700s were the first people other than American Indians to enter the Sacramento Valley area. For the most part, the region was little affected by Spanish occupation, being removed from

the missions' sphere of influence. Land in the Sacramento Valley was not claimed for private ownership until Mexican land grants were issued in the 1830s. The Rio Ojotska land grant, issued in 1833 to J.B.R. Cooper, was the earliest land grant given in the area; however, the recipient failed to lay claim to the land and renounced the grant the following year (USFWS 1992).

New Helvetia, established by John A. Sutter in 1839 near the present site of Sacramento, was the first Euroamerican settlement in the valley. Sutter obtained 11 leagues of land through a grant from the Mexican government, which approved of Sutter's plan to build a fort and establish order on the edges of their frontier. Sutter's Fort was founded with goods purchased from the Russians when Fort Ross was abandoned in 1841. A large number of horses and cattle were brought to Sutter's Fort, along with a cannon and several pieces of artillery. These accoutrements gave the fort a military appearance, which undoubtedly discouraged skirmishes between the settlers and American Indians (USFWS 1992).

Lands along the Cosumnes River, northeast of the Refuge, were claimed in 1844 by two employees of Sutter. At the time, the Cosumnes area was "thickly populated by Indians" (USFWS 1992). The land, which was claimed to graze cattle, was called Rancho Omochumnes after the local American Indian tribelet. Another land grant, Sanjon de los Moquelumnes, included the southeastern portion of the Refuge; this land grant was also named after a Plains Miwok tribelet.

In 1848, California and the Sacramento Valley were changed forever by the discovery of gold in the Sierra Nevada foothills. Until that time, most of California had been unaffected by Euroamerican settlement. With the discovery of gold, thousands of miners entered the state. Thousands of settlers soon followed the miners. Sacramento was the main community, surrounded by dozens of smaller settlements. In the beginning, the locations of early towns coincided with mining activities. Probably only limited mining occurred in the vicinity of the Refuge because of the scarcity of gold-bearing gravels at such low elevations. Later, as agricultural pursuits replaced mining, farming communities appeared. By the 1860s, agricultural enterprises were well established in the Sacramento Valley and the Delta region. A variety of crops were grown on and west of the Refuge while areas to the east were used for mixed agriculture and to raise livestock. Towns that were established near the Refuge include Franklin, Bruceville, Locke, Sheldon and Wilton.

Archeology

Requests have been submitted to the North Central Information Center of the California Archaeological Inventory for information regarding the types and location of archeological sites on and in the vicinity of the Refuge. Historic and ethnographic sources were also reviewed for information pertaining to the area.

Types of Archeological Sites. Intensive prehistoric and historic habitation and use in the Sacramento area has resulted in a large and diverse archeological resource base. Over 450 archeological sites have been recorded in Sacramento County. Many sites have been recorded, although most lands within the approved Refuge boundary have not been surveyed systematically for cultural resources.

Most of the recorded sites within the vicinity of the Refuge are prehistoric in nature. Although this is partly because prehistoric site density is greater than historic site density in the Refuge area, it is also because most archeologists working in the area did not record historic sites until quite recently. Sites associated with American Indian occupation include large sites, small, seasonally occupied camps, sites with burials and sites that were considered sacred. Historic sites represent a wide variety of activities, including homesteading and settlement, trade, transportation, agriculture and ranching. The material remains of these activities probably include standing structures and foundation, still occupied dwellings, abandoned trails and

ferry sites, extant roadways and railroad lines.

Location of Archeological Sites. Both prehistoric and historic sites within and around the Refuge tend to be located on high ground near permanent water sources. Determining areas of historic sensitivity is difficult, however, because of the lack of identified historic period sites within the Refuge. For the most part, early historic settlements (before the establishment of reliable flood control measures) were located on prehistoric sites. In fact, it is common to find a prehistoric midden site under a historic dwelling because American Indians often chose to live on topographic high points. American Indian habitation sites became even higher points of land as their refuse accumulated over hundreds or even thousands of years of occupation, and these mounds were attractive building locations for early settlers. In addition to topographic high points, historic remains should be expected near early settlement locations, along railroad lines and near ferry sites.

Many prehistoric archeological sites have been identified along major drainages, such as the Mokelumne and Cosumnes rivers and Laguna, Skunk, Badger and Deer creeks. Many unidentified sites are probably present on these drainages although intensive, systematic surveys have never been done. Additional areas of prehistoric sensitivity include the lands around Beach, North, and South Stone lakes and Snodgrass and Bear sloughs.

Land Use

Natural biologic communities presently occurring within the entire approved Refuge project boundary encompass a total of 8,283 acres and include: annual grasslands (71 percent), seasonal wetlands (13 percent), perennial wetlands (7 percent), riparian forest and scrub shrub (5 percent), deepwater aquatic habitat (3 percent) and oak woodlands (1 percent). Existing agricultural cover types within the Refuge occupy an additional 10,321 acres and are comprised of: corn (28 percent), pasture (21 percent), range (17 percent), wheat (8 percent), sugar beets (8 percent), grapes (7 percent), other field crops (4 percent), pears (2 percent) and tomatoes (1 percent).

Adjacent lands in this region are shifting from low density, rural, residential homes and structures, agriculture, and recreational areas to medium density single family suburban tract homes, master-planned communities and vineyards (B. Treiterer, USFWS, pers. comm.).

Wilderness and Other Special Management Areas

As required by Service planning policy, a wilderness review (Appendix G) was conducted for the Refuge. None of the Refuge lands were eligible for wilderness designation.

Current Management Practices

The primary management focus of the Refuge is enhancing, restoring and maintaining wetlands, riparian woodlands, grasslands and valuable agricultural lands. Wetland habitats include permanent and seasonal wetlands, including vernal pools, riparian woodlands, open water and aquatic beds.

Wetlands

Water Management. As an integral part of the Refuge program, the Service manages water on seasonal and permanent wetlands on the South Stone Lake, Headquarters and Beach Lake units totaling approximately 335 acres. Sources of water for managed Refuge wetland units include SP Cut, Lower Beach Lake, Sacramento Drainage Canal and South Stone Lake. A total of seven surface pumping stations draw water from Refuge waterways to manage wetland impoundments on the Refuge. Water control structures (i.e., screw gates) are also used to manage water entering other permanent wetlands areas, such as North Stone Lake and Parker Slough and portions of the Sun River property. The overall water flow in the SP Cut is controlled by screw and flap gates passing under Lambert Bridge, upstream drainage, groundwater levels and irrigation return flows.

Flood up, drawdown and summer irrigations are planned to provide habitat for migrating, wintering and breeding water birds. Timing of flood up is constrained to varying degrees by the amount of water available under appropriative and riparian water rights in any given year and to minimize mosquito production.

Permanent Wetlands. Permanent wetlands are managed to provide brood rearing habitat during the summer months for waterfowl and other waterbirds and year round habitat for other species, including bitterns, herons and marsh wrens. Periodic draw downs of the permanent wetlands on the Beach Lake, Headquarters and South Stone Lake units are done when vegetation, such as cattails and tules, covers more than 75 percent of the surface area and to control undesirable fish species such as carp. These treatments occur approximately every three to five years. Not more than three out of the five permanent wetland impoundments on these units are drawn down in any given year, in order to maintain habitat for the federally-threatened giant garter snake and summer resident birds. In other permanent wetlands, such as Parker Slough, North Stone Lake, and the Sun River property, water levels can be manipulated using screw gates to lower levels, but not completely de-water wetlands. In these situations, the goals are to stimulate growth of desirable moist soil plants along pond edges and allow for some control of dense vegetation, if necessary.

Seasonal Wetlands. Seasonal wetlands are managed to provide feeding and loafing habitat for the thousands of migratory waterbirds that winter in the Central Valley and make use of the Beach-Stone Lakes Basin. During years with no restrictions on water use, flood ups begin in early to mid-September and continue through mid-October. To minimize mosquito production, impoundments are rapidly filled to a maximum depth of one to two feet. Occasional pumping may be required during the winter if rainfall levels are below normal. Drawdowns commence in early April and continue through mid-June. Varying the draw down schedule in wetland units stimulates production of different plants. Early draw downs favor grasses, such as swamp timothy and watergrass; late drawdowns favor smartweeds and some undesirable plants, such as cocklebur. Late drawdowns occur in one or two wetland units per year to provide habitat for nesting shorebirds, including black-necked stilts (*Himantopus mexicanus*), American avocets (*Recurvirostra Americana*) and Wilson's phalaropes (*Phalaropus tricolor*). Summer irrigations are designed to stimulate the growth of high quality foods for waterfowl, such as swamp timothy and watergrass. These are done in late July and early August when the unit is flooded to a depth of 12 inches and then drawn down. Close coordination with the Sacramento/Yolo Mosquito Vector Control District is essential to minimize mosquito production on managed wetlands.

SP Cut. Water levels in the SP Cut are controlled by screw and flap gates passing under Lambert Bridge, upstream drainage, groundwater levels and irrigation return flows. Through informal agreement with Sacramento County Department of Water Resources, the screw gate on the Lambert Bridge flood control structure is operated by a local landowner to manage availability of upstream water for irrigation and wetland management. Water levels are generally higher during the summer months when the gate at Lambert Bridge is open and farmers upstream are irrigating crops. During the winter, water levels are determined by rainfall levels and drainage entering from upstream. During large rainfall events, water enters SP Cut when floodwaters overtop the Morrison Creek dam at the north end of Lower Beach Lake.

North Stone Lake. North Stone Lake is roughly 260 acres in size with depths ranging from 0.5 feet to 8.0 feet. Water enters the lake via concrete culverts under Interstate-5 that bring water from upstream developed areas to the east and from SP Cut to the west, through a single pipe fitted with a screw gate. Water levels in the lake can be manipulated to a limited degree (12 inches

maximum) by opening or closing this screw gate, depending on water fluctuations in the SP Cut. There are no control structures on the Interstate-5 culverts.

South Stone Lake. Water levels in various parts of South Stone Lake fluctuate with levels in SP Cut and tidal influences from downstream of Lambert Bridge. As with North Stone Lake, water levels are highest during the summer irrigation months and winter rainfall months. Except for requesting opening of the screw gate at Lambert Bridge, Refuge staff have little control over water levels in South Stone Lake.

Habitat Manipulations. Managed wetlands are dynamic systems that require periodic habitat manipulations to maintain a desired successional stage, optimal for feeding, loafing, breeding waterfowl and waterbirds. Mowing, prescribed burning, discing and noxious weed control during late summer are all part of efforts to manage less desirable vegetation with limited food value for migratory waterbirds, such as cocklebur and spike rushes. These activities also improve conditions for grasses and forbs to grow, such as watergrass, swamp timothy, smartweeds as well as other desirable vegetation, such as bulrush, buttonbush and willow. Each unit is evaluated annually to determine the need for manipulations. Permanent wetland units are disced every three to five years to maintain an equal ratio of open water to vegetation. Seasonal wetlands are disced or mowed every other year, depending on vegetation response. The perimeter of each wetland is disced to enhance access by mosquito fish and water management.

Mosquito Control

The Refuge staff works closely with the Sacramento/Yolo Mosquito Vector Control District (SYMVCD) to reduce or eliminate production of mosquitos on the Refuge. In accordance with the EIS (USFWS 1992), the Refuge entered into an MOU with SYMVCD in 1993. This MOU outlines an effective mosquito suppression program that includes biological and chemical controls to be used on the Refuge, wetland design and water level and vegetation management recommendations and research partnerships. Biological controls include the placement of mosquito fish and guppies (*Poecilia reticulate*) in permanent and seasonal wetlands and the use of *Bacillus thuringiensis israeliensis* (Bti) and *B. sphaericus*, which are effective at controlling certain life stages of mosquito larvae with minimal non-target organism impacts. Any pesticides to be used on the Refuge must be approved by the Service prior to the onset of mosquito season in early spring. Pesticides may target mosquito larvae and adults and may include aerial applications, as well as ultra-low volume ground application. In keeping with the MOU, the Refuge consults with SYMVCD to ensure wetlands are designed to minimize mosquito habitat. For example, berms along some managed wetland units are graded with a slope of 1.5-2.0 feet horizontal to 1.0 foot vertical to limit the growth of marginal vegetation. Furthermore, the perimeters of seasonal wetlands may be disced to enhance access by foraging mosquito fish to larvae. Wetlands are also designed and constructed to allow for rapid flooding and draw down.

Riparian

Agricultural conversion, water conveyance, and flood control, and other changes in land use have eliminated much of the original riparian and oak woodland habitat from the Beach-Stone Lakes Basin. Overall, the Central Valley has lost over 95 percent of its wooded riparian habitats. Within the approved Refuge boundary, the widths of riparian forest corridors vary from 10-300 feet wide along Morrison Creek, SP Cut, Parker Slough, the south arm and smaller branches of North Stone Lake, and South Stone Lake (see Figure 5, Vegetation Map). The only mature valley oak forest remaining in the basin exists along Morrison Creek. Restoration efforts on the Beach Lake, North Stone Lake, Headquarters and South Stone Lake units have expanded riparian zones by 100-120 acres.

Restoration practices include planting a variety of riparian trees, such as Fremont

cottonwood, willow, box elder, sycamore,, valley oak and associated understory shrubs and grasses and then providing supplemental irrigation and weeding for a period of three to five years to facilitate plant establishment. In the case of valley oaks, both planting acorns with no watering and seedlings with watering have been used with success. Choosing an appropriate site based on soil type and elevation is the most important aspect of a successful restoration project.

Grasslands

Grasslands once covered vast stretches of the Central Valley, supporting extirpated species, such as pronghorn antelope, tule elk (*Cervus elaphus nannodes*), grizzly bear and millions of waterfowl and other migratory birds. These grasslands supported seasonal wetlands such as vernal pools and wet meadows populated by perennial and annual grasses. Over 98 percent of Central Valley native grasslands have been converted to agriculture and urban development or displaced by exotic vegetation. . Many native annual grassland species no longer occur and have been replaced by nonnative annuals such as annual rye. The remaining grasslands are now a mix of native and nonnative species.

The North Stone Lake Unit of the Refuge supports one of the only remaining continuous tracts of un-leveled grasslands in the eastern Sacramento-San Joaquin Delta region, with approximately 1,900 acres of annual and perennial grasslands. Preservation of this remnant grassland topography is a high priority. Other small (one to 21 acres) areas exist on the Beach Lake and Headquarters units. General management goals for the North Stone Lake Unit are to: maintain and expand existing native grasses, such as creeping wild rye (*Leymus triticoides*), meadow barley (*Hordeum brachyantherum*), and sedges; minimize the fire hazard posed by accumulated dead grasses; control the spread of noxious weeds; and provide habitats for grassland-dependent species, including greater sandhill cranes, arctic nesting geese, white-faced ibises, long-billed curlews, western meadowlarks, horned larks, and birds of prey, including Swainson's hawks, burrowing owls, and northern harriers. These management goals are being accomplished through implementation of a cattle grazing program, small-scale prescribed burning, and aggressive noxious weed control.

General restoration goals for the grasslands on the North Stone Lake Unit are to: maintain and expand existing native grasses, decrease the fire danger, control noxious weeds and provide habitat for a variety of grassland dependent species like this Swainson's hawk.
Photo by USFWS

The Refuge grazing program on the North Stone Lake Unit consists of running cattle on the dry pasture from November through mid-June, until annual grasses turn brown. Some cattle are then moved to the 172 acres of irrigated pasture on the unit from June through October. Cattle stocking rates vary in the five dry pastures depending on rainfall, timing, quantity and frequency, with a target of 1,500-2,000 pounds of Residual Dry Matter (RDM) in three of the five pastures and 2,000-4,000 pounds of RDM in the remaining two pastures. The irrigated pastures are stocked at a rate of one animal unit month (AUM), which is the amount of forage needed by a cow and her suckling calf for one month, per one to two acres. Following a 10-year period during which grazing had been curtailed on the North Stone Lake Unit, use by sandhill cranes, long-billed curlews, white-fronted geese, and other waterfowl has increased substantially on the unit after the Refuge re-introduced a grazing program in 1999. Excluding cattle from the majority of riparian areas through fencing was completed in 2003. Other measures to improve management of the unit will include developing alternative watering sources ,erosion control measures near the irrigated pastures, noxious weed control and continued monitoring of wildlife responses.

The Refuge holds title to a conservation easement on the 1,400-acre Wetland Preserve Unit that supports a mixture of natural and man made vernal pools and

seasonal wetlands. Recent studies at the Cosumnes River Preserve (J. Marty, TNC, pers. comm.) indicate that a managed grazing program is most effective at maintaining and enhancing vernal pool plant and animal species. Grazing conducted by the landowner from November through June on the preserve results in a RDM rate of 600 to 800 pounds and is ideal to reduce competition between vernal pool plants and nonnative grasses, such as annual rye grass, and noxious weeds, such as yellow starthistle (*Centaurea solstitialis*). Refuge staff are working with representatives of the landowner, AKT Development Corporation, to develop a grazing program that will protect and enhance seasonal wetlands on the preserve.

Weed Control

Since 1995, the Refuge has adopted an active aquatic and terrestrial weed management program in the Beach-Stone Lakes Basin, particularly as a founding member of the Stone Lakes Water Hyacinth Control Group. The Refuge conducts treatments for control of water hyacinth under a Statewide National Pollution Discharge Elimination System (NPDES) General Permit (No. CAG990005) for discharge of aquatic pesticides. The Refuge and SRCSD utilize Reward (Diquat) and Aquamaster (glyphosphate) to control water hyacinth in the basin. Another aquatic species, Brazilian elodea (*Egeria densa*), is also abundant in waterways and may emerge as a management concern as opportunities for recreational boating are developed on the Refuge.

The Refuge Integrated Pest Management approach used to control weeds relies on burning, mowing, grazing, discing and herbicide applications. Due to the persistence and abundance of most weeds in the environment and regulatory constraints on use of fire, chemical applications are the only currently effective method for controlling water hyacinth, perennial pepperweed (*Lepidium latifolium*) and yellow star thistle. The Refuge uses Transline and Telar to control yellow star thistle and perennial pepperweed, respectively. Mechanical control methods tend to spread, rather than control, perennial pepperweed. Potential biological control organisms, including water hyacinth-eating weevils (*Neochitina* spp.) and moths (*Sameodes albiguttlilis*), have been introduced into the Delta through a cooperative program with the U.S. Department of Agriculture, Agricultural Research Service (USDA-ARS) and California Department of Food and Agriculture (CDFA) to evaluate control of water hyacinth. Unfortunately, these biological control agents have not been affective in reducing stands of water hyacinth. Given the vast amounts of hyacinth produced each year on the Refuge and its inaccessibility to equipment, mechanical control is not feasible. Mechanical removal in isolated water ways would be prohibitively expensive, costing an estimated $80,000 annually and accessing sites with heavy equipment would likely cause significant impacts to sensitive habitats. Non-chemical methods to prevent the spread of water hyacinth include deploying log booms at strategic locations to prevent spread, screening culverts to prevent re-introduction and removing water hyacinth from small water bodies by hand. The Refuge also participates in the Sacramento Weed Abatement Team which is coordinated by the Sacramento County Agricultural Commission.

Farming Program

A variety of migratory birds, including waterfowl, long-billed curlew, black-bellied plover, white-faced ibis and sandhill cranes, feed on waste grain and invertebrates remaining in agricultural fields after harvest. These migratory birds depend on farm fields of small grains, alfalfa, tomatoes, etc. for a marked portion of their diet. Therefore, it is vital that the Service, private landowners, and Sacramento County cooperate to maintain viable “wildlife friendly” agriculture in the vicinity of the Refuge. Except for the grazing programs that the Refuge oversees, cooperative farming on Refuge lands currently is limited to the Headquarters Unit. To date, the goal of the farming program has been to maintain

the fields in corn, wheat, safflower, or grass to provide habitat for wildlife and control weeds until a larger scale restoration project is implemented.

Monitoring and Surveys

A variety of surveys and studies have been conducted by Service staff, volunteers and students on the Refuge since its establishment. These studies are primarily intended to evaluate the effectiveness of management activities and monitor the status of biological resources. A summary of ongoing surveys and studies and their objectives follows.

- Colonial waterbird survey. Rookeries of nesting great blue heron, great egrets, and double-crested cormorants are monitored yearly to determine abundance, distribution and nesting success.
- Landbird monitoring program. A cooperative mist netting and bird banding program is conducted in selected areas with SYMVCD to monitor and document bird diversity and relative abundance. The program is also investigating the role of wild bird populations as reservoirs for mosquito-borne diseases such as Western equine encephalitis virus, St. Louis encephalitis virus and west Nile virus.
- Modesto song sparrow study. As part of the landbird banding program, song sparrows are also color banded on the South Stone Lake Unit in an ongoing effort to determine nesting success and survival of young.
- Weekly waterfowl survey, October through May. Waterbird (waterfowl, shorebirds and cranes) counts are done weekly during the fall, winter and spring to determine population trends and use patterns.
- Plant surveys. Vegetation in moist soil wetlands is qualitatively surveyed each spring to guide management actions such as discing, mowing and timing of summer irrigations.
- Noxious weed surveys. Refuge units are surveyed and mapped with GPS equipment to monitor noxious weeds such as yellow starthistle, perennial pepperweed and water hyacinth.
- Pasture monitoring A residual dry matter survey (measure of the amount of dry grass remaining after the growing season) is conducted annually to adjust grazing rates for the upcoming year.

A cooperative mist netting and bird banding program is conducted in selected areas with the Sacramento-Yolo Mosquito and Vector Control District to monitor and document the diversity and relative abundance of bird species, such as this blue grosbeak, and to evaluate their role in the transmission of mosquito-borne viruses.
Photo by USFWS

The following studies have been completed primarily by graduate students on the Refuge:

- Western pond turtle survey. Determined turtle survival and reproductive success.
- Native grass. Determined effects of various treatments (e.g., burning, grazing and no treatment) on three species of native grasses on the North Stone Lake Unit.
- Nitrogen. Determined the role increased nitrogen levels may play in exotic weed expansions along freeway corridors.
- Sunflower moth. Evaluating the relationship between the California sunflower and its parasitoids.
- Bats. Conducted presence or absence surveys on selected sites on the Refuge.
- Aquatic surveys. Conducted fish, amphibian, and reptile surveys to determine presence and absence of various species.

Further refinement of survey and monitoring protocol for the Refuge is needed. Additional baseline inventories need to be completed and a relational database should be developed to store and access monitoring and inventory data.

4 Challenges

Invasive Species

As defined in Executive Order 13112, an invasive species is an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Invasive species can impact human health, interfere with agriculture and aquaculture, interfere with water delivery, increase flooding and erosion, block access to water ways, decrease habitat for native plants and animals and compete with native species for resources. Invasive species are one of the most critical nationwide challenges facing national wildlife refuges (NWRA 2002). The Service and other bureaus within the Department of the Interior have been working to eradicate invasive species on Federal lands and are partnering with State agencies and local organizations to restore ecosystems with native plants and species. By 1998, the battle against invasive species was costing the Refuge System an estimated $13 million per year (NWRA 2002). By 2002 a $150 million backlog of critical invasive species projects had been identified within the Refuge System (NWRA 2002). Most current management practices are aimed at control and eradication of existing invasive species; much work remains to prevent introduction of additional invasive species, educate the public and to fund more research and monitoring.

A large number of invasive species now reside on the Refuge. Vertebrate invasive species found on the Refuge that are well established in the region include European starlings (*Sturnus vulgaris*), rock doves (*Columba livia*), American bullfrogs red-eared sliders, feral dogs (*Canis lupus familiaris*), feral cats (*Felis silvestris*), black rats (*Rattus rattus*), Norway rats (*Rattus norvegicus*) and house mice (*Mus musculus*). The majority of fishes occurring in Sacramento-San Joaquin Delta and Refuge waterbodies are non-native , including carp, catfish, sunfish and largemouth bass. Except for capture of feral dogs and cats and localized reductions of rodents near buildings and carp from wetland impoundments, no active control of these species is currently conducted or planned. As urban areas expand, we expect to see increases in feral dogs and cats, rock doves and great basin Canada geese. Preliminary studies at the Cosumnes River Preserve indicate black rats are negatively affecting reproductive success in a variety of songbirds nesting in mature valley oak riparian forest. Invasive invertebrates found on the Refuge, such as various species of mosquitos and mitten crab (*Eriocheir sinensis*), may act as hosts to various diseases. Control of mosquito populations is addressed in Chapter 3 under Current Management. Mosquitos are a vector for western equine encephalomyelitis virus. St Louis encephalitis and west Nile virus that can cause disease in humans. Mitten crabs can act as a host to the Asian lung fluke (*Paragonimus westermani*), which can cause disease in humans and other mammals if consumed without thorough cooking (ANSTF 2003).

Methods used to control invasive weeds include chemical, mechanical (including mowing, discing and hand removal) and biological control. The majority of grasslands on the Refuge and throughout California are now composed of nonnative annual grasses, such as annual rye, soft chess (*Bromus hordeaceus*), wild oats and Mediterranean barley (*Hordeum marinum*). Himalayan blackberries (*Rubus armeniacus*) are prevalent in riparian zones and along waterways. Invasive tree species

on the Refuge include black locust (*Robinia pseudoacacia*) and osage orange (*Maclura pomifera*). Many of these invasive species have replaced native vegetation, but are so well established that eradication would be nearly impossible. Current control and eradication efforts concentrate on three noxious weeds that require immediate attention (Table 1). Other species being considered for monitoring, control and eradication from grassland, aquatic, and riparian habitats include: medusahead grass (*Taeniatherum caput-medusae*), barbed goat grass (*Aegilops triuncialis*), Brazilian elodea, and giant reed (*Arundo donax*).

Basin Hydrology and Water Quality

Floodplain Conditions

The hydrologic regime and configuration of the 100-year floodplain in the Beach-Stone Lakes Basin have been dramatically altered when compared with historic pre-settlement conditions. Changes to the landscape have included: (1) completion of the Sacramento River levee system and Sacramento Flood Control Project; (2) dam placement on the Mokelumne River; (3) construction of the Southern Pacific Railroad; (4) reclamation of tracts and islands in the basin for farming; and (5) constricting of downstream channel capacities due to raising of levees.

The approved Refuge boundary lies entirely within the 100-year floodplain of Morrison Creek and the Cosumnes and Mokelumne rivers and the current 100-year flood elevation is 16.00 feet above mean sea level. Damaging floods have occurred in the Beach-Stone Lakes basin an average of one out of every three years (USACE 1987, Hart 1999). Extensive flooding occurred in 14 of the last 40 years. The primary source of water during flood events is from the accumulated flows of the 192 square mile watershed of the Morrison Creek Stream Group (Morrison, Elder, Unionhouse, Florin and Laguna creeks). During high water events, Morrison Creek drains from east to west, then south through Beach Lake, North Stone Lake, and South Stone and finally through the Lambert Road bridge to Snodgrass Slough, thence into the North Mokelumne River. Alternately or concurrently, flood waters may flow south to north from the Cosumnes and Mokelumne Rivers up Snodgrass Slough and the Sacramento Drainage Canal, over the top of the Lambert Road bridge and into SP Cut

Table 1. Invasive Plant Species Targeted for Control on Stone Lakes National Wildlife Refuge.

Common Name	Scientific Name	**State Noxious Listing	Distribution and Origin
perennial pepperweed	*Lepidium latifolium*	B	waterways, riparian restoration sites, grasslands and along roadsides
yellow starthistle	*Centaurea solstitialis*	C	grasslands, roadsides
water hyacinth	*Eichhornia crassipes*	none	waterways, permanent wetlands, lakes
Brazilian elodea	*Egeria densa*	none	waterways, permanent wetlands, lakes
giant reed	*Arundo donax*	none	waterways, ditches
black locust	*Robinia pseudoacacia*	none	ornamental landscapes
osage orange	*Maclura pomifera*	none	hedgerows, ornamental landscapes
medusa head grass	*Taeniatherum caput-medusae*	C	grasslands

**"B"—Eradication, containment, control or other holding action at the discretion of the commissioner. "C"—State endorsed holding action and eradication only when found in a nursery; action to retard spread outside of nurseries at the discretion of the commissioner; reject only when found in a cropseed for planting or at the discretion of the commissioner (CDFA 2006).

and the Beach-Stone Lakes basin. Cosumnes and Mokelumne river flows may also enter the basin from the west by backing up along and passing under the Western Pacific Railroad grade. The flood season normally extends from November through April (USFWS 1992).

The Refuge receives storm water runoff from upstream urban developments, including Laguna West, Lakeside and Stonelake, which flow into Beach Lake and North Stone Lake. Projections are that continued urbanization will lead to a loss of upstream storage area and a doubling of storm water runoff entering the Stone Lakes basin. Build-out of the East Franklin, Poppy Ridge, Laguna Ridge and Lent Ranch projects east of Franklin Boulevard, will result in an additional 10,000 acres of urban development between Interstate-5 and Highway 99. This may lead to increases in both the elevation of the 100-year floodplain and duration of downstream flooding (CEG 2000). Under this scenario, impacts are anticipated to Refuge infrastructure, habitats and wildlife.

Increases in elevation and duration of flooding resulting from upstream development may affect the grassland, riparian and wetland habitats and associated wildlife now using the Refuge. Noxious weeds, such as perennial pepperweed, yellow star thistle and other species, may become more invasive on grassland habitats as seed sources are washed into the Refuge. Long term monitoring will be necessary to document changes in the nature of grasslands. Riparian habitats may be affected due to prolonged high flood water levels, particularly during the spring. Conversion of stands of willows and cottonwood trees in low lying areas to more aquatic habitats may result and the composition of seasonal and permanent wetlands may change.

Migratory birds that frequent large expanses of open water may benefit from these habitat conversions, such as white pelicans and tundra swans and the composition of local duck populations may shift from dabbling ducks, such as mallard and northern pintails, to diving ducks, such as canvasbacks (*Aythya valisineria*) and lesser scaup (*Aythya affinis*). Reduction in the availability of high ground for high water refugia may further impact listed species such as the giant garter snake and valley elderberry longhorn beetle.

More frequent and longer flooding events could also affect management of the grazing program on the North Stone Lake Unit of the Refuge. From November through mid July, cattle are rotated among five pasture units and during heavy rainfall events, they are moved from the southern to the northern pastures in anticipation of flooding. Floodwaters rose 6 inches an hour during heavy rains in the winter of 2000, making unsafe conditions for driving the cattle north. Similar heavy rains during the winter of 2005/2006 also required relocation of cattle grazing. Increases in storm water flows could exacerbate this situation which may result in shortening of the grazing period.

Some species that frequent large expanses of open water, such as white pelicans, may benefit from more frequent flooding of the Refuge.
Photo by USFWS

Flood Control Projects

In addition to ongoing upstream development, hydrologic regimes on the Refuge may also be affected by new projects that could alter the configuration or depth of the 100-year floodplain. The hydrology of the Mokelumne and Cosumnes rivers and

the Morrison Creek watershed has been studied extensively for various potential flood control projects by the USACE, California Department of Water Resources, City of Sacramento and Sacramento County. These projects include a recently completed project by Sacramento Area Flood Control Agency and the USACE to raise and re-configure levees along Morrison Creek and a project by Teichert to realign Laguna Creek for gravel extraction, which may decrease summertime flows from reaching Beach Lake.

Since the mid-1980s, Sacramento County has been exploring the feasibility of implementing a flood control project in the basin that could reduce the extent of the 100-year floodplain and in particular, decrease flooding in the community of Point Pleasant in southern Sacramento County. In 1998, the County Board of Supervisors adopted the Beach-Stone Lakes Flood Control Plan, outlining county policies for reducing flooding in the basin. Most recently, the County has convened a facilitated private and public stakeholder forum to explore alternatives for reducing or compensating for flood damages to landowners in the Beach-Stone Lakes basin. The forum will report back to the County Board of Supervisors with the results of their deliberations regarding a potential regional project to attenuate peak flood flows or improve flood conveyance. The County will then utilize engineering studies and the forum results to prepare a report on key findings of this effort.

Water Quality

Water quality is an important component in determining the overall function of the Refuge area ecosystem and is a major factor in determining the health of wildlife, aquatic organisms and fisheries. Water, sediment, and biota samples collected from eight locations indicate that levels of heavy metals, although present, were not sufficient to cause deleterious impacts to wildlife; however, concentrations of selenium in all five waterbodies tested are above levels recommended for the protection of aquatic life (USFWS 1992).

The Refuge is virtually surrounded by urban and agricultural areas. Environmental contaminants on the Refuge or in the area have the potential to accumulate on the Refuge and affect large numbers of fish and wildlife. Agricultural lands to the east, south, and southwest are potential sources of contaminants to Snodgrass Slough, as well as to South and North Stone lakes. Many small waterways and seasonal swales connect the agricultural lands with the Snodgrass Slough and North and South Stone lakes. The City of Sacramento is another potential contaminant source. Morrison Creek runs through southern Sacramento prior to entering the north end of the Refuge and has been characterized by the Environmental Protection Agency (EPA) as an impaired waterway because of high Diazinon concentrations. The EPA found that Diazinon poses unacceptable risks to agricultural workers and to birds and other wildlife species. Diazinon can overstimulate the nervous system, causing nausea, dizziness and confusion and at very high exposures caused by accidents or major spills, it can also cause death.

Additional studies of water quality conducted by Service Contaminants staff from 1999 to 2000 found that levels of pesticides with Diazinon in Morrison Creek were sufficient to cause mortality in bioassay organisms after rainfall greater than one inch. Most likely these pesticides were flushed through the stormwater runoff drainage system after accumulating on lawns and other areas during the dry season. Also see Chapter 3, Contaminants and Water Quality.

Sacramento County's National Pollutant Discharge Elimination System (NPDES) Municipal Permit requires reduction of pollutants found in urban stormwater runoff to the maximum extent possible. Stormwater detention basins are constructed as urban expanses east and upstream of the Refuge are developed. These basins are effective in reducing pollutants by 30 percent to 90 percent. The pollutants that are not detained will likely enter the Refuge in runoff, potentially affecting fish and wildlife.

Land Use Changes

Urbanization and Vineyard Conversion

Elk Grove incorporated as a city in 2000 and had the fastest growth rate for any large U.S. city between July 2004 and July 2005 (USDOC 2006). The city adopted its general plan in November 2003. When the City of Elk Grove incorporated, it adopted as a feature of its general plan, the urban service boundary previously identified in the Sacramento County General Plan, which defines the limit of urban development in the County. A 90-acre portion of the Wetland Preserve Unit of the Refuge lies within Elk Grove's city limit. As provided for in the Elk Grove general plan, approximately 8,000 acres of former agricultural land east and upstream of the Refuge is now being developed into residences, a regional shopping mall and office parks. Over 18,000 additional homes are expected to be constructed by 2010 on land previously supporting dry and irrigated pastureland and crops (SACOG 2000). Many migratory birds which frequent the Refuge are also dependent on habitats outside of the Refuge. For example, the greater sandhill crane has a wintering range of approximately three square miles (G. Ivey, pers. comm. 2003). Therefore, cranes utilizing the Refuge also rely on nearby agricultural fields, grasslands and wetlands for feeding, loafing, etc. As open land is lost, these birds are either forced to fly longer distances to suitable habitat or pushed into smaller and smaller parcels. Over the last ten years, the ability of the eastern Sacramento-San Joaquin Delta region to support wintering cranes and other species such as long-billed curlew, white-faced ibis, burrowing owl and Swainson's hawk has declined and continues to be threatened by urban development and conversion of pasture and row crops to vineyards. From 1992 to 2004, the acreage planted in vineyards within the approved Refuge boundary increased from 685 to 2,013 acres. The acreage of vineyards in Sacramento County nearly doubled from 1998 to 1999 (Sacramento County 1999, Sacramento County 2000). Whereas smaller vineyards interspersed with pasture, croplands and natural habitats can support a variety of wildlife, large expanses of vineyards provide little to no habitat for migratory birds and other wildlife.

Other Human Impacts

Air Quality

Poor air quality injures wildlife and vegetation, causes acidification of water, accelerates weathering of buildings and other facilities and impairs visibility. Air quality, and pollution control in particular, is regulated by a number of Federal and State agencies. Both the State of California and the Federal government have established a variety of ambient air quality standards. PM10 land ozone are two pollutants that are monitored and used to determine air quality on a daily basis. PM10 refers to particulate matter suspended in the air that is smaller than 10 microns, which are small enough to reach the lungs. Ozone is the main component of photochemical smog, which is formed through a series of chemical reactions involving compounds known as ozone precursors.

Sacramento County PM10 emissions are generated by a variety of sources, primarily entrained road dust, construction and demolition activities. Farming operations and agricultural waste burning are also important sources. Motor vehicles are the primary contributors to regional ozone concentrations because they are sources of ozone precursors. The U.S. EPA has declared that the Sacramento region is not meeting air quality standards. The Federal air quality standard for ozone is exceeded several times a year and the County has been classified as a PM10 nonattainment area (USEPA 2006).

Illegal Activity

The majority of illegal activities involve some sort of trespass by people or incursions by feral animals, such as cats and dogs. Trespass occurs in the form of walking, jogging, horseback riding,, hunting, fishing, and plant and material collecting. Trespassing results in poaching, wildlife disturbance, littering, vandalism and wildfires. Feral dogs and cats disturb and kill native wildlife and disturb cattle used to graze managed grasslands. Feral animal

feces can also spread disease to native wildlife populations. Noxious weeds are spread when people and animals trespass into previously uninfested areas. Unwanted pets (rabbits, chickens, guinea pigs, dogs, cats) that are commonly released at entrances to the Refuge can cause similar problems.

Illegal dumping of both non-hazardous and hazardous materials (e.g., methamphetamine lab waste, pesticides, waste oil) near Refuge entrances presents an ongoing concern. Littering along Interstate-5, particular where commercial truck rigs make overnight rest stops (e.g., Hood-Franklin Road exit), has also become a significant problem as traffic increases on the interstate. The Refuge works with the County of Sacramento and the California Department of Transportation (Caltrans) to remove debris as quickly as possible but additional efforts and more cooperation are needed. Finally, arson-caused or accidental fires along Interstate-5 have become a serious management concern as the Refuge has expanded east of the freeway (i.e., Wetland Preserve Unit). As a result, the Refuge has pursued new partnership opportunities with the Elk Grove Community Services District under the Wildland Urban Interface program to create adequate firebreaks and ensure protection of adjacent communities such as the Stonelake subdivision.

Illegal dumping of both non-hazardous and hazardous materials inside and at the entrance gates to the Refuge is an obvious problem.
Photo by Tom Harvey, USFWS

More serious crimes, such as burglary and abandonment of burning stolen cars at more remote Refuge entrances, occur occasionally (one to two times per year). Marijuana gardens and evidence of other illegal drug activities have also been found. Illegal hunting and fishing occur most often along easy access points, such as roads or from private property.

Mosquito Management

In 1993, the Service and the Sacramento-Yolo Mosquito and Vector Control District entered into an MOU regarding management of mosquitos on the Refuge. The goal of the MOU is to minimize mosquito production and promote the least intrusive approaches to control mosquitos on the Refuge. The Refuge coordinates with SYMVCD in a variety of ways to minimize mosquito breeding habitat. For example, the Refuge staff ensure that wetlands are designed and water is manipulated in such a way to minimize mosquito production. The SYMVCD monitors wetlands on the Refuge and plants mosquito fish, when necessary, as an initial method of control. Alternately, if mosquito larvae are detected, Bti (*Bacillus thuringiensis israeliensis*) or *B. sphaericus* may be applied..

As a result, mosquito larval control activities since 1994 have been largely limited to localized (less than five acres) applications of larvicides and until 2005, and only three applications of an adulticides. In 2005, West Nile Virus (WNV) arrived and became established in Sacramento and Yolo counties, triggering more aggressive mosquito control. During 2005, the Refuge received ultra-low volume (ULV) ground treatments of pyrethrin on 18 occasions from September 28 through October 12. As of July 2006, the Refuge has been adulticided six times between June 27 and July 21.

Avian Bird Flu

To date, the virulent form of Highly Pathogenic Avian Influenza referred to as H5N1 has not been detected in either wild or domestic birds or in humans in North America. In fact, between 1998 and 2004 more than 12,000 wild bird samples from

Alaska were analyzed, and no evidence of this virus has been discovered, although birds migrating from Asia to Alaska could potentially carry the H5N1 virus.

The Service, U.S. Geological Survey (USGS), State and partnering academic institutions are continuing surveillance of wild birds in Alaska for the H5N1 virus. The Service is working with an interagency group of scientists and public health and policy officials to design an intensified effort for surveillance and early detection of this virus in wild birds. This effort will help ensure that the Service is in position to support prompt detection and response activities and to take appropriate measures to conserve bird populations while protecting the safety of employees, partners and the public.

The USGS National Wildlife Health Center, in consultation with the Centers for Disease Control and Prevention, has produced Wildlife Health Bulletin 05-03, entitled *Interim Guidelines for the Protection of Persons Handling Wild Birds With Reference to Highly Pathogenic Avian Influenza H5N1*. While reiterating that the H5N1 virus has not been detected in North America, these guidelines remind us of the importance of sensible safety practices. As the situation and information with regard to the H5N1 virus changes, these guidelines may be updated.

5 Refuge Vision, Goals, and Objectives

Vision Statement

"Stone Lakes National Wildlife Refuge belongs to a limited group among the 540 national wildlife refuges that protect fish, wildlife, and habitat within an urban area. Through collaboration with public and private partners, Stone Lakes conserves and enhances a range of scarce Sacramento-San Joaquin Delta and Central Valley habitats and the fish, wildlife, and plants they support. It sustains freshwater wetlands, wooded riparian corridors, and grasslands that facilitate wildlife movement and compensate for habitat fragmentation. Managed wetlands are of sufficient size to maintain abundant wildlife populations. Grasslands consist of a sustainable mix of native and desirable nonnative species that support a variety of grassland-dependent species. The Refuge reduces further habitat fragmentation and buffers the effects of urbanization on agricultural lands and adjacent natural areas within the Delta region.

The Refuge pursues a land conservation program that complements other regional efforts and initiatives. Management efforts expand and diversify habitats for migratory birds and a range of species at risk. The Refuge promotes cooperative farming opportunities and strives to maintain traditional agricultural practices in southwestern Sacramento County that have proven benefits for migratory birds experiencing declines, such as long-billed curlews, Swainson's hawks and sandhill cranes. Through cooperation with other agencies, conservation organizations, neighbors, and other partners, the Refuge develops and manages wetlands in a manner that reflects historic hydrologic patterns and is consistent with local, State, and Federal floodplain management goals and programs.

Volunteers from all walks of life find an outlet for their interests and talents in a responsive and appreciative setting.
Photo by USFWS

Stone Lakes was established as a national wildlife refuge because of passionate support from people who recognized its ecological importance and critical role for the floodplain of the Beach-Stone Lakes basin.. The community sees the Refuge as a sanctuary for fish, wildlife and the habitats upon which they depend, a site for recreation and learning and a natural setting that can enrich their lives according to their values. Visitors representing the area's diversity enjoy increasing opportunities for accessible recreation that harmonizes with Refuge conservation efforts, such as hunting, fishing, wildlife observation and photography. The education community looks to the Refuge as a key partner in environmental education programming. Volunteers from all walks of life find an outlet for their interests and talents in a responsive and appreciative setting."

Goals

Goals are descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measurable outcomes. Goals translate Refuge purposes into management direction. Each goal is supported by measurable, achievable objectives with specific strategies needed to accomplish them. Objectives are designed to be accomplished within 15 years. Actual implementation, however, may vary as a result of available funding or other resource limitations. Figures 6 and 7, respectively, show summaries of the proposed habitat management and visitor services plans for Stone Lakes National Wildlife Refuge.

Currently, the Service manages about 30 percent of the lands within the approved Refuge boundary. This CCP presents goals and objectives for only those lands that are or will soon be managed by the Service. The restoration objectives identified in this CCP are consistent with the restoration goals identified in Chapter 3B-3 of the 1992 Environmental Impact Statement (EIS) at the time of establishment of the approved Refuge boundary (USFWS 1992).

Goal 1. Conserve, enhance, restore and manage Central Valley wetland, riparian, grassland and other native habitats to benefit their associated fish, wildlife, plants and special status species.

Objective 1.A. Within 15 years, establish a minimum of 65 acres of valley foothill riparian and oak woodland habitat with a canopy cover of 20-80% and a canopy height of 2-10 meters. These newly planted habitats will have a complex structure with a canopy, subcanopy and understory shrub layer that will continue to mature beyond the lifetime of this CCP. An additional 40 acres of understory shrubs and herbaceous cover would be established in areas restored from 1995-1998. In the restored valley riparian habitats, wild grape will often cover trees and shrubs and will dominate 30 to 50 percent of the ground cover along with a shrub layer consisting of wild rose, California blackberry, blue elderberry, poison oak, buttonbush and willows. The herbaceous layer will consist of various grasses and sedges. Dominant trees will include valley oak, cottonwood, California sycamore, white alder (Alnus rhombifolia), box elder and Oregon ash.

Rationale: Over 89 percent of the historic riparian woodland and 99 percent of oak savanna habitat in the Central Valley has been lost or converted since Euro-American settlement (DFG 2006). Refuge riparian habitat restoration efforts to date have produced approximately 107 acres of restored habitat, primarily on the Beach Lake Unit. Based on the riparian habitat restoration goals defined in the EIS (USFWS 1992), the Service intends to restore a minimum of 65 acres of additional riparian habitat over the next 15 years. Expanding riparian zones along lakes, sloughs and waterways will benefit a variety of species that use these habitats during migration, for nesting, feeding and roosting habitat. These restored habitats would provide breeding and migratory habitat for a variety of riparian dependent species which have been identified by the Central Valley Habitat Joint Venture as species of concern (G. Geupel, pers. comm.), including the yellow warbler, song sparrow, spotted towhee, yellow breasted chat, black headed grosbeak and common yellowthroat. Some of these species, extirpated locally or in severe decline, such as yellow warbler and yellow-breasted chat, would also benefit from restoration efforts. Understory shrub plantings that include elderberry bushes would benefit the Federally-listed valley elderberry longhorn beetle. Additionally, restoring riparian habitat will help achieve the conservation action recommendations set forth in the Riparian Bird Conservation Plan by the California Partners in Flight and the Riparian Habitat Joint Venture (RHJV 2004).

Strategies:

1. Restore and expand cottonwood riparian forest habitat along the south arm of North Stone Lake through planting and beaver exclusion fencing.

Figure 6. Proposed Habitat Management

Stone Lakes National Wildlife Refuge

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

- Grasslands, Farmlands, & Other
- Unmanaged Wetlands & Vernal Pools
- Managed Wetlands
- Riparian Forest
- Open Water
- Non-Refuge Lands
- Seasonally Flooded
- Wetland Restoration
- Riparian Restoration
- Natural Riparian Expansion

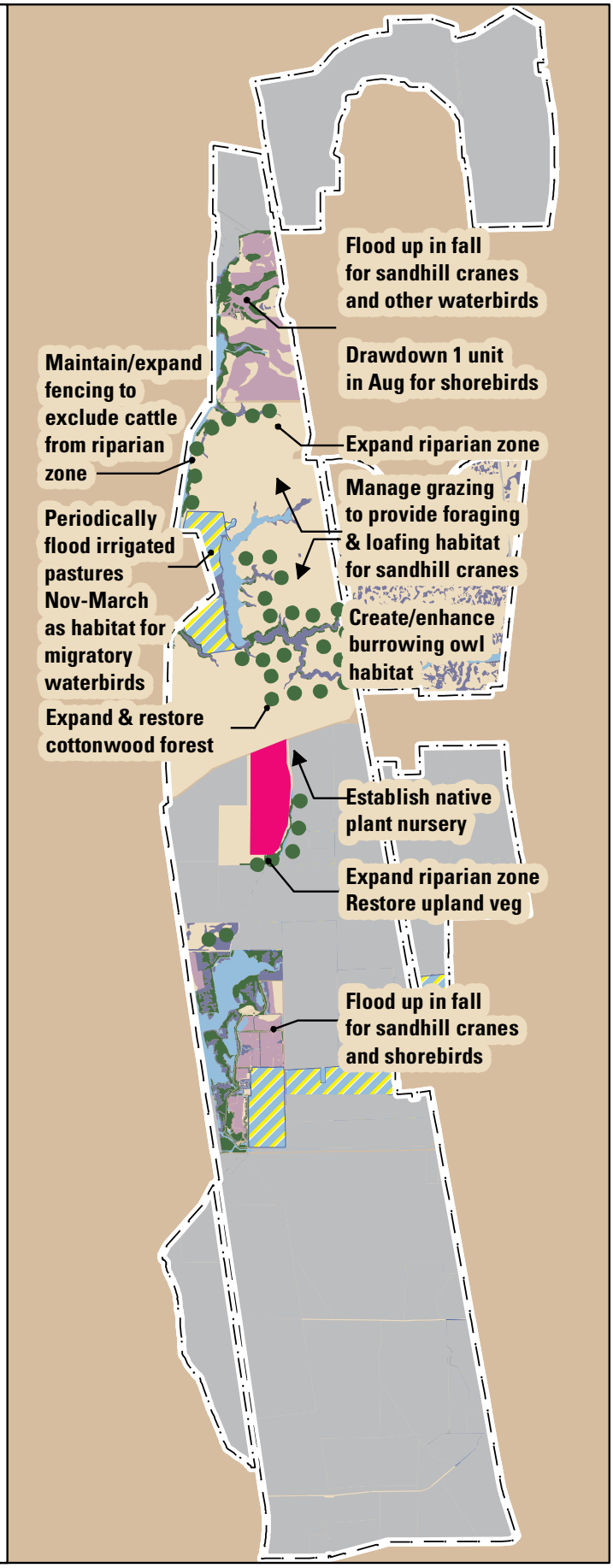


Figure 7. Proposed Visitor Services Plan

Stone Lakes National Wildlife Refuge

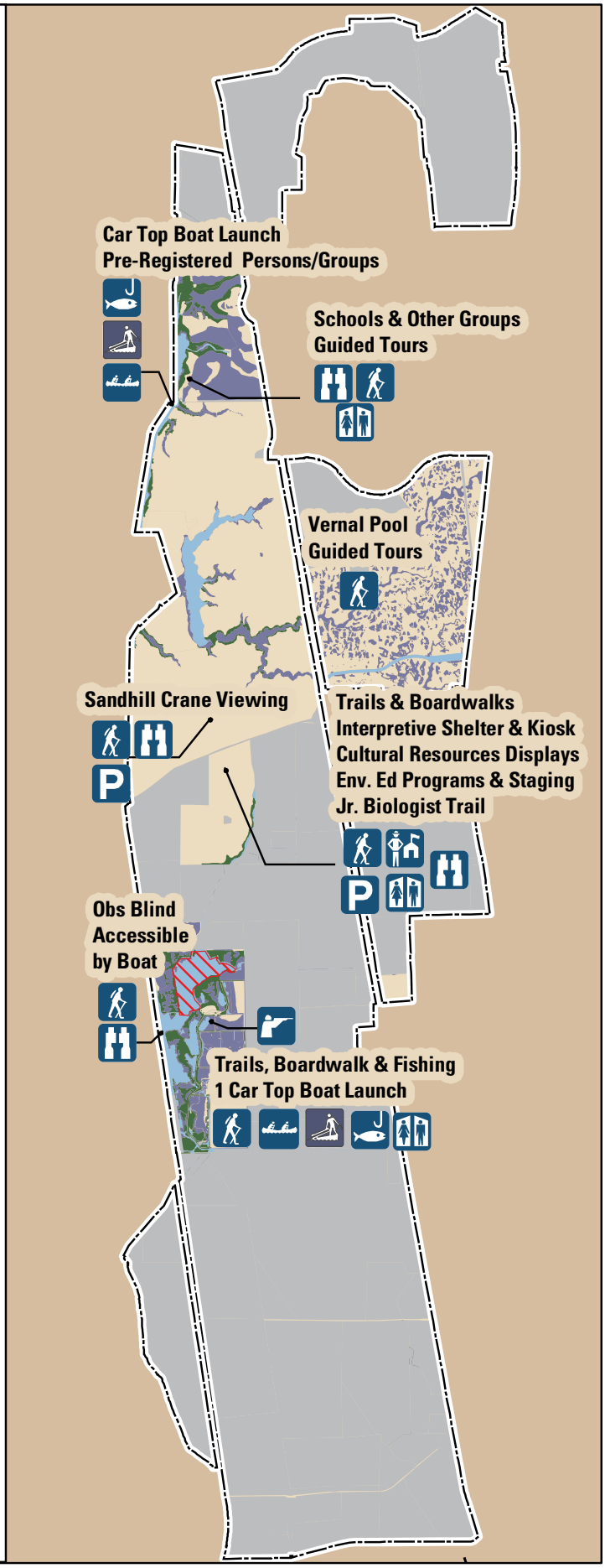
0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

- Refuge Headquarters
- Hiking Trails
- Parking
- Car-Top Boat Launch
- Photo Blind or Observation Platform
- Waterfowl Hunting
- Non-Motorized Boating
- Boat Fishing

- Grasslands, Farmlands & Other
- Wetlands & Vernal Pools
- Riparian Forest
- Open Water
- Non-Refuge Lands

- Wetland Restoration
- Seasonal Closure



2. Expand the riparian zone to a range of 150 to 400 feet wide along the Sacramento Drainage Canal of the South Stone Lake and Headquarters Units.
3. Restore approximately 20 acres to a combination of native trees, shrubs, and grasses on the upland areas of the Headquarters Unit.
4. Establish/enhance subcanopy and understory in new and established riparian habitat areas on the Beach Lake and North Stone Lake units.
5. Establish native plant nursery at the Headquarters Unit for use in restoration projects.
6. Plant early to mid-successional vegetation on the western portion of the Lewis Investment Co. tract of the South Stone Lake Unit.
7. Assist the Sacramento Regional County Sanitation District in expanding the valley oak forest along lower Morrison Creek on the CAMRAY tract of the Beach Lake Unit by seeking funding and other support for restoration.
8. Allow expansion of riparian habitat along existing riparian corridors including managed seasonal wetlands.
9. Identify and map weed infestations, track assessments and treatments and produce maps and reports that can be shared with other interested parties.
10. Intensify control efforts for perennial pepperweed in riparian areas using a variety of methods including pesticides, mowing, and hand-pulling.
11. Cooperate with U.S. Department of Agriculture (USDA) and local academic institutions to research new methods for controlling invasive plants.
12. Measure habitat characteristics (e.g., canopy cover, species composition) of riparian plantings in areas with a high diversity of bird species, as indicated by mist netting data collected over the past six years on Lewis unit, to guide future restoration efforts.

Objective 1.B: Maintain and manage on an annual basis 425 acres of riparian and oak woodland habitat, consisting of 360 acres of existing habitat and 65 acres of restored habitat (See Objective 1.A). This habitat encompasses riparian and oak woodland habitat in various successional stages comprising a complex structure with a canopy, sub-canopy, and understory shrub layer (usually impenetrable). Restoration would occur through habitat manipulations, including control of invasive plant species and restoration of the sub-canopy and understory shrub layer by planting native species. Wild grape often covers trees and shrubs and dominates the ground cover along with a shrub layer consisting of wild rose, California blackberry, blue elderberry, poison oak, buttonbush and willows. The herbaceous layer consists of various grasses and sedges. Dominant trees include valley oak, cottonwood, California sycamore, white alder, box elder and Oregon ash.

Rationale: Valley foothill riparian habitats occur in the Central Valley and the lower foothills of the Sierra Nevada and Coast Ranges and are associated with low velocity flows, floodplains and gentle topography. Over 89 percent of the historic riparian woodland and 99 percent of oak savanna habitat in the Central Valley has been lost or converted since Euro-American settlement (DFG 2006). These habitats comprise a complex structure with a canopy, subcanopy and understory shrub layer. Based on the population trends and life history requirements of various species in the Central Valley, the Central Valley Habitat Joint Venture has developed a list of focal migratory bird species that can be used to guide restoration and management efforts. Riparian habitats provide breeding and migratory habitat for the following focal species for the Central Valley, as defined by the Central Valley Habitat Joint Venture (G. Geupel, PRBO, pers. comm.): yellow warbler, song sparrow, spotted towhee, yellow breasted chat, black headed grosbeak and common yellowthroat. Furthermore, these riparian areas support heron and egret rookeries that vary in size from ten to 50 nests. The bird species previously listed and others, use a variety of successional stages within riparian habitat. Maintaining and managing high quality riparian habitat, in

various successional stages, will help achieve the conservation action recommendations set forth in the Riparian Bird Conservation Plan (RHJV 2004).

Strategies:

1. Monitor riparian and oak woodland habitats each spring for invasive species such as perennial pepperweed and yellow star thistle and implement control methods based on integrated pest management techniques, including herbicide applications and grazing (see Objective 1.A).
2. Monitor riparian areas for existing and newly-established heron and egret rookeries (See Strategy 2.B.2).
3. Maintain and expand fencing along SP Cut on the North Stone Lake Unit to exclude cattle from riparian areas.
4. Conduct annual surveys of riparian habitats for damage by beavers, research methods to discourage beavers, and implement protection measures (e.g., wrapping trees with hog wire or fencing).

Objective 1.C: Within five years, enhance and maintain approximately 50 acres of seasonal and permanent wetlands created on the 70 acre Lewis Investment Co. tract of the South Stone Lake Unit by promoting growth of wetland species such as swamp timothy, smartweeds, watergrass and associated invertebrates. These wetland species provide food for waterfowl and other waterbirds.

Rationale: Approximately 95 percent of wetlands in the Central Valley have been lost or converted to other land uses (DFG 2006). Improving water management on the Lewis Investment Co. tract would reverse some of these losses and benefit a wide variety of migratory birds and other wildlife, including special status species, such as giant garter snake, western pond turtle, white-faced ibis, greater sandhill crane, long-billed curlew, black-bellied plover, black-necked stilt and long-billed dowitcher (*Limnodromus scolopaceus*) and help achieve CVJV goals.

Strategies:

1. Modify existing water delivery system on the South Stone Lake Unit to deliver water to the Lewis Investment Co. Tract.
2. Control undesirable vegetation using a combinations of the following treatments: mowing, discing, burning, herbicide applications and summer flooding.
3. Explore the possibility of applying reverse-cycle water management on an experimental basis to benefit shorebirds.

Objective 1.D: ***Manage on an annual basis 529 acres as moist soil habitat, characterized by a plant composition of 50 percent or more moist soil, high-energy waterfowl plant foods including: watergrass, swamp timothy and smartweeds. Flood approximately 60 percent of the moist soil units to a depth of 2 to 10 inches for dabbling ducks and shorebirds and 40 percent to depths of 6 inches to 3 feet for diving ducks, grebes, cormorants, pelicans, waders and other waterbirds.***

Rationale: All managed seasonal wetlands on the Refuge consist of moist soil impoundments which support a wide variety of waterbirds, with peak numbers of waterfowl and shorebirds occurring in the late fall and winter. Species groups having varying requirements for vegetation and water depth. For example, dabbling ducks, such as cinnamon and green winged teal, mallard and northern pintail prefer to feed in shallow water, with an equal ratio of open water and emergent vegetation, whereas diving ducks, such as bufflehead (*Bucephala albeola*), canvasback and common goldeneye (*Bucephala clangula*) prefer deeper water. Shorebirds, such as long-billed dowitcher, black-bellied plover, and black-necked stilts, feed on mudflats or in shallow water of varying depths, depending on species. Managed seasonal wetlands on the Refuge are currently operated under a fall-migration-oriented regime with flood-up from mid-September or October through May, which optimizes habitat availability for fall migrants. Flooding seasonal wetlands under a reverse-cycle regime from March through August could provide late winter

food before migration and habitat for breeding shorebirds and waterfowl broods. Species supported by this objective include special status species such as white-faced ibis and greater sandhill crane.

Strategies:

1. Flood moist soil wetland impoundments, depending on water availability, on Beach Lake and South Stone Lake units starting September 1 and no later than mid-September and maintain through March to May for migratory and wintering waterbirds, including waterfowl, shorebirds and sandhill cranes.
2. Stagger the timing of drawdown for moist soil units beginning in March.
3. Irrigate units one or two times from May through August to promote waterfowl food such as watergrass and swamp timothy
4. Disc and/or mow 25-50 percent of the units to stimulate growth of waterfowl food plants and mow or disc to maintain an equal ratio of open water to emergent vegetation.
5. Control undesirable plants such as cocklebur and joint grass using one or more of the following treatments: mowing, discing, burning, herbicide applications, or summer flooding.
6. Explore the possibility of applying reverse-cycle water management on an experimental basis to benefit shorebirds.
7. Draw down one permanent wetland unit beginning in August to provide habitat for migrating shorebirds. Flood the unit again in late September, when other wetlands are being flooded.

Objective 1.E: Maintain 452 acres annually of unmanaged seasonal wetlands (i.e., wetlands with no capability to manipulate water regimes) so they support 50 percent or more moist soil, high energy waterfowl plant foods, including watergrass, swamp timothy, and smartweeds, interspersed with open water while controlling undesirable vegetation, such as cocklebur, yellow star thistle and perennial pepperweed to benefit wintering and migratory waterfowl, as well as other wetland-dependent species.

Rationale: Unmanaged seasonal wetlands with no capability for water manipulations are found on all units of the Refuge. These wetlands receive water passively from rain and runoff only and are typically dry during summer. Once flooded, these wetlands attract a variety of waterbirds such as cinnamon teal, northern pintail, white-fronted goose, black-bellied plover, black necked stilt, long-billed dowitcher, sandhill crane and long-billed curlew.

Strategies:

1. Monitor unmanaged wetlands each spring for undesirable vegetation such as cocklebur and other noxious weeds such as yellow star thistle and perennial pepperweed and implement control methods as needed.
2. Use burning, grazing, discing, mowing and/or herbicide application to control the growth of invasive species and promote the growth of desirable wetland plants, such as watergrass, swamp timothy, smartweeds and nutsedges, in seasonal swales.

Objective 1.F: Annually maintain 136 acres of vernal pool seasonal wetlands characterized by greater than 70 percent native vernal pool vegetation.

Rationale: Vernal pool habitats support a variety of vernal pool species, including the federally endangered vernal pool fairy shrimp and vernal pool tadpole shrimp, as well as various species of special concern, including vernal pool plant species (USFWS 2006). These pools are best managed through prescribed grazing from November through June. Without grazing, a dense layer of nonnative annual grasses can exclude native vernal pool plants and consume water to the extent that vernal pools become prematurely dry. Grazing reduces the competitiveness of native plants versus nonnative plants, and may prolong inundation of vernal pools in the spring (J. Marty, TNC, pers. comm.).

Strategies:

1. Monitor wetlands each spring for undesirable vegetation, such as cocklebur, and noxious weeds, such

as yellow starthistle and perennial pepperweed and implement control efforts as needed.
2. In cooperation with the landowner, develop a grazing management plan for the Wetland Preserve Unit that maintains a residual dry matter level, as measured in August through September, of 800-1000 lbs/acre.
3. Depending on air quality regulatory restrictions, employ prescribed burns to reduce nonnative annual grasses and replicate the historical fire regime as closely as possible.
4. Develop proposals and support research to characterize plant and animal communities in natural versus created vernal pools.

Objective 1.G: Annually maintain 715 acres of deep water wetlands (including wetlands with and without a capability to manipulate water regimes), lakes, sloughs and SP Cut to provide breeding, foraging and loafing habitat for waterfowl and other wetland dependent species, such as giant garter snakes and western pond turtles. Deep water wetlands will be characterized by water depths of greater than three feet supporting wetland plants species such as tules, cattails, burreed (Sparganium spp.) and water primrose. Wetlands with the capability to manipulate water regimes (106 acres) will be managed to support a 50:50 ratio of tall emergent vegetation to open water.

Rationale: Permanent wetlands include wetlands, lakes, sloughs and waterways with different water management capabilities. Deeper water habitats interspersed with tall emergent vegetation, such as cattails and tules, provide excellent habitat for a variety of migrating, wintering and resident birds, including special status species, such as greater white-fronted geese, canvasbacks, northern pintails, wood ducks, common moorhens, American bitterns, American white pelicans and pied-billed grebes. An approximately equal percentage of open water for foraging and tall emergent vegetation for cover provides an optimal mix of habitat types. Riparian habitats associated with these wetlands may support colonies of nesting great blue herons, great egrets, double-crested cormorants, black-crowned night herons, and snowy egrets and a variety of raptors such as the Swainson's hawk. Fallen trees and logs provide basking sites for species such as western pond turtles and permanent wetlands, sloughs and waterways provide habitat for the endangered giant garter snake. Many of these wetlands were degraded through dredging, farming and other activities and are currently further threatened by degradation of water quality and invasive aquatic weeds such as water hyacinth.

Strategies:
1. Reduce human disturbances to nesting birds and other wildlife on deep water habitats such as lakes, sloughs and the SP Cut by limiting public access.
2. Continue to work in partnership with private landowners and local and State agencies and academic institutions to control water hyacinth and participate in the Stone Lakes Basin Water Hyacinth Control Program.
3. Within five years, survey aquatic plants in South Stone Lake and map distribution of Brazilian elodea and other non native plants to determine if control efforts are needed and if so, what methods can be used .
4. Cooperate with the U.S. Department of Agriculture and local academic institutions on evaluating alternate, nonchemical methods of controlling invasive weeds.
5. Assess necessity and feasibility of drawing down North Stone Lake to solidify a portion of the bottom of the lake to stimulate plant growth.
6. Maintain approximately an equal ratio of emergent vegetation to open water on the Beach Lake and South Stone Lake units through a combination of drawdowns, mowing, discing and prescribed burning in sloughs.
7. Drawdown managed permanent wetlands every two to four years to control carp populations and improve germination of desirable wetland plants..

8. Maintain sanctuary areas for nesting waterbirds, (e.g., pied-billed grebes) waterfowl broods, giant garter snakes, and western pond turtle from May through September in the central portion of South Stone Lake (see Figure 6).

Objective 1.H: Manage and enhance approximately 1,900 acres of non-irrigated grasslands on the North Stone Lake Unit on an annual basis to provide a variety of grass heights and densities as measured by residual dry matter (RDM) at the end of the grazing season, which is typically November to June depending primarily on precipitation and other factors. Pasture rotation reduces grazing pressure on different pasture units and promotes a diversity of grassland-dependent species, such as arctic nesting geese, shorebirds, songbirds, burrowing owl and other raptors, sandhill crane and long-billed curlew which have been identified by the Service as focal species.

Rationale: Over 99.9 percent of historic native grasslands in the Central Valley have been lost to agricultural conversion and urban development since Euro-American settlement (DFG 2006). The large ungulates, pronghorn antelope and tule elk, that once grazed these grasslands were extirpated from the valley by the 1870s. The natural hydrologic regime of the area has also been irreversibly modified. Despite these changes, the 2,600-acre North Stone Lake Unit is one of the largest and relatively unaltered grassland areas left in the Stone Lakes Basin. It supports a variety of special status species, such as the greater sandhill crane, burrowing owl, Swainson's hawk, California horned lark, long-billed curlew and western meadowlark. Since grazing was reintroduced following a ten-year absence, many of the species mentioned above expanded their use of the Refuge.

Strategies:

1. Graze cattle on the North Stone Lake Unit from November 1 to July 15; actual termination dates will vary from year to year depending on rainfall and grass production.
2. Use integrated pest management techniques, including prescribed fire, mowing, discing, hand removal and herbicide applications, to reduce invasive plants, such as yellow starthistle, pepperweed and other undesirable grassland vegetation.
3. Implement a long term grazing management plan developed in collaboration with USDA Natural Resource Conservation Service (NRCS) and other range management experts. The plan prescribes stocking rates to achieve varying grass heights and densities in the five pastures of the unit to accommodate habitat requirements of breeding and wintering bird species, including sandhill cranes, long-billed curlews and western meadowlarks. The overall goal is to annually rotate grazing pressure (e.g., low, medium or high) among the five pastures, resulting in a range of grass heights and densities. Two pastures will be maintained with relatively lower residual dry matter (RDM) values as measured at the end of the grazing season (1,200 lbs/acre), two pastures with medium RDM values (1,750 lbs/acre) and one pasture with a higher RDM value (+2,500 lbs/acre). .
4. Enhance and create habitat for burrowing owls by reintroducing ground squirrels to the North Stone Lake Unit and constructing and maintaining artificial burrows until sufficient natural burrows are available.
5. Develop long term monitoring plan to survey population trends of greater sandhill cranes, arctic nesting geese, long-billed curlews, white-faced ibis, burrowing owls, and western meadowlarks to evaluate wildlife responses to range management.
6. Develop methodologies to restore native grasses on the North Stone Lakes Unit through test plots in conjunction with USDA NRCS and Agriculture Plant Material Center.

Objective 1.I: Annually maintain 460 acres of irrigated pasture/wet meadow to provide habitat for a variety of grassland dependent species, including sandhill cranes, white faced ibis, long-billed curlew and arctic nesting geese.

Rationale: With less than one percent of native grasslands left in the Central Valley, many grassland dependent species now rely on dry and irrigated pastures for migrating and wintering habitat. Irrigated pastures on the North Stone Lake Unit support the largest concentration of native grasses on the Refuge. Irrigated pasture is sheet-flooded in winter to bring invertebrates to the surface, providing foraging habitat for cranes and shorebirds.

Strategies:

1. Continue irrigation of 460 acres of pastures on the North Stone Lake and South Stone Lake units and the Gallagher tract from June through October.
2. If feasible, sheet flood irrigated pastures to a depth of less than six inches every two weeks from November through March on the North Stone Lake Unit (also see 2.A.2).
3. Provide short grass habitat through a managed grazing program from July through October.
4. Develop a monitoring plan to survey native grasses and develop mapping capabilities and strategies to expand native grasses.

Objective 1.J: Restore approximately 30 acres to grassland habitat consisting of a minimum of 70 percent native grasses including; needlegrass, bluegrass (Poa spp.), rye grass, Elymus spp., and Melica spp. on various Refuge units within 10 years to promote biodiversity and improve the grassland communities on the Refuge.

Rationale: Native grasses once covered nearly 22 million acres of California, including much of the Central Valley (Heady 1977). Today, over 99.9 percent of these grasslands have been lost (DFG 2006). Although little is known about the original composition of native grasses of the Stone Lakes Basin, purple needlegrass may have dominated the valley grasslands with a mix of other perennial grasses, including bluegrass, rye grass, *Elymus* spp. and *Mellica* spp.; annual grasses such as Fescue (*Festuca* spp.); and a mixture of broad-leaved forbs (Heady 1977; Stebbins 1965). Because little is known about the original composition of the grasses and dramatic changes in land use and hydrology have occurred, local experts are the best source of information when planning native grassland restorations.

Strategies:

1. Establish small (less than 0.25 acre) experimental native grass plots before large scale restoration activities are conducted.
2. Remove nonnative seed sources by mowing, discing, burning, or chemical applications for two seasons before establishing native grasses and control broadleaves and other invasive plants on newly restored areas for three years or more.
3. Maintain grasslands by periodic disturbance, such as mowing, grazing, burning, or discing outside of the breeding season for birds.
4. Use local expertise in developing native grassland restoration plans.
5. Restore 3-5 acres of the western portion of the Lewis Investment Co. tract of the South Stone Lake Unit to a grassland community with an objective of 60 percent native grasses through discing, seeding, mowing and herbicide applications outside of the breeding season for birds.
6. Develop a monitoring plan to assess the success of native grass restoration projects.

Objective 1.K: Within 15 years, coordinate the Refuge land conservation program to protect 75 percent of the land within the approved Refuge boundary to help achieve the Central Valley Joint Venture (CVJV) regional habitat protection goals.

Rationale: One of the goals identified in the EIS that established the approved Refuge boundary (USFWS 1992), is creating linkages between Refuge habitats and habitats on adjacent lands to reverse the impacts of past habitat fragmentation on wildlife and plants. Therefore, priority should be given to conserving lands within the approved Refuge boundary and coordinating Refuge land conservation activities with other nearby regional conservation projects to compensate for habitat fragmentation caused by agricultural conversion and urban development. The CVJV is a partnership of conservation organizations and State and Federal agencies whose mission is to work collaboratively through diverse partnerships to protect, restore and enhance wetlands and associated habitats for waterfowl, shorebirds, waterbirds and riparian songbirds, in accordance with conservation actions identified in the CVJV Implementation Plan. Through these actions, the CVJV aims to advance its vision of providing diverse habitats necessary to sustain migratory bird populations in perpetuity for the benefit of those species, resident wildlife and the public. The Central Valley of California is the most important waterfowl wintering area in the Pacific Flyway, supporting 60 percent of the total duck and goose population. In its implementation plan, the CVJV sets out habitat protection, enhancement and restoration objectives for sub-basin of the Central Valley, including the Sacramento San Joaquin Delta.

Strategies:

1. Coordinate Refuge land conservation activities with local and State agencies and private organizations, including the Sacramento Regional County Sanitation District, Sacramento County Department of Regional Parks, Recreation and Open Space, California Department of Parks and Recreation, California Department of Water Resources, The Nature Conservancy, the Trust for Public Land and the American Land Conservancy.
2. Continue to seek congressionally-appropriated funds (including Land and Water Conservation Funds and Migratory Bird Conservation Funds) and other Federal, State and private funding for land conservation.
3. Acquire agricultural and conservation easements on farmland and other fish and wildlife habitats within the approved Refuge boundary.
4. Participate actively in regional land planning efforts by Sacramento County, Cities of Elk Grove and Sacramento, Sacramento Area Council of Governments, and others that may promote the maintenance of open space and wildlife corridors between the Refuge and other regional open space areas.
5. Within one year, complete conveyance of fee title interest in the 150-acre Beach Lake Mitigation Bank (Beach Lake Unit) from California Department of Transportation.
6. Within two years, finalize a cooperative agreement with the Sacramento Regional County Sanitation District for joint management of the 1,800 acres of the Sacramento Regional Wastewater Treatment Plant Bufferlands lying within the approved Refuge boundary.
7. Within 15 years, secure funding to protect 75 percent of land with the approved Refuge boundary by working with willing landowners.

Objective 1.L: Coordinate Refuge habitat conservation efforts with other private and public conservation efforts within the Sacramento-San Joaquin Delta to contribute to regional habitat conservation needs.

Rationale: The EIS establishing the approved Refuge boundary (USFWS 1992) identified two goals: (1) coordinate Refuge land acquisition and management activities with other agencies and organizations to maximize the effectiveness of Refuge contributions to regional habitat needs, and (2) preserve, enhance, and restore Central Valley wetlands and agricultural lands to provide foraging and sanctuary habitat to achieve distribution and population levels of migratory waterbirds consistent

with goals and objectives of the Central Valley Joint Venture (CVJV). Therefore, coordination of the conservation efforts of various management entities should support a greater diversity of fish and wildlife values and recreational opportunities. Under the North American Waterfowl Management Plan, the CVJV was established for habitat conservation and management of migratory waterbirds in the Central Valley. Current CVJV habitat objectives for the Sacramento-San Joaquin Delta to which the Refuge may contribute include: (1) restore 19,000 acres of wetlands; (2) enhance 2,112 acres of wetlands; and (3) enhance 23,000 acres of agricultural land. The Service would coordinate efforts with ongoing private and public conservation projects, including the CVJV, Riparian Habitat Joint Venture, Cosumnes River Preserve, Yolo Basin Wildlife Area, Delta Meadows State Park and other State-owned Delta properties.

Strategies:

1. Within three years, modify the existing cooperative agreement with Sacramento County Department of Regional Parks, Recreation and Open Space for their 1,567-acre portion of the North Stone Lake Unit so the agreement has a 30-year duration, and includes the habitat and visitor use strategies outlined in the CCP and Sacramento County's revised Draft North Stone Lake Management and Restoration Plan.
2. Within three years, secure long term management through cooperative agreement of the California Department of Parks and Recreation 1,224-acre portion of the North Stone Lake Unit.
3. Within five years, develop a cooperative agreement with California Department of Water Resources for joint management of the 410 acres they own within the approved Refuge boundary.
4. Pursue inclusion of the Service as a signatory to the joint operating agreement for the Cosumnes River Preserve to support the conservation and management of lands within and adjacent to the approved Refuge boundary.
5. In cooperation with the Natural Resources Conservation Service (NRCS) and other agencies and private organizations, pursue enhancement of privately-owned lands within and outside of the approved Refuge boundary by working with landowners through various programs, such as Partners for Fish and Wildlife and NRCS programs (e.g., Conservation Reserve Enhancement Program, Environmental Quality Incentives Program, and Wildlife Habitat Incentives Program).
6. Continue to participate actively in regional land use planning by State, county and municipal entities that may affect Refuge resources or complement Refuge conservation goals (see also 1.M).

Objective 1.M: Manage Refuge floodplain lands in a manner consistent with local, State and Federal flood management, sediment and erosion control and water quality objectives as described in the Environmental Impact Statement (EIS) establishing the approved Refuge boundary.

Rationale: The importance of the Beach-Stone Lakes Basin as a flood storage area during winter high flow events continues to increase with upstream urban development. The resulting changes in the flooding regime have also reduced the viability of some agricultural operations and modified patterns of remaining natural vegetation. In the EIS that established the approved Refuge boundary (USFWS 1992), the Service recognized flood storage as an important benefit and natural component of the Beach Stone Lakes ecosystem. Refuge restoration and management will be consistent with Federal, State and local flood guidelines.

Strategies:

1. Participate in regional interagency floodplain management planning efforts that may affect the Beach-Stone Lakes Basin, including the North Delta Improvement Group, Lower Morrison Creek planning, Mokelumne-Cosumnes Watershed Alliance, Pt. Pleasant Flood

Control Working Group and Sacramento River Planning Forum.

2. Implement Refuge habitat improvement strategies so that they do not exacerbate local or regional flooding, degrade water quality, or cause erosion impacts for adjacent or nearby landowners or residents.
3. Review and participate in regional planning activities sponsored by Sacramento County and local municipalities, such as the City of Elk Grove, which may affect flooding regimes or water quality in the Beach-Stone Lakes Basin.
4. Develop a Refuge levee flood control channel maintenance MOU in coordination with local agencies, such as reclamation and resource conservation districts, the City of Elk Grove, and Sacramento County, that is consistent with existing or future flood control policies.

Objective 1.N: Within 10 years of CCP approval, work toward achieving the water quality supply standard for wetlands and fish and wildlife resources set forth by the U.S. Environmental Protection Agency (USEPA), the California Department of Fish and Game (DFG) and the Regional Water Quality Control Board.

Rationale: Establishing a water quality monitoring program was recommended as a mitigation measure in the EIS establishing the approved Refuge boundary (USFWS 1992) and as part of subsequent water quality investigations (Thomas 2003). A water quality monitoring program can be used to further education and outreach efforts to local landowners, businesses and agricultural landowners, and can inform regulatory activity, if needed. Current threats to Refuge water quality include: eutrophic conditions (excess nutrients), turbidity, low dissolved oxygen, contaminants in urban and agricultural runoff (e.g., polycyclic aromatic hydrocarbons (PAHs), fecal coliform and pesticides) as well as mercury from historic mining operations.

Two options exist for the Refuge to comply with the Central Valley Regional Water Quality Control Board's (Regional Board) Irrigated Lands Conditional Waiver for water dischargers: filing as an individual discharger; or joining a discharge Coalition Group. Discharges from the Refuge into Waters of the State are not a regular occurrence and only occur periodically during flood events in which most of the flood water stays on Refuge lands and is not discharged. In addition the Refuge cooperates with the SRCSD Bufferlands staff to collect and analyze water samples to assess any impacts resulting from the application of aquatic herbicides. Previously the Refuge complied with water quality testing, to assess any concentration of aquatic herbicides, in compliance with the California Department of Boating and Waterways National Pollution Discharge Elimination System (NPDES) permit. Given that minimal discharge, if any, occurs from the Refuge and that water quality monitoring is already occurring, the Refuge will file as an individual discharger, or as a Coalition Group Member if appropriate.

To comply with the Irrigated Lands Conditional Waiver as an Individual discharger, the Refuge must file a Notice of Intent (NOI) to comply and a Farm Evaluation Report. Additional required reports will include a Monitoring and Report Program Plan and water quality monitoring, evaluated in a complete annual report to the Regional Water Board. In addition, technical reports may also be required, by the Regional Board, should water quality problems occur. The requirements for those that join a Coalition Group and file under the Conditional Waiver for Coalition Groups are identical except that a Watershed Evaluation Report is required in place of a Farm Evaluation Report. The reports required from the Coalition Groups include the filing of a NOI and General Report, Monitoring and Reporting Program Plan, Annual Monitoring Reports and the potential for a development of a Management Plan if required to resolve exceedance of water quality objectives.

Strategies:

1. Work to ensure coverage under the Central Valley Regional Water Quality Control Board Irrigated Lands Conditional Waiver, either as an Individual discharger or as a Coalition Group member if appropriate.
2. Develop a Refuge water quality monitoring program to track changes in contaminant concentrations, and water quality parameters (pH and dissolved oxygen) resulting from current and future land use patterns around the Refuge within five years.
3. Develop a long-term water quality monitoring program to assess the effects of non-point sources of pollution (including stormwater and agriculture runoff) entering the Refuge and the contaminant levels in fish and other biota.
4. Develop strategies to work with local landowners, businesses and neighborhood organizations within the watershed to educate and reduce quantities of pesticides and runoff entering the Refuge.
5. Expand the Refuge outreach and education effort to inform upstream urban residents and businesses of the sensitivity of downstream water uses.
6. Develop a partnership with Franklin High School to monitor water quality on the Refuge.

Goal 2. Conserve, enhance, and restore high quality migrating, wintering and breeding habitat for migratory birds within the Sacramento San Joaquin Delta of the Central Valley.

Objective 2.A: Manage 2,950 acres of Refuge lands and cooperate with nearby farmers and landowners to conserve and enhance agricultural lands and habitats that support 400-700 greater and lesser sandhill cranes wintering in the Stone Lakes Basin. The Refuge will continue management of seasonal wetlands and irrigated pasture to provide roosting and foraging habitat and pursuing projects and partnerships to maintain dry and irrigated pastures, wheat, corn, and alfalfa for cranes foraging in the basin.

Rationale: The greater sandhill crane is listed by the State as a threatened subspecies, under the California Endangered Species Act (CESA). Cranes winter in the Central Valley and depend on a combination of agricultural lands, wetlands and pasture. As urban expansion and conversion of agricultural crops and pastures to vineyards continues, habitat availability for cranes has decreased. Winter home ranges for greater sandhill cranes are relatively small, averaging less than one square mile, despite fluctuating food availability during the winter season (G. Ivey, pers. comm.). Nightly roost sites need to be in close proximity (less than one mile) to feeding sites. The Refuge can play an important role in the recovery of this subspecies by providing winter roosting and foraging habitat to support approximately 200 to 300 greater sandhill cranes near the North and South Stone Lake units and the surrounding area.

Strategies:

1. Begin flood up of seasonal and permanent wetlands on the Beach Lake and South Stone Lake units in early September to provide habitat for arriving (migrating) cranes, particularly when roosting habitat in the area is in short supply.
2. Periodically sheet-flood irrigated pastures in winter to provide foraging opportunities on the North Stone Lake Unit.
3. Continue grazing the North Stone Lake Unit to provide foraging and loafing habitat adjacent to roosting sites in wetlands (see objective 1.F).
4. Develop and host workshops to provide private landowners with information about USDA, NRCS and other Federal, State and private grant and incentive programs aimed at maintaining small grain fields for crane forage and protecting or enhancing other habitats important for wintering crane within a five-mile radius of the Refuge.
5. Maintain 40 to 60 acres of agriculture fields on the Headquarters Unit of the Refuge for foraging cranes. Crops could include corn, winter wheat and other small grains.

6. Conduct bimonthly sandhill crane surveys and coordinate results with appropriate researchers and refuges including the Cosumnes River Preserve and Modoc and Malheur national wildlife refuges.
7. Incorporate crane roosting habitat characteristics (e.g., shallow water, small islands with gravel, and minimizing human disturbance) into any new wetland development plans.

Objective 2.B: Develop monitoring strategies for focal species identified in various regional bird conservation plans to assess current and guide future habitat restoration activities. The regional plans include: the Central Valley Joint Venture Implementation Plan, the Riparian Bird Conservation Plan, the Grassland Bird Conservation Plan, the Oak Woodland Bird Conservation Plan, the North American Waterbird Conservation Plan, the North American Waterfowl Management Plan, and the North American Landbird Conservation Plan.

Rationale: Population monitoring and research assessing the habitat requirements of migratory birds is needed to evaluate the effectiveness of Refuge management strategies and facilitate adaptive management. Monitoring and research on the Refuge, in cooperation with other similar efforts in the Central Valley, will provide valuable information about population trends and assist with development of overall strategies for the recovery and management of migratory birds and other key species groups. Collaborative efforts between the Refuge and other agencies, academic institutions, and private organizations will increase the effectiveness of data collection efforts, expand the resources available and enable the Service to address a larger array of research and monitoring needs.

The Sacramento-Yolo Mosquito and Vector Control District (SYMVCD) has monitored landbirds on the Refuge weekly through mist netting and banding since 1995. The program has assisted the Service with assessing the quality of Refuge riparian habitats and avian species diversity. The goals of this program are to: assess the role of wild birds as reservoirs for mosquito-borne diseases such as Western Equine Encephalitis, St. Louis Encephalitis, and West Nile virus; assess the usefulness of bird populations as an early warning system for potential viral episodes; and provide information regarding species diversity, population status, seasonal use and reproductive success and recruitment on the Refuge.

Strategies:
1. Conduct biweekly waterfowl, shorebird and waterbird censuses from September through June and coordinate surveys with the annual inter-agency mid-winter waterfowl survey.
2. Continue monitoring of existing heron and egret rookeries and annually survey suitable riparian areas for new colonies (See Strategy 1.B.2).
3. Pursue opportunities to recruit qualified volunteers and develop partnerships with resource agencies, academic institutions and private organizations to accomplish monitoring and research projects related to Refuge habitats and wildlife.
4. Develop and annually update a list of Refuge monitoring needs with universities in the region and other agencies which conduct research.
5. Develop surveys on the South Stone Lake, Headquarters, and Wetland Preserve Units and other lands as they come under Refuge management.
6. Develop data management strategies to store data and make data available to other researchers.
7. Assess feasibility of creating tricolored blackbird habitat in grassland habitat (e.g., planting large California blackberry patches and expanding tule areas in wetlands for nesting).

Goal 3. Provide visitors with wildlife-dependent recreation, interpretation and education opportunities which foster an understanding of the Refuge's unique wildlife and plant communities in an urban setting.

Objective 3.A: Within the next five years, recruit and maintain sufficient short and long term volunteers to accomplish three habitat restoration projects, eight wildlife surveys, six environmental education programs, and remain active in offering a variety of other volunteer opportunities.

Rationale: Refuge volunteer programs are a vital instrument for providing educational and interpretive opportunities to the public and for assisting with biological monitoring and visitor use programs. The reauthorization of the National Wildlife Refuge Volunteer and Community Partnership Enhancement Act of 1998 illustrates the importance of volunteer programs and community partnerships in helping to fulfill the mission of the National Wildlife Refuge System.

Strategies:

1. Broaden the scope of volunteer tasks and define volunteer positions to better utilize the diverse interests, talents and abilities of residents in the surrounding communities.
2. Develop a Refuge volunteer manual to aid the volunteer coordinator with planning and implementing the volunteer program.
3. Provide at least one comprehensive volunteer training opportunity per year with a revised and updated volunteer training manual and other educational opportunities.
4. Develop and maintain a volunteer database.
5. Pursue opportunities to collaborate on expanding volunteer activities with the Sacramento Regional County Sanitation District, Cosumnes River Preserve and Delta Meadows State Park.
6. Recruit Student Conservation Association, AmeriCorps, California Conservation Corps and other interns to work in a variety of programs.
7. Explore and continue ongoing outreach efforts to recruit quality volunteers.
8. Expand opportunities for specific one-time volunteer events, ongoing individual opportunities and ongoing group opportunities, including community service hour use opportunities.
9. Continue and expand volunteer participation in three habitat restoration projects on the Headquarters Unit, including 176 acres of managed and passive seasonal and permanent wetlands, 82 acres of wet meadow and upland native grasslands and 83 acres of riparian habitats.
10. Maintain and expand volunteer participation in eight ongoing wildlife monitoring surveys including waterbird monitoring, nest box monitoring, rookery surveys, landbird mistnetting/disease monitoring, sandhill crane surveys, grasslands monitoring, frog malformation survey and Swainson's hawk/burrowing survey.
11. Maintain and expand volunteer participation in six environmental education programs including school groups, special group tours, partnering with schools on curricula, special events, volunteer work and teacher workshops.

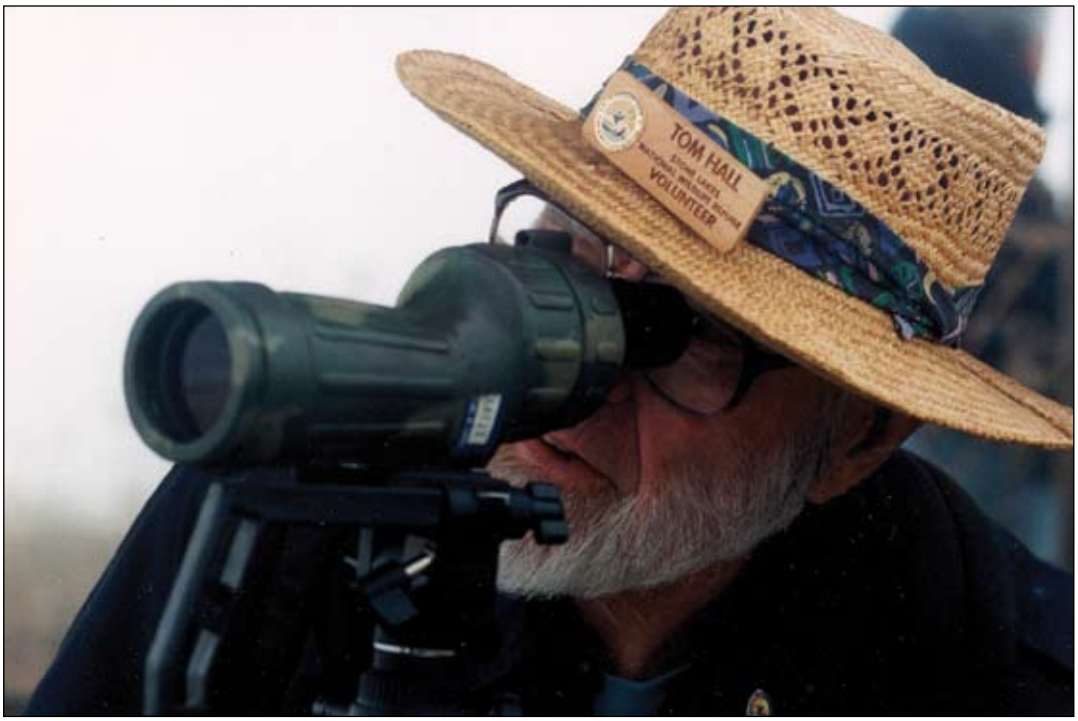
Objective 3.B: Construct adequate facilities and develop programs for visitors to visit the Refuge seven days a week to observe, photograph and enjoy the Refuge's unique natural habitats and wildlife during all seasons of the year with a target of 10,500 visit opportunities per year by 2009.

Rationale: Wildlife observation and photography are two of the six priority visitor uses identified in the National Wildlife Refuge System Improvement Act of 1997. These wildlife dependent activities were identified in the EIS (USFWS 1992) and should be offered on the Refuge. Currently, the Refuge has limited visitor access to two days per month and, as a result, the expectations of the visiting public are not being met A great potential also exists to provide visitors opportunities for

wildlife observation and photography from boats. To prevent disturbance of wildlife, boats would be limited to using trolling motors. A no-wake zone on the entire Refuge would minimize conflicts with other users, water quality degradation, erosion to levees and disturbance to wildlife. Boating would be allowed from June to September to minimize impacts to heron rookeries and Swainson's hawks nesting along riparian corridors.

Strategies:

1. Construct two photography blinds on the Headquarters and North Stone Lake units.
2. Construct restrooms on the Beach Lake, Headquarters and South Stone Lake units.
3. Construct two miles of universally accessible trails and 200 feet of boardwalk on the Headquarters Unit.
4. Construct a safe entrance road and parking area for approximately 40 vehicles on the Headquarters Unit
5. Construct a viewing platform on the Headquarters Unit overlooking newly constructed wetlands.
6. Construct a safe vehicular access point, a parking area for 15 cars and a trail and a wildlife observation platform on the southern portion of the North Stone Lake Unit, accessible from Hood-Franklin Road. Design and locate facilities to minimize impact on sandhill cranes, arctic nesting geese, giant garter snakes and burrowing owls.
7. Provide parking for up to 20 cars at the boat launch on the South Stone Lake unit to provide wildlife viewing, photography, fishing and associated cartop boating opportunities. Only non-motorized or electric motor-only boats would be allowed on South Stone Lake from June through September. South Stone Lake would be an enforced no-wake zone.
8. Construct 1.5 miles of foot trails and 200 feet of boardwalk on the South Stone Lake unit open to the public seven days a week with seasonal restrictions.
9. Develop a boat-accessible haul-out site, walking trail and viewing blind on the South Stone Lake Unit (i.e., Lodi Peninsula)..
10. Provide parking and boat launch capacity for a maximum of 10 cartop boats (including canoes and kayaks) on



Wildlife observation and photography are two of the six priority public uses identified in the National Wildlife Refuge System Improvement Act of 1997.
Photo by USFWS

the Beach Lake unit at the end of Elliott Ranch Road to provide wildlife viewing, photography and fishing opportunities for pre-registered groups in SP Cut from June through September.

11. Once visitor use facilities are made available on the Headquarters unit, shift the focus of the Beach and North Stone Lake units within one year from open-touring days to pre-registered school and docent-guided tour groups.
12. Develop guided tours for the Wetland Preserve Unit.
13. Restrict land-based visitor use near habitat suitable for heron/egret rookeries, nesting Swainson's hawks and other areas used by nesting migratory birds during sensitive laying and incubation periods (approximately February to June 15).
14. Minimize disturbance to sandhill crane foraging and roosting habitats on the Refuge by restricting public access during October through March.
15. Reduce potential spread of invasive species by visitors by restricting access to paved or graveled trails and maintaining trails in good condition through regular weed control.

Objective 3.C: Within five years, develop an environmental education program with a target of providing 80 opportunities per year for groups with an outdoor experience where visitors become aware of the Refuge's role in the conservation of Central Valley and Sacramento San Joaquin Delta habitats and their fish and wildlife.

Rationale: Environmental education is one of the six priority visitor uses identified in the National Wildlife Refuge System Improvement Act of 1997. The Refuge provides a unique opportunity for the local community to experience Central Valley habitats and wildlife in proximity to an urban area. Refuge-based environmental educational activities can also be integrated into both indoor and outdoor classroom curriculums.

Strategies:

1. Offer up to four staff and/or docent lead environmental education tours on the Refuge per week.
2. Within five years, conduct teacher workshops to develop an environmental education program featuring teacher lead tours with a target of training six to 12 groups of teachers per year.
3. Develop a Junior Biologist Trail as part of the proposed Blue Heron Trail System on the Headquarters Unit to be used by schools and other groups and individuals.
4. Develop a Refuge elementary school curriculum manual for teachers to use while visiting the Refuge that includes pre- and post-visitation activities.
5. Explore feasibility of a Refuge fee area to support environmental education programs and general maintenance of visitor use areas.

Objective 3.D: Within five years, develop two interpretive programs where visitors could learn of the Refuge's role in conserving the Central Valley and Sacramento-San Joaquin Delta habitats and their fish and wildlife, with an emphasis on outdoor hands-on experiences.

Rationale: Interpretation is one of the six priority visitor uses identified in the National Wildlife Refuge System Improvement Act of 1997. Interpretive activities can introduce the public to the Refuge's habitat management activities and familiarize them with the conservation efforts that protect local natural resources.

Strategies:

1. Develop a self-guided trail as part of the proposed Blue Heron Trails System on the Headquarters Unit with hands-on learning stations within two years.
2. Develop a class/group staging area and 5 open air interpretive shelters with one kiosk and exhibits as part of the Blue Heron Trails system that would accommodate approximately 40 children at a time.
3. Develop interpretive displays on the Headquarters Unit that illustrate

traditional dwellings, various subsistence strategies and the overall lifestyle of local American Indian Tribes (see Objective 4.F).
4. Continue existing guided hikes and offer one additional interpretive docent guided hike per month.
5. Develop interpretive panels and exhibits on South Stone Lake Unit.
6. Develop self-guided trail and interpretive displays for the Wetland Preserve Unit.
7. Develop a variety of written interpretive materials such as brochures, flyers and handouts

Objective 3.E: Within five years, the Refuge will provide safe, boat-only fishing with day use parking facilities to accommodate a maximum of 20 boats on South Stone Lake and a minimum of ten boats on SP Cut from June through September.

Rationale: Fishing is one of the six priority visitor uses identified in the National Wildlife Refuge System Improvement Act of 1997. Fishing has traditionally occurred on South Stone Lake and surrounding Delta waterways since American Indians occupied the area. In this objective, "safe," is defined as the absence of any fishing-related safety incidents.

Strategies:
1. Develop and maintain a safe public parking lot and boat launch facilities to accommodate a maximum of 20 cartop (not trailered) boats on the South Stone Lake unit, including an informational kiosk with maps and brochures on regulations, health warnings, species identification and Refuge boundaries. Boating will extend up the SP Cut to the culvert on the South Stone Lake unit.
2. Provide a launch for pre-registered canoe/kayak groups in SP Cut on the Beach Lake unit from June through September. Access would be from the end of Elliott Ranch Road and a no wake zone will be enforced.
3. Fishing will be in accordance with all State regulations. Fishing will not include take of frogs or crayfish and will only be done with rod and reel.
4. Restrict water-based visitor use near habitat suitable for heron/egret rookeries and Swainson's hawks during sensitive laying and incubation periods (approximately February to June 15).
5. Develop facilities for mobility impaired persons to enter and exit canoes and kayaks safely.
6. See objective 3.B for other strategies related to opportunities for boating programs.

Objective 3.F: Continue to expand the Refuge outreach program, targeting the local community and nontraditional users, by expanding partnerships for the annual Walk on the Wildside event and prepare for a minimum of four appropriate off-Refuge events, per year, to increase awareness of the Refuge's role in conserving Central Valley and Sacramento San Joaquin Delta habitats and their associated fish and wildlife.

Rationale: Environmental education is one of the six priority visitor uses identified in the National Wildlife Refuge System Improvement Act of 1997. The urban location of the Refuge provides opportunities for the Service to educate broader audiences within the local community, including nontraditional users, about the Refuge's role in conserving Central Valley habitats and wildlife and the benefits the Refuge provides to the surrounding communities and Central Valley.

Strategies:
1. Maintain Refuge website for a one-stop source of information about Refuge history, events and biological resources with links to the Stone Lakes National Wildlife Refuge Association and other partners.
2. Continue and expand partnerships for the annual Walk on the Wildside festival to celebrate the National Wildlife Refuge System and other events, such as International Migratory Bird Day.
3. Participate in at least four appropriate local off-refuge events each year, such

as the Lodi Crane Festival and Salmon Festival.

4. Support the Stone Lakes National Wildlife Refuge Association by actively participating in their events, activities and meetings and making monthly contributions to Association outreach related materials, including newsletters, the website and brochures.
5. Collaborate with and assist local resource-oriented agencies and city departments, such as the Elk Grove Community Service District, on outreach programs involving the Refuge.
6. Develop new portable refuge displays for use at fairs, shows and festivals.
7. Expand the number of presentations given to schools, conservation groups and public service organizations.

Goal 4. In cooperation with tribal representatives, identify and protect cultural resources on the Refuge and educate the public regarding American Indians and the history of the region.

Objective 4.A: Prepare a cultural resources overview of the Refuge, within 15 years of CCP approval.

Rationale: Although record searches have been conducted for all Service-managed properties, a complete compilation of site records and relevant reports summarizing the number and locations of all recorded sites within the approved Refuge boundary would aid in planning land conservation, management and landowner outreach. Refuge planning efforts would be enhanced by identifying the location and composition of collections of human remains, funerary objects, sacred objects, or objects of cultural patrimony that were discovered and removed from within the approved Refuge boundary prior to the Service assuming land management authority. However, this overview would be for the sole purpose of identifying cultural resources and these collections would not fall under Service jurisdiction.

Strategies:

1. Compile and maintain all existing baseline data on cultural resources sites, surveys and reports within one mile of the approved Refuge boundary.
2. In consultation with archaeologists and tribal representatives, approximate the location of unrecorded sites and culturally sensitive areas within the approved Refuge boundary by using site records, maps and other data. Identify cultural resources issues and needs and draft potential solutions.
3. To aid with Refuge planning, identify the location and composition of any collections of human remains and Native American Grave Protection and Repatriation Act (NAGPRA) covered items removed from within the approved Refuge boundary prior to the Service's assumption of land management.

Objective 4.B: Within 15 years of CCP approval, evaluate conditions of known cultural resource sites on Refuge managed lands and conduct seasonal monitoring of known sites.

Rationale: The Service is required to ensure that the integrity of any cultural sites on Refuge lands are protected. As a result of the activities of previous landowners, sites may have been impacted or may still be vulnerable to continued degradation (e.g.,erosion, traffic, theft). Therefore, sites should be evaluated by qualified professionals and measures to stop and/or reverse deterioration of the sites should be developed and implemented.

Strategies:

1. Conduct monthly monitoring visits of known cultural resource sites on the North Stone Lake Unit to ensure that existing grazing protection measures are intact.
2. As needed, consult with professional archaeologists, local tribal representatives and the Regional Office Archaeologist regarding any necessary protection or remediation measures for cultural resource sites.

3. Develop additional measures to protect sites and/or remediate past damages, if necessary.

Objective 4.C: Identify and delineate any cultural resources on new lands coming under Refuge management.

Rationale: Identifying historic properties on lands as they come under Refuge management will enable staff to ensure that any restoration and management programs for fish and wildlife will also protect the integrity of sensitive cultural resources.

Strategies:
1. As funding is available, a qualified archeologist will survey new properties coming under Refuge management to locate and delineate, as needed, any known or previously unrecorded cultural resource sites.
2. In consultation with the appropriate Service or other professional cultural resource experts, evaluate sites on newly-managed properties to identify any protection, restoration, and/or management measures that may be necessary.

Objective 4.D: Meet annually with the Ione Band of Miwok Indians and other concerned tribal groups to discuss land management and restoration activities planned for the upcoming field season.

Rationale: The Service has agreed to meet annually with the Ione Band of Miwok Indians to keep them informed regarding planned Refuge activities. Meetings will also provide a forum for tribal representatives to present any of their proposals or discuss other concerns that relate to management of Refuge lands.

Strategies:
1. As the Service has previously agreed, hold an annual meeting to review previous projects or summarize management or restoration projects and public events that are planned by the Refuge for the upcoming year, whether or not these activities will require formal State Historic Preservation Office consultation.
2. Review and reissue, if appropriate, any special use permits for traditional activities such as plant collecting for basket weaving.

Objective 4.E: Within five years, begin developing a memorandum of understanding or agreement with the Ione Band of Miwok Indians or with other involved tribal organizations to facilitate compliance with the Native American Grave Protection and Repatriation Act (NAGPRA) and to establish protocols for treating human remains and associated funerary objects, sacred objects or objects of cultural patrimony.

Rationale: Due to previous land uses, some Refuge lands and other properties within the approved Refuge boundary have human remains or NAGPRA covered items exposed on the surface of the ground. Currently, the Refuge consults with the Ione Band of Miwok Indians regarding land management programs and the status of burial sites. In addition to the Ione Band, other organizations may need to be consulted. In consultation with the Ione Band and other relevant authorities and experts, the Refuge has implemented some protection measures and assisted with some repatriation of human remains and funerary items. Since more sites are expected to come under Refuge management and to facilitate compliance with NAGPRA, a formal agreement with tribal groups should be developed to define the protocol to be followed when protection, repatriation and re-interment measures are appropriate.

Strategies:
1. Develop an agreement that includes the following elements: notification procedures; when appropriate, procedures for collection of human remains and associated funerary objects, sacred objects, or objects of cultural patrimony; criteria for defining NAGPRA covered items; any data collection or study of materials that may be warranted; guidelines for any

temporary or permanent curation of non-repatriated materials; and a re-interment protocol.

Objective 4.F: Develop a minimum of two interpretive panels and exhibits, located various on units, to educate the public regarding the cultural resources of the Refuge and past and present American Indian cultural practices, within 15 years of CCP approval.

Rationale: Developing interpretive and educational materials to increase public understanding about local American Indian peoples is necessary, given the abundance of cultural resources within the approved Refuge boundary and the historic role of Indians in the Sacramento-San Joaquin Delta. These materials will aid Refuge staff in explaining historical ecological conditions, the importance of restoring and/or maintaining the integrity of those conditions and the role fish and wildlife played in American Indian culture and history.

Strategies:

1. Develop exhibits for the Headquarters and Beach Lake units to illustrate traditional dwellings, various subsistence strategies and the overall lifestyle of local American Indian peoples.
2. Solicit input and advice from concerned tribal representatives in planning, information gathering and review of educational, interpretive and outreach programs and publications. Work with Tribes and universities to identify the messages and resources that would be most appropriate to share with the public.
3. In publications or exhibits, provide a brief history of the indigenous peoples of greater California, scaling down to the Sacramento Valley and then to the Sacramento-San Joaquin Delta region to educate the public.
4. Include a cultural resource element in special events held on the Refuge.

6 Implementation and Monitoring

Once the preferred management alternative and CCP are finalized and approved and the Service has notified the public of its decision, the implementation phase of the CCP process begins. Implementation occurs over a period of 15 years, during which the CCP will serve as the primary reference document for all Refuge planning, operations and management until it is formally revised. The Service will implement the final CCP with assistance from existing and new partner agencies and organizations and from the public.

The activities required to realize the management goals discussed in this CCP are referred to as "projects" below. Every effort will be made to implement the projects by the established deadlines. However, the implementation timing of the management activities proposed in this document is contingent upon a variety of factors, including:

- Completion of detailed step-down management plans
- Funding
- Staffing
- Compliance with other Federal laws and regulations
- Partnerships
- The results of monitoring and evaluation

Each of these factors is described briefly below as they apply to the Service's proposed action.

Step-Down Management Plans

Some projects or types of projects require more in-depth planning than the CCP process is designed to provide. For these projects, the Service prepares step-down management plans. In essence, step-down management plans provide the additional planning details necessary to implement management strategies identified in a CCP. Refuge staff members have already completed a number of step-down plans. These include fire management, grazing, land protection and mosquito integrated pest management plans. This CCP proposes several new step-down plans that are identified in Table 2, along with target dates for completion.

Funding and Staffing

Resources are required to adequately operate any national wildlife refuge including initial capital outlay for equipment, facilities, labor and other expenses as well as recurring, annual costs for staff, contracts, supplies, maintenance and other recurring expenses (See Table 3, Estimated Initial Capital Outlay to Implement CCP). The estimated initial capital outlay for the Refuge, described in this CCP would cost approximately $10 million. Not all of these capital expenditures would occur in the same year as many of these expenses would be most likely implemented over the course of several years. The detailed descriptions of objectives and their associated implementation strategies serve as a guide to the ideal time frame in which to implement capital expenditures. The largest costs for initial outlays are for visitor

Table 2. Step-down Management Plans

Step Down Plan	Target for Completion
Fisheries Management Plan	2008
Invasive Weed - Integrated Pest Management Plan	2008
Volunteer Plan	2009
Comprehensive Inventory and Monitoring Plan	2009
Habitat Management Plan	2009

services and habitat restoration as should be expected for an urban refuge.

To fully implement this CCP, personnel dedicated to the Refuge would include:
- 1 Project Leader
- 1 Deputy Project Leader
- 1 Wildlife Biologist
- 1 Administrative Support Assistant
- 1 Outdoor Recreation Specialist
- 1 Park Ranger
- 1 Motor Vehicle Operator
- 1 Engineering Equipment Operator

Annual contracts or cooperative agreements will also be needed to provide specialized services beyond the core Refuge functions, for which staff are required. The recurring staffing and other costs associated with CCP implementation total approximately six hundred and seventy thousand dollars (See Table 4, Estimated Annual Cost to Implement the CCP). This is approximately a 54 percent increase over the Fiscal Year 2006 operations budget of 435,000.

Compliance Requirements

This CCP was developed to comply with all Federal laws, executive orders and legislative acts to the extent possible. Some activities , particularly those that involve revising an existing step-down management plan or preparing a new one, would need to comply with other laws or regulations. In addition to NEPA and the Improvement Act, full implementation of all components of this CCP would require compliance with:
- Executive Order 11988 (Floodplain Management)
- Executive Order 12372 (Intergovernmental Review of Federal Programs)
- Executive Order 11593 (Protection of Historical, Archaeological, and Scientific Properties)
- Executive Order 11990 (Protection of Wetlands)
- Executive Order 12996 (Management and General Public Use of the National Wildlife Refuge System)
- Executive Order 12898 (Environmental Justice in Minority Populations and Low-Income Populations)
- Secretarial Order 3127 (Hazardous Substances Determinations)
- Endangered Species Act of 1973, as amended
- Refuge Recreation Act of 1962, as amended
- National Historic Preservation Act of 1966, as amended

Partnership Opportunities

As described in Chapter 1, a wide array of private and public partners play an important role in helping the Service achieve its goals and objectives for the Refuge. The Service will continue to rely on these and other partners in the future to help implement the final CCP and to provide input for future CCP updates. This draft CCP identifies many projects that provide new opportunities for existing or new partners. There is great potential for more public participation and assistance in the management and interpretation of the Refuges. The Service welcomes and encourages more public participation in the Refuges.

Adaptive Management

This draft CCP provides for adaptive management of the Refuge. Adaptive management is a flexible approach to long-term management of biotic resources that is directed by the results of ongoing monitoring activities and new data. Management techniques, objectives and strategies are regularly evaluated in light of monitoring results, new scientific understanding and other new information. These periodic evaluations are used to adapt management objectives and techniques to better achieve the Refuge's goals. Monitoring is an essential component of adaptive management in general and of this draft CCP. Specific monitoring strategies have been integrated into the goals and objectives whenever possible.

Plan Amendment and Revision

Refuge CCPs are meant to evolve with each individual Refuge unit. The Improvement Act specifically requires that CCPs be formally revised and updated at least every 15 years. The formal revision process will

follow the same steps as the CCP process (see Chapter 2: The Planning Process). In the meantime, the Service will annually review a checklist of the goals, objectives and management strategies of this CCP to assist in tracking and evaluating progress. The final CCP would also be informally reviewed by Refuge staff while preparing annual work plans and updating the Refuge database. It may also be reviewed during routine inspections or programmatic evaluations. Results of any or all of these reviews may indicate a need to modify the plan. The goals described in the final CCP would not change until they are re-evaluated as part of the formal CCP revision process. The objectives and strategies, however, may be revised to address changing circumstances or to take advantage of increased knowledge of the resources on the Refuge. If changes are required, the level of public involvement and associated NEPA documentation would be determined by the Refuge Manager, in accordance with Service policy.

Table 3. Estimated Initial Capital Outlay to Implement the CCP

Expenditure (Related Strategy)	Unit Cost	Unit	Quantity	Total Cost
Plant trees with beaver exclusion fences (1.A.1)	$15,000	mile	1.3	$19,500
Expand riparian zone at S. Stone Lakes and HQ (1.A.2)	$6,000	acre	5	$30,000
Restore 20 acres by HQ to native plants (1.A.3)	$8,000	acres	20	$160,000
Enhance sub-canopy in BL, NSL units (1.A.4)	$3,000	acre	115	$345,000
Establish native plant nursery by HQ (1.A.5)	$65,399	ea	1	$65,399
Plant early/mid-seccessional vegetation on west portion of Lewis and SSL Units (1.A.6)	$6,000	acre	126	$756,000
Maintain/expand fencing along SP cut (1.B.3)	$10,000	mile	1.3	$13,000
Modify existing water delivery system on SSL Unit (1.C.1)	$25,000	mod.	1	$25,000
Map elodea at SSL and initiate control (1.G.3)	$10,000			$10,000
Enhance burrowing owl habitat at NSL unit (1.H.4)	$15,000	exp. unit	1	$15,000
Establish experimental native grass plots (1.J.1)	$8,000	acre	0.25	$2,000
Restore Lewis Unit grasslands (1.J.5)	$8,000	acre	108	$864,000
Develop a levee and flood control channel maintenance MOU (1.M.4)	$20,000	program dev.	1	$20,000
Develop a Refuge volunteer manual (3.A.2)	$19,505	ea	1	$19,505
Develop a Refuge volunteer database (3.A.4)	$19,505	ea	1	$19,505
Construct photography blinds (3.B.1)	$15,000	ea	2	$30,000
Construct restrooms at BL, SSL and HQ (3.B.2)	$50,000	ea	3	$150,000
Construct 2 miles of universally accessible trails at HQ Unit (3.B.3)	$100,000	mile	2	$200,000
Construct 200 ft. boardwalk at HQ (3.B.3)	$1,060	feet	200	$212,000
Construct entrance road and parking area (3.B.4)	$1,500,000	ea	1	$1,500,000
Construct viewing platform and associated boardwalk on HQ site (3.B.5)	$500,000	ea	1	$500,000
Construct parking lot, trail and observation platform at NSL site (3.B.6)	$620,000	ea	1	$620,000
Improve entrance road and parking area at SSL boat launch site (3.B.7)	$1,000,000	ea	1	$1,000,000
Construct foot trails at SSL (3.B.8)	$100,000	mile	1.5	$150,000
Construct 200 ft. boardwalk at SSL (3.B.8)	$1,060	feet	200	$212,000
Develop boat haul out and assoc. trail at Lodi Gun Club (3.B.9)	$30,000	ea	1	$30,000
Improve parking at BLU Lewis tract at end of Elliott Ranch Road (3.B.10)	$163,000	ea	1	$163,000
Develop a Junior Biologist Trail at HQ complete with entrance signs, universally accessible trails, entrance kiosk, interpretive panels (3.C.3, 3.D.1)	$1,630,000	ea	1	$1,630,000
Develop a an EE elementary school curriculum (3.C.4)	$19,505	ea	1	$19,505
Develop open air shelters (5) and main shelter (3.D.2)	$50,000	ea	6	$300,000
Develop local Indian displays at HQ (3.D.3, 4.F.)	$50,000	ea	1	$50,000
Develop interpretative panels at SSL (3.D.5)	$50,000	ea	1	$50,000
Develop self-guided trail and interpretative displays for the Wetlands Preserve Unit (3.D.6)	$300,000	ea	1	$300,000
Develop written interpretative materials (3.D.7)	$19,505	ea	1	$19,505

Table 3. (continued)

Expenditure (Related Strategy)	Unit Cost	Unit	Quantity	Total Cost
Develop parking lot and boat launch at SSL (3.E.1)	$55,000	ea	1	$55,000
Develop disabled accessible boating facilities (3.E.5)	$50,000	ea	1	$50,000
Compile baseline cultural resources data (4.A.1)	$5,000	ea	1	$5,000
Locate unrecorded cultural sites and sensitive areas (4.A.2)	$5,000	ea	1	$5,000
Identify location of human remains and NAGPRA items located in collections and museums (4.A.3)	$5,000	ea	1	$5,000
Develop exhibits for the HQ and BL units to illustrate traditional dwellings, subsistence strategies and lifestyle (4.F.1)	$25,000	ea	2	$50,000
Total				**$9,669,919**

Table 4. Estimated Annual Cost to Implement the CCP

Expenditure (Related Objective)	Unit Cost	Unit	Quantity	Total Cost
Staff Salaries and Benefits (# indicates position filled)				
# Refuge Refuge Manager/PL - GS-13	$102,450	ea	1	$102,450
# Refuge Assistant Refuge Manager - GS -12	$84,032	ea	1	$84,032
Wildlife Biologist GS-9	$65,680	ea	1	$65,680
# Administrative Support Assistant - GS-7	$54,268	ea	1	$54,268
# Outdoor Recreation Planner GS-11	$70,122	ea	1	$70,122
Park Ranger GS-7	$47,372	ea	1	$47,372
Engineering Equipment Operator - WG - 8	$53,560	ea	1	$53,560
# Motor Vehicle Operator WG - 6	$46,540	ea	1	$46,540
Maintenance supplies (1.D., 1.H., 1.F.)	$50,000	1	1	$50,000
Invasive weed management program (1.A., 1.B., 1.D., 1.E., 1.F., 1.H.)	$60,000	ea	1	$60,000
Water/pumping cost (1.I., 2.A.)	$20,000	ea	1	$20,000
Maintain 40-60 acres or agricultural fields (2.A.5)	$5,000	ea	1	$5,000
Levee and flood control channel maintenance MOU coordination (1.M.4)	$10,000	ea	1	$10,000
Water quality monitoring (1.N.)	$60,000	ea	1	$60,000
Travel/training	$6,000	ea	1	$6,000
Supplies	$25,000	ea	1	$25,000
Printing	$5,000	ea	1	$5,000
Pump-out for restroom	$5,000	ea	1	$5,000
Total				**$667,574**

References

Ahl, J. S. B. 1991. Factors affecting contributions of the tadpole shrimp, *Lepidurus packardi*, to its oversummering egg reserves. Hydrobiologia 212:137-143.

Air Resources Board of California (ARB). 2006. ARB Health-Related Factsheets. http://www.arb.ca.gov/research/health/fs/fs.htm Viewed on June 29, 2006.

American Community Survey (ACS). 2004. 2004 American Community Survey Fact Sheet. Sacramento County, California. http://factfinder.census.gov Viewed on June 20, 2006.

Aquatic Nuisance Species Taskforce (ANSTF). 2003. National Management Plan for the Genus Eriocheir (Mitten Crabs). Prepared by the Chinese Mitten Crab Working Group, November 2003. http://www.anstaskforce.gov/control.php

Bennyhoff, J.A. 1977. Ethnogeography of the Plains Miwok. Center for Archaeological Research at the University of California at Davis. Publication 5.

Bloom, P.H. 1980. The status of the Swainson's hawk in California, 1979. U.S. Department of Interior, Bureau of Land Management, Sacramento. Project W-54-R-12, Job II-8, Final Rep. 42pp.

California Agricultural Statistics Service (CASS). 2004. Summary of County Agricultural Commissioner's Reports, 2002-2003. California Agricultural Statistics Service, Sacramento, CA.

California Department of Food and Agriculture (CDFA). 2006. Pest Ratings of Noxious Weed Species and Noxious Weed Seed. State of California Department of Food and Agriculture, Division of Plant Health and Pest Prevention Services. http://www.cdfa.ca.gov. Viewed on June 20, 2006.

California Department of Fish and Game (DFG). 2000. The status of rare, threatened, and endangered animals and plants of California, Annual Report for 2000. California Department of Fish and Game. Sacramento, CA. 226 pp.

California Department of Fish and Game (DFG). 2001. The status of rare, threatened, and endangered animals and plants of California, Annual Report for 2000. California Department of Fish and Game. Sacramento, CA. 226 pp.

California Department of Fish and Game (DFG). 2004. California Natural Diversity Database Rarefind.

California Department of Fish and Game (DFG). 2006. California Wildlife: Conservation Challenges (California's Wildlife Action Plan). Prepared by Bunn, David, Andrea Mummert, Roxie Anderson, Kirsten Gilardi, Marc Hoshovsky, Sandra Shanks and Kiffanie Stahle. Wildlife Health Center, University of California, Davis.

California Department of Water Resources (DWR). 2006. Where Rivers Meet…the Sacramento-San Joaquin Delta. State Water Project. http://www.publicaffairs.water.ca.gov/swp/delta.cfm Viewed on June 27, 2006.

California Labor Market Information (CLMI). 2006. http://www.labormarketinfo.edd.ca.gov Viewed on June 20, 2006.

California Partners in Flight (CPIF). 2000. Version 1.0. The Draft Grassland Bird Conservation Plan: a Strategy for Protecting and Managing Grassland Habitats and Associated Birds in California (B. Allen, lead author). Point Reyes Bird Observatory, Stinson Beach, CA. http://www.prbo.org/CPIF/Consplan.html Viewed on June 27, 2006.

California Regional Water Quality Control Board – Central Valley Region (CRWQCB-CVR). 2004. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region. http://www.swrcb.ca.gov/rwqcb5/available_documents/index.html#anchor616381 Viewed on July 25, 2006.

California Regional Water Quality Control Board – Central Valley Region (CRWQCB-CVR). 2006. ORDER NO. R5-2006-0054: Individual Discharger Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands.

Central Valley Joint Venture (CVJV). 1990. Central Valley Habitat Joint Venture Implementation Plan, A Component of the North American Waterfowl Management Plan.

City of Elk Grove (CEG). 2000. East Franklin Specific Plan. http://www.egplanning.org/projects/eastfranklin_sp/index.html Viewed on July 21, 2006.

City of Elk Grove (CEG). 2006. Community Profile, Residential. http://www.elkgrovecity.org/economic-development/ Viewed on June 26, 2006.

Cogswell, H.L. 1977. Water birds of California. University of California Press, Berkeley. 399pp.

Eckert, A.W. and K.E. Karalus. 1981. The wading birds of North America. Doubleday and Co., Garden City, NY. 252 pp.

Executive Order 13112. 1999. Invasive Species. Federal Register vol. 64, No. 25. February 8, 1999.

Fitch, H.S. 1941. The feeding habits of California garter snakes. California Department of Fish and Game 27:1-32.

Garrett, K. and J. Dunn. 1981. Birds of southern California. Los Angeles Audubon Society 408pp

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna No. 27, 608 pp.

Hart, J.A. 1999. Draft North Stone Lake Restoration and Management Master Plan. HART Inc. 82 pp.

Heady, H. F. 1977. Valley grassland. Pages 491-514 In M. G. Barbour and J. Major, eds. Terrestrial vegetation of California. John Wiley and Sons, New York.

Heady, H. A. 1988. Valley grassland. Pages 491–514. M. G. Barbour and J. Major, editors. Terrestrial vegetation of California. Wiley Interscience, John Wiley and Sons, New York, New York, USA.

Helm, B. 1998. The biogeography of eight large branchiopods endemic to California. Pages 124–139 in C. W. Witham, E. Bauder, D. Belk, W. Ferren, and R. Ornduff (eds.), Ecology, conservation, and management of vernal pool ecosystems – proceedings from a 1996 conference. Sacramento, CA: California Native Plant Society.

Ivey, G.L. and C.P. Herziger. 2001. Distribution of greater sandhill crane pairs in California 2000. California Department of Fish and Game. Sacramento, California.

James, A.H. 1977. Sandhill cranes breeding in Sierra Valley, California. West Birds 8:159-160.

Jones and Stokes Associates, Inc. 1989. Urban Forest Master Plan for the Buffer Lands Surrounding the Sacramento Regional Wastewater Treatment Plant. (JSA 88-078.) Sacramento, CA. Prepared for County of Sacramento, Department of Public Works, Sacramento, CA.

Jones, Roger, B. Young, and T. Faith. 1994. 1992 - 1994. Summary of Bufferlands Fish Sampling Program 1992-1994.

Johnsgard, P.A. 1975a. North American game birds of upland and shoreline. University of Nebraska Press, Lincoln. 183 pp.

Katibah, E.F. 1984. A brief history of riparian forests in the Central Valley of California in California Riparian Systems: Ecology, Conservation, and Productive Management. Edited by R.E. Warner and K.M. Hendrix. University of California Press, California. Pages 23-29.

Kroeber, A.L. 1932. The Patwin and Their Neighbors. University of California Publications I American Archaeology and Ethnology 29 (4):254:-23.

Kuminoff, Nicolai V., Alvin D. Sokolow, Ray Coppock, George E. Goodman, Greg Poseley and Susan Kester. 2000. Agriculture in the Sacramento Region: Trends and Prospects. Materials and summary from the forum: The Future of Agriculture in the Sacramento Region held February 14, 2000.

Littlefield, C. D., and G. L. Ivey. 2002. Washington State Recovery Plan for the Sandhill Crane. Washington Department of Fish and Wildlife, Olympia, Washington. 71 pages.

McCaskie, G., P. De Benedictis, R. Erickson, and J. Morlan. 1979. Birds of northern California, an annotated field list. 2nd ed. Golden Gate Audubon Society, Berkeley. 84 pp.

Merriam, C.H. 1907. Distribution and Classification of the Mewan Stock of California. American Antiquity n.s. 9:338-357.

National Wildlife Refuge Association (NWRA). 2002. Silent Invasion. National Wildlife Refuge Association. Washington D.C.

Pacific Flyway Council. 1997. Pacific Flyway management plan fro the Central Valley Population of Greater Sandhill Cranes, Pacific Flyway Comm. [c/o Pacific Flyway Representative USFWS], Portland, OR 97232. Unpubl. Rept. 44 pp. + appendices.

Polite, C. 2000. Swainson's Hawk (*Buteo swainsoni*), California's Wildlife Volume II: Birds, Report B121 (Updates from Zeiner, D.C., W.F. Laudenslayer, Jr., and M. White, Eds., 1988-1990), California Department of Fish and Game, Sacramento.

Remsen, J.V., Jr. 1978. Bird species of special concern in California. Calif. Dept. of Fish and Game, Sacramento. Wildl. Manage. Admin. Rep. No. 78-1. 54 pp.

Riparian Habitat Joint Venture (RHJV). 2004. Version 2.0. The Riparian Bird Conservation Plan: a Strategy for Reversing the Decline of Riparian Associated Birds in California. California Partners
in Flight. http://www.prbo.org/calpif/pdfs/riparian.v-2.pdf.
Viewed on June 26, 2006.

Robins, J.D., and J.E. Vollmar. 2002. Livestock grazing and vernal pools from Wildlife and Rare Plant Ecology of Eastern Merced County's Vernal Pool Grasslands, IN: Wildlife and Rare Plant Ecology of Eastern Merced County's Vernal Pool Grasslands. Merced County Natural Community Conservation Plan and Habitat Conservation Plan.
http://www.mercednccp-hcp.net/vollmar/
Viewed on June 26, 2006.

Rossman, D.A., N.B. Ford, and R.A. Siegel. 1996. The garter snakes: evolution and ecology. University of Oklahoma Press, Norman. 332 pp.

Sacramento Area Council of Governments (SACOG). 2001. Documentation: Projections for Population, Housing, Employment and Primary/Secondary Students.

Sacramento County (Sacramento County). 2000. Environmental Impact Report - East Franklin Specific Plan and Associated Rezones and Subdivisions Maps Known as Jungkeit Dairy, Laguna Creek South, Franklin Meadows, Laguna Meadows, and JAS Development. Volume 1 of 3.

Sacramento County Department of Agriculture (Sacramento County). 1999. Agricultural crop and livestock report. 1999. Sacramento, CA.

Sacramento County Department of Agriculture (Sacramento County). 2002. Agricultural crop and livestock report. 2002. Sacramento, CA.

Sacramento County Division of Public Health (Sacramento County). 2006. 2005 Summary of West Nile Virus Activity in Sacramento County.
http://www.sacdhhs.com/article.asp?ContentID=1402
Viewed on July 21, 2006.

Sacramento Forecast Project (SFP). 2006. Sacramento County Economic Forecast.
http://www.csus.edu/indiv/j/jensena/sfp/sa11/sac5/sac/sacramen.htm#C
Viewed on June 20, 2006.

San Francisco Estuary Project (SFEP). 2000. State of the Estuary 2000, Restoration Primer. S.F. Estuary Project, Oakland, CA.

Smithsonian Zoological Park. 2006. Western Riparian Systems: Magnets for Migrants. Written by John Sterling http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Fact_Sheets/default.cfm?fxsht=5
Viewed on August 11, 2006.

Stebbins, G. Ledyard. 1965. Colonizing species of the native California flora. In The Genetics of Colonizing Species, Academic Press, NY, pp. 173-191.

Terres, J.K. 1980. The Audubon Society encyclopedia of North American birds. A. Knopf, New York. 1100 pp.

Thomas, Carmen. 1997. Contaminant Concentrations in Water, Sediment, and Biota from Stone Lakes National Wildlife Refuge. U.S. Fish and Wildlife Service, Environmental Contaminants Division, Sacramento Fish and Wildlife Office. 34 pp.

Thomas, C.M., and T.C. Maurer. 2003. Toxicity of Stormwater Runoff at Stone Lakes National Wildlife Refuge, 1999-2000, Final Report, Investigation No.: 199910003, U.S. Department of the Interior, Fish and Wildlife Service, Portland, Oregon.

Tremaine, K.J. 1997. Revisiting Archaeological Sites CA-SAC-85 and 86 within the Stone Lakes National Wildlife Refuge, Sacramento County, California. June 1997. U.S. Fish and Wildlife Service Document. 83 pp.

U.S. Army Corps of Engineers. 1987. Morrison Creek Stream Group, California – Beach-Stone Lakes Reconnaissance Report. Sacramento, CA.

U.S. Census Bureau (USCB). 2000. Census 2000 Redistricting Data (Public Law 94-171) Summary File.
http://factfinder.census.gov
Viewed on June 20, 2006.

U.S. Census Bureau (USCB). 2006. State and County Quick Facts, Sacramento County, California.
http://quickfacts.census.gov
Viewed on June 20, 2006.

U.S. Department of Commerce (USDOC). 2006. U.S. Census Bureau News: Released 12:01 a.m. (EDT), June 21, 2006.

U.S. Environmental Protection Agency (USEPA). 2006. Green Book Non-Attainment Areas.
http://epa.gov/air/oaqps/greenbk/index.html
Viewed on June 29, 2006.

U.S. Fish and Wildlife Service (USFWS). 1992. Environmental impact statement with appendices for Stone Lakes National Wildlife Refuge Project, Sacramento County, California; Final. With technical assistance provided by Jones & Stokes Associates, Inc. (JSA 91-047.) Sacramento, CA.

U.S. Fish and Wildlife Service (USFWS). 1993. Determination of threatened status for the giant garter snake. Federal Register 58(201):54053-66.

U.S. Fish and Wildlife Service (USFWS). 1994. 50 CFR Part 17. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Conservancy Fairy Shrimp, Longhorn Fairy Shrimp, and the Vernal Pool Tadpole Shrimp; and Threatened Status for the Vernal Pool Fairy Shrimp. Federal Register Notice Vol. 59 Number 180. September 19, 1994.

U.S. Fish and Wildlife Service (USFWS). 2003a. Stone Lakes National Wildlife Refuge Bird List. May 2003.

U.S. Fish and Wildlife Service (USFWS). 2003b. Stone Lakes Contaminant Assessment Process Final Report. Service Database. 19 February 2003b

U.S. Fish and Wildlife Service (USFWS). 2003c. 50 CFR Part 17. Plants; Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Final Rule. Federal Register Notice Vol. 68 Number 151. Aug 6, 2003.

U.S. Fish and Wildlife Service (USFWS). 2003d. Toxicity of Stormwater Runoff at Stone Lakes National Wildlife Refuge, 1999-2000, Final Report, Investigation No.: 199910003. July 2003.

U.S. Fish and Wildlife Service (USFWS). 2004. Monitoring and Reporting Program Plan: San Luis National Wildlife Refuge Complex. Environmental Contaminants Division, Sacramento Fish and Wildlife Office, Sacramento, CA.

U.S. Fish and Wildlife Service (USFWS). 2006. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Sacramento, CA.
http://www.fws.gov/sacramento/es/recovery_plans/vp_recovery_plan_links.htm
Viewed on June 26, 2006.

Vanicek, C. David. 1992. Memorandum, Dec 2, 1999 to Tom Harvey.

Wylie 1997. Biological Resources Division (BRD) survey for the giant garter snake.

Personal Communications

Geupel, Geoff. Point Reyes Bird Observatory (PRBO). 2003.

Ivey, Gary. Private Consultant. 2003.

Marty, J. 2004. Biological Resources Division (BRD). Science Talk, September 2004.

Treiterer, Beatrix. U.S. Fish and Wildlife Service (USFWS). September 2004, July 2006.

Appendices

Appendix A. Compatibility Determinations

Compatibility Determination for Recreational Fishing on the Stone Lakes National Wildlife Refuge

Use: Fishing

Refuge Name:

Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority(ies):

Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, and the Endangered Species Act of 1973. The approved refuge boundary contains about 18,000 acres, of which the Service owns or manages approximately 6,000 acres. Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: the California Environmental License Plate Fund, the Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), the North American Wetland Conservation Act, the Land and Water Conservation Fund, the Sacramento County Environmental Mitigation Grant/Packard Foundation, the Central Valley Improvement Act, the National Fish and Wildlife Fund, the Trust for Public Land Grant/Packard Foundation, the City of Sacramento and the CalFed Bay Delta Program.

Refuge Purpose(s):

Stone Lakes NWR purposes include:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. § 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission: The mission of the National Wildlife Refuge System (System) is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:

Fishing is one of six priority public uses (i.e., hunting, fishing, wildlife observation, photography, environmental education and interpretation) identified in the National Wildlife Refuge System Improvement Act of 1997. Fishing has occurred within the Stone Lakes Basin and surrounding Delta waterways since prior to European settlement of the region. The visitor use program in the CCP proposes to open portions of the Refuge to fishing from boats from June through September and to expand visitor opportunities for wildlife-dependent recreation (USFWS 2006a). Due to limitations in parking space, launching sites, and the navigability of Refuge waterways, only cartop, hand-launched boats, such as canoes and kayaks will be permitted. Gas-powered outboard motors will not be allowed and a no wake zone will be enforced but use of electric motors will be possible in the South Stone Lake unit. Fishing will not include take of frogs or crayfish and will only be with rod and reel. The Service does not intend to allow bank fishing on the Refuge, due to a number of concerns, including: erosion of banks and other habitat impacts from trampling of vegetation, lack of staff to monitor use, and lack of infrastructure such as piers or platforms.

Game fish species to be allowed for legal take will include all native and introduced species listed in the California Freshwater Sport Fishing Regulations (e.g., bass, catfish, crappie, bluegill, sunfish, shad, carp). Fishing will be permitted in accordance with State and Federal regulations to ensure it will not interfere with conservation of fish and wildlife and their habitats. An informational kiosk with maps and brochures on regulations, health warnings, species identification, and Refuge boundaries will be available near the boat launch area. Chapter 5 of the Comprehensive Conservation Plan, Refuge Vision, Goals and Objectives, is herein incorporated by reference.

Availability of Resources:

Staff necessary to oversee the Refuge fishing program will be shared with other programs as described in the Draft Stone Lakes NWR CCP (USFWS 2006a). Shared staff member(s) would be sufficient to operate the modest program described in this plan. Facilities to support the program will require capital outlays and recurring costs however, some of the costs will be available through other visitor use programs, such as wildlife observation and photography. If unexpected costs arise, such as the need for more enforcement or higher than expected maintenance needs, we will reevaluate the program and make necessary adjustments, such as seeking volunteers or other partnerships to maintain facilities and administer the program.

Item	One Time Cost	Recurring Costs
Boat Ramp	$30,000	$5,000
Parking Area	$20,000	$5,000
Maintenance of Parking Lots and Boat Launches	N/A	$5,000
Maintenance (0.50 FTE)	$26,000	$26,000
Restroom	$50,000	$2,000
Law Enforcement (0.50 FTE)	$25,000	$25,000
Administration	$2,000	$2,000
TOTAL	**$153,000**	**$70,000**

Anticipated Impacts of the Use(s):

Impacts are discussed in detail in the Environmental Assessment for the Draft Comprehensive Conservation Plan (USFWS 2006). Fishing and other human activities may cause disturbance to wildlife (Burger 1981) and the cumulative effects of this expanded use will likely have effects on habitat and the fisheries resource (Buckley and Buckley 1976, Glinski 1976, Miller et al. 1998, Reijnen and Foppen 1994, Smith and Hunt 1995). Fishing

may result in increased problems with vandalism and litter such as discarded monofilament line and tackle. Because few native fish species are found at Stone Lakes, and non-native game species are plentiful, the impact on the native fishery is not expected to be significant.

Federally-listed species that may occur on the Refuge include the giant garter snake, valley elderberry longhorn beetle, and the vernal pool tadpole and fairy shrimp (USFWS 2006b). No impacts to vernal pool species are anticipated from fishing because fishing will be permitted only on waterways of the Beach Lake, North Stone Lake and South Stone Lake units where there are no vernal pools. State-listed species that may inhabit the Refuge include greater sandhill crane and Swainson's hawk. The most sensitive period for Swainson's hawk is during the nesting season, typically mid-February through July. Likely nesting areas would be closed to visitors during the nesting season. Impacts to greater sandhill cranes are not anticipated since the fishing season does not coincide with wintering crane use at the Refuge.

The following measure will be taken to avoid impacts to fish and wildlife:
- Provide printed materials to inform anglers about fishing regulations and boundaries of fishing areas;
- Maintain parking areas, roads, and boat launches to prevent erosion or habitat damage;
- Monitor fishing to ensure that facilities are adequate and wildlife disturbance is minimal;
- Prohibit gas-powered watercraft to protect water quality and submerged vegetation;
- Implement a seasonal closure from October through May to reduce disturbance to wintering, nesting, resting, and foraging birds and other wildlife, their habitats, and public engaged in other wildlife-dependent uses;
- Prohibit watercraft within 0.25 miles of occupied Swainson's hawks nests until the young have fledged (i.e., 2nd half of July);
- Refuge law enforcement staff will randomly check anglers for compliance with state fishing laws and refuge-specific fishing regulations; and
- Comply with all measures identified in the CCP Section 7 Consultation to minimize or eliminate conflicts with federally-listed or non-target species.

Public Review and Comment:

Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment on the CCP and this CD. Following the public review and comment period, comments and actions taken to address comments will be summarized here.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Fishing will be permitted at Stone Lakes NWR with the following stipulations:
- Fishing will be conducted exclusively from boats
- No trailered boats will be permitted. Cartop, hand-launched boats with or without electric motors will be permitted; gas motor boats will not allowed;
- No vehicles will be allowed in boat launch areas;
- All closed areas will be identified in printed materials provided to anglers and posted and patrolled to prevent trespass through adjacent properties;
- Littering regulations will be strictly enforced;
- Use or possession of alcohol while sport fishing will be prohibited;

- No building or maintaining of fires will be permitted on the Refuge;
- The Sun River Unit will be closed to fishing during the waterfowl hunting season; and
- Fishing will be allowed during daytime hours only.

The Refuge Manager will have authority to close certain areas during critical wildlife use periods and cancel any activities deemed necessary to fulfill Refuge purposes or ensure visitor safety. Sensitive nesting areas will be protected from disturbance by visitors with signs and barriers. Visitors will be directed away from areas where major habitat restoration or management projects are under way.

Justification:

Fishing is an appropriate wildlife-dependent recreational activity. Based upon biological impacts described in the Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, it is determined that fishing within the Refuge will not materially interfere with or detract from the purposes for which the Refuge was established.

Fishing is a priority wildlife-dependent visitor use provided for in the National Wildlife Refuge System Improvement Act of 1997. By facilitating this use on the Refuge, we hope to increase the visitors' knowledge and appreciation of fish and wildlife, which may lead to increased public stewardship of wildlife and their habitats on the Refuge. Increased public stewardship will support and complement the Service's actions in achieving the Refuge's purposes and the mission of the National Wildlife Refuge System. This program as described is determined to be compatible and will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Reevaluation Date (provide month and year):

Aug 2021 Mandatory 15-year Reevaluation Date (for priority public uses)

_____ Mandatory 10-Year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

Conducted with Comprehensive Conservation Plan

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

__X____CCP Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

References Cited:

Buckley, P. A. and F. G. Buckley. 1976. Guidelines for protection and management of colonially nesting waterbirds. North Atlantic Regional Office, National Park Service, Boston, MA. 52pp.

Burger, J. 1981. The effect of human activity on birds at a coastal bay. Biol. Cons. 21:231-241.

Glinski, R. L. 1976. Bird watching etiquette: the need for a developing philosophy. Am. Bird 30(3):655-657.

Miller, S. G., R. L. Knight, and C. K. Miller. 1998. Influence of recreational trails on breeding bird communities. Ecol. Appl. 8:162-169.

Reijnen, R. and R. Foppen. 1994. The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for willow warbler (*Pylloscopus trochilus*) breeding close to a highway. J. Appl. Ecol 31: 85-94.

Smith, L. and J. D. Hunt. 1995. Nature tourism: impacts and management. Pp. 203-219 in Knight, R. L.; Gutzwiller, K. J. (Wildlife and recreationists: coexistence through management and research, eds.). Island Press, Washington, D. C.

U.S. Fish and Wildlife Service (USFWS). 2006a. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, 2006. U. S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2002b. Biological Opinion for the Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan. U.S. Fish and Wildlife Service, Sacramento, California.

Refuge Determination:

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence:

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for Wildlife Observation and Photography on the Stone Lakes National Wildlife Refuge

Use: Wildlife Observation and Photography

Refuge Name:
Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority:
Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, and the Endangered Species Act of 1973. The approved refuge boundary contains about 18,000 acres, of which the Service owns or manages approximately 6,200 acres. Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: California Environmental License Plate Fund, Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), North American Wetland Conservation Act, Land and Water Conservation Fund, Sacramento County Environmental Mitigation Grant/Packard Foundation, Central Valley Project Improvement Act, National Fish and Wildlife Foundation, Trust for Public Land Grant/ Packard Foundation, the City of Sacramento, and CalFed Bay Delta Program.

Refuge Purpose(s):
Stone Lakes NWR purposes include:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. § 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use(s):
Wildlife observation and photography are two of the six priority visitor uses (e.g., hunting, fishing, wildlife observation and photography, environmental educations and interpretation)

identified in the National Wildlife Refuge System Improvement Act of 1997. Currently, visitor access to Stone Lakes National Wildlife Refuge (Refuge) is limited to two days per month and as a result the expectations of the visiting public are not being met. The Refuge proposes to provide adequate facilities to observe, photograph and enjoy wildlife and natural habitats during daylight hours in all seasons of the year

The Refuge would provide opportunities for wildlife observation and photography by constructing approximately 4.6 miles of universally accessible trails on the Headquarters, North Stone Lake and South Stone Lake Units, two photography blinds and two viewing platforms, expanding entrance roads and parking areas, and by offering boat access and guided tours to areas of interest, including vernal pools and wetlands. For additional details about this proposed use, please see the Stone Lakes National Wildlife Refuge Final Comprehensive Conservation Plan (USFWS, 2006) which is herein incorporated by reference.

Availability of Resources:

Staff necessary to oversee the wildlife observation and photography programs will be shared with other programs described in the 2006 Draft CCP for Stone Lakes NWR. To fully implement this program as described in the CCP, significant increases in staff and, capital outlays, and recurring costs will be necessary. Facilities and materials to support the program will require capital outlays and recurring costs, however, some of the costs will be shared with other visitor used programs. If unanticipated costs arise, the program will be reevaluated and necessary adjustments made such as seeking volunteer or cooperator assistance to maintain facilities or applying for educational grants.

Item	One Time Cost	Annual Costs
Photo Blinds (HQ, North Stone Lake)	$ 30,000	$ 2,500
Viewing Platforms (HQ, North Stone Lake)	$620,000	$ 5,000
Parking Areas (HQ, North Stone Lake)	$520,000	$ 5,000
Trails		
2.6 miles at South Stone Lake Unit	$150,000	$15,000
2 miles at Headquarters Unit	$400,000	$10,000
Boardwalks		
1500 feet at Sun River	$1,590,000	$ 7,000
200 feet at HQ	$200,000	$ 2,500
Entrance Road Sun River Property	$400,000	$ 5,000
Restrooms (HQ, Sun River, Lewis)	$150,000	$ 6,000
Park Ranger (0.5 FTE)	$ 25,000	$ 5,000
Maintenance Staff (0.5 FTE)	$ 26,000	$26,000
Administration	$2,000	
TOTAL	**$4,113,000**	**$89,000**

Anticipated Impacts of the Use(s):

Human activity may disturb migratory birds utilizing the Refuge's habitats for feeding or nesting. Off-trail human activity in habitat restoration areas can slow restoration efforts through soil compaction, vegetation trampling and the introduction of invasive plants. Litter discarded by visitors can entangle wildlife or be ingested, resulting in injury or death. The construction and maintenance of trails and boardwalks may impact soils, vegetation, and in some instances hydrology around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition and sediment loading (Cole and Marion 1988).

Federally-listed species that may occur on the Refuge include the giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole and fairy shrimp. No impacts to vernal pool species are anticipated from wildlife observation and photography. California state-listed species that inhabit the Refuge include greater sandhill crane and Swainson's hawk. The primary disturbance season for Swainson's hawk is during their nesting season, typically mid-February through July. Prime nesting habitat would be closed to visitors during the nesting season.

Of the wildlife observation techniques, wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop to view species, wildlife photographers are more likely to approach wildlife (Klein 1993). Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time, in an attempt to habituate the wildlife subject to their presence (Dobb 1998) and the tendency of casual photographers, with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails. This usually results in increased disturbance to wildlife and habitat, including trampling of plants. Impacts of wildlife observation and photography are also discussed in the Compatibility Determination for environmental education and interpretation.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and Service responses will be summarized here.

Determination (check one below):

_____ Use is Not Compatible

_X_ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

To allow visitor access to the Refuge for wildlife observation and photography, the following measurers would be taken:

- By 2008, interpretive signs and an orientation kiosk will be installed on the Headquarters Unit of the Refuge to inform visitors about Refuge habitats and wildlife and how to minimize adverse impacts. Access to the Refuge will be allowed only between sunrise and sunset, unless a permit for alternative hours is issued by the Refuge Manager in advance.

- The main kiosks on the Headquarters Unit and South Stone Lake units will clearly state the regulations governing wildlife observation and photography on the Refuge and will include the following information:
  (1) a trail map, trail information and regulations;
  (2) a description of the National Wildlife Refuge System; and
  (3) an interchangeable sign for any closures during the waterfowl hunting or Swainson's hawk nesting seasons.

- Trails will be well marked and symbolic fencing will be installed to guide visitor access through sensitive habitats. This will minimize trespass into closed areas and reduce disturbance to nesting birds and other sensitive species.

- The Refuge will maintain an active law enforcement presence to ensure visitor compliance with all Refuge rules and regulations. Refuge law enforcement and other Refuge staff presence will be increased to ensure compliance with Refuge regulations.

Justification: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation and wildlife photography as priority visitor uses for national wildlife refuges, along with hunting, fishing, environmental education and interpretation. In Refuge planning and management, priority uses take precedence over other potential visitor uses. The Service strives to provide priority visitor uses when compatible with the purpose(s) and goals of the Refuge and the mission of the National Wildlife Refuge System (System).

Expanding existing wildlife observation and photography opportunities on the Refuge would allow visitors to experience, enjoy, and learn about native wildlife and plant species in the Central Valley. The Refuge has one of the few remaining natural riparian areas in the valley as well as wetlands, vernal pools, and open water habitats harboring many species of migratory waterfowl, raptors and other wildlife species. Due to its proximity to urban areas, the Refuge attracts a high number of visitors. With management consistent with the stipulations herein, expanding wildlife observation and photography opportunities would substantially increase visitor use and would be compatible with Refuge purposes and the System mission.

Mandatory Reevaluation Date (provide month and year):
__2021__Mandatory 15-year Reevaluation Date (for priority visitor uses)

_____Mandatory 10-Year Reevaluation Date (for all uses other than priority visitor uses)

NEPA Compliance for Refuge Use Decision (check one below):

Conducted with Comprehensive Conservation Plan

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X____Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References Cited:

Cole, D. N. and P. B. Landres. 1995. Indirect effects of recreation on wildlife. Pages 183-201 in R. L.

Cole, D. N. and J. L. Marion. 1988. Recreation impacts in some riparian forests of the eastern United States. Env.Manage. 12:99-107.

Dobb, E. 1998. Reality check: the debate behind the lens. Audubon: Jan.-Feb.

Klein, M. L. 1993. Waterbird behavioral responses to human disturbances. Wildl. Soc. Bull. 21:31-39.

Liddle, M. J. 1975. A selective review of the ecological effects on human trampling on natural ecosystems. Biol.Conserv. 7:17-36.

Morton, J. M. 1995. Management of human disturbance and its effects on waterfowl. Pages F59-F86 in W. R.

U.S. Fish and Wildlife Service (USFWS). 2006. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, 2006. U. S. Fish and Wildlife Service, Sacramento, California.

Refuge Determination

Prepared by: _____ _____
(Signature) Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for Environmental Education and Interpretation on the Stone Lakes National Wildlife Refuge

Use: Environmental Education and Interpretation

Refuge Name:
Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority:
Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, and the Endangered Species Act of 1973. The approved refuge boundary contains about 18,000 acres, of which the Service owns or manages approximately 6,200 acres. Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: California Environmental License Plate Fund, Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), North American Wetland Conservation Act, Land and Water Conservation Fund, Sacramento County Environmental Mitigation Grant/Packard Foundation, Central Valley Project Improvement Act, National Fish and Wildlife Foundation, Trust for Public Land Grant/ Packard Foundation, City of Sacramento, and CalFed Bay Delta Program.

Refuge Purpose(s):
Stone Lakes NWR purposes include:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. § 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "to administer a national network of lands and waters for the conservation, management and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use(s):
Environmental education and interpretation are two of the six priority public uses (e.g., hunting, fishing, wildlife observation and photography, environmental educations and

interpretation) identified in the National Wildlife Refuge System Improvement Act of 1997. Stone Lakes National Wildlife Refuge (Refuge) is one of the few urban refuges in the western region and has the potential to attract thousands of visitors annually from the greater Sacramento area to experience Central Valley habitats including wetlands, grasslands and riparian habitats. Currently, public access to the Refuge is limited to two days per month and as a result expectations of the visiting public are not being addressed.

The Refuge proposes to provide for expanded environmental educational use by: (1)offering staff and/or docent led tours on the Refuge,(2) conducting teacher workshops, (3) developing a class or group staging area, (4) developing a Refuge relevant elementary school curriculum, and (5) exploring the feasibility of a Refuge fee demonstration area.

The Refuge plans to develop an interpretive program by: (1) developing a self-guided trail system, (2) developing interpretive panels and exhibits, and (3) by building an open air interpretive shelter on the Headquarters Unit as part of the Blue Heron Trails project. In addition, the Refuge would develop environmental education and interpretive materials, including fact sheets on particular species and habitats, and an education guide for educators on Central Valley habitat conservation and restoration issues. Additional information about this proposed use are in the Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan (USFWS, 2006) which is herein incorporated by reference.

Availability of Resources: Staff necessary to oversee the Refuge Environmental Education and Interpretation program will be shared with other programs as described in the 2006 Draft CCP for Stone Lakes NWR. Additional staff will be required to fully implement this program, such as an Interpretative Specialist. Facilities and materials to support the program will require capital outlays and recurring costs, however, some of the costs will be shared with other visitor programs. If unanticipated costs arise, the program will be reevaluated and necessary adjustments made, such as securing additional volunteers or financial assistance.

Item	One Time Cost	Recurring Costs
Interpretive Panels	$210,000	$15,000
Kiosks (1 main + 4 small)	$300,000	$5,000
Trails*	$1,630,000	$10,000
Outdoor Rec Planner	$50,000	$50,000
Maintenance Staff	$26,000	$26,000
Administration	$2,000	$2,000
Total	**$2,118,000**	**$108,000**

**Includes "Junior Biologist Trail" at Headquarters Unit, complete with entrance signs, universally accessible trails, entrance kiosk, and interpretive panels.*

Contingent on increased funding and staff identified in the CCP, the Refuge would expand interpretation and environmental education opportunities, as well as generate additional educational materials.

Anticipated Impacts of the Use(s):
Disturbances to wildlife resulting from environmental education and interpretation activities are considered to be of minimal impact because: (1) the total number of students permitted through the reservation system will be limited, (2) students and teachers will be trained in trail etiquette and how to minimize wildlife disturbance, (3) educational groups will be required to have a sufficient adult to student ratio for adequate supervision, (4) trail design will provide adequate cover for wildlife, and (5) observation areas and scopes will be provided to view wildlife at a distance

Human activity may disturb migratory birds utilizing Refuge habitats for feeding or nesting activities. Off-trail human activity in habitat restoration areas can slow restoration efforts through soil compaction, vegetation trampling, and the introduction of invasive plants . Litter discarded by visitors can entangle wildlife or be ingested, resulting in injury or death. The construction and maintenance of trails and boardwalks will impact soils, vegetation and in some instances hydrology around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition and sediment loading (Cole and Marion 1988).

Federally-listed species that may occur on the Refuge include the giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole and fairy shrimp. . No significant impacts to vernal pool species are anticipated from environmental education and interpretation as visitors to vernal pools areas (e.g., Wetland Preserve) will be confined to established trails or led by docents or Refuge staff. California-listed species that inhabit the Refuge include greater sandhill crane and Swainson's hawk. The primary disturbance season for Swainson's hawk is during the nesting season, typically mid-February through July. Prime nesting habitat would be closed to visitors during the nesting season. Impacts are also discussed in Chapter 5 of the Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan (USFWS, 2006).

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and Service responses will be summarized here.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility: In order to allow public access to the Refuge for environmental education and interpretation, the following measurers will be taken:

- Access to the Refuge will be allowed only during daylight hours unless a permit for alternative hours is issued by the Refuge manager. The Refuge manager will have the authority to close certain areas to interpretive programs or to cancel activities to fulfill Refuge purposes.
- Public access will be restricted to areas where the least disruption to wildlife and their habitats would occur. Visitors will be directed to remain a safe distance from nesting areas with signs and barriers. Visitors will be directed away from areas where sensitive habitat restoration projects are underway
- Educators or groups who wish to visit or learn about the Refuge would receive interpretive materials in advance.
- Trails from parking lots to viewing areas will be well marked to minimize trespass through closed areas and reduce disturbance to nesting migratory birds and other sensitive resources.
- The Refuge will maintain an adequate law enforcement capability to ensure public safety and compliance with all rules and regulations.

Justification:

The goals of the National Wildlife Refuge System (System) include providing an understanding and appreciation of fish and wildlife ecology and the human role in the environment and providing Refuge visitors with high quality and safe recreational experiences oriented toward wildlife, to the extent that these activities are compatible with the purposes for which a refuge was established and the mission of the System. Moreover, the National Wildlife Refuge System Improvement Act of 1997 identifies environmental education and interpretation as priority public uses for National Wildlife Refuges, along with hunting, fishing, wildlife observation and photography. As expressed priority uses of the Refuge system, these uses take precedence over other potential public uses in Refuge planning and management. The Service strives to provide priority public uses when compatible with the purpose and goals of the Refuge and the mission of the System.

Environmental education and interpretive programs provide opportunities for the visiting public to learn about and experience native plants, fish and wildlife in their natural habitat. The Refuge can also educate the public about its role within the agency and the National Wildlife Refuge System, developing better community awareness, volunteer involvement and advocacy. The Refuge also has the opportunity to provide the community educational information on habitat restoration, migratory waterfowl and wetland conservation in the Central Valley.

Mandatory Reevaluation Date (provide month and year):

__2021__Mandatory 15-year Reevaluation Date (for priority public uses)

_____Mandatory 10-Year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

Conducted with Comprehensive Conservation Plan

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X____Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References Cited:

Cole, D. N. and P. B. Landres. 1995. Indirect effects of recreation on wildlife. Pages 183-201 in R. L.

Cole, D. N. and J. L. Marion. 1988. Recreation impacts in some riparian forests of the eastern United States. Env. Manage. 12:99-107.

Liddle, M. J. 1975. A selective review of the ecological effects on human trampling on natural ecosystems. Biol.Conserv. 7:17-36.

U.S. Fish and Wildlife Service (USFWS). 2006. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, 2006. U. S. Fish and Wildlife Service, Sacramento, California.

Refuge Determination

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for High-Speed Boating on the Stone Lakes National Wildlife Refuge

Use: High-Speed Boating

Refuge Name:
Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority(ies):
Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, and the Endangered Species Act of 1973. The approved refuge boundary encompasses about 18,000 acres, of which the Service owns or manages 6,200 acres. Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: California Environmental License Plate Fund, Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), North American Wetland Conservation Act, Land and Water Conservation Fund, Sacramento County Environmental Mitigation Grant/Packard Foundation, Central Valley Project Improvement Act, National Fish and Wildlife Foundation, Trust for Public Land Grant/Packard Foundation, City of Sacramento, and CalFed Bay Delta Program.

Refuge Purpose(s):
Stone Lakes NWR purposes include:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. " 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. " 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. " 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. " 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. " 1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:
High-speed boating, primarily associated with waterskiing, has occurred on Refuge waterways since before lands and waterways were incorporated into the National Wildlife

Refuge System as part of Stone Lakes NWR. The high-speed boaters are members of a private club, Beach Lake Ski Club, who launch power boats from privately-owned land within the approved Refuge boundary. Approximately 85 percent of the 2.6 miles of waterway used for waterskiing lies within Stone Lakes NWR in the Beach Lake and North Stone Lake units. The waterway consists of portions of Lower Beach Lake and Southern Pacific Railroad (SP) Cut and is bounded to the west by the abandoned railroad levee and primarily by Refuge lands to the east. Most of the channel is relatively narrow, approximately 200 to 250 feet across but it expands to approximately 750 feet at its widest point. Boaters first pass through 0.47 miles of a privately-owned portion of SP Cut. The remainder of the waterski route lies in 1.0 mile of water owned in fee title by the Refuge and 1.2 miles owned by the state of California and managed by the Refuge under cooperative agreement (see Figure 1).

Standard waterskiing, slalom, wake board, and barefoot waterskiing all occur on Refuge waters. Boats travel up to 45 mph for barefoot waterskiing (American Barefoot Club 2005) and up to 35 mph for slalom waterskiing (USA Waterskiing 2005). Waterskiers modify Refuge aquatic habitat by removing floating and submerged woody snags and debris presenting a navigational and/or safety hazard and by anchoring a slalom course marked by floats and a covered float for docking boats.

Availability of Resources: No additional funding required.

Anticipated Impacts of Use:
Riparian habitat adjacent to Lower Beach Lake and SP Cut on the Beach and North Stone Lake units provides crucial foraging, resting, and breeding habitat for wide variety of migratory songbirds, raptors, and waterbirds including waterfowl, waders, and shorebirds. Raptors such as the California Endangered Species Act listed Swainson's hawk, red-tailed hawk, red-shouldered hawk, and white-tailed kite and colonially-nesting species such as great blue heron, great egret, black-crowned night-heron, snowy egret, and double-crested cormorant, may all nest in the woody riparian habitat adjacent to Refuge waterways and may be affected by high-speed boating. Though motorized boats generally have a greater effect on wildlife, even non-motorized boat use can alter use patterns, reduce use of particular habitats, alter feeding behavior and nutritional status, and cause premature departure by migratory birds from areas (Knight and Cole 1995). In England, an increased rate of disturbance from boats partly caused a decline in roosting numbers of shorebird species (Burton et al. 1996). In addition, boaters have been observed to cause massive flights of diving ducks on the Mississippi River (Thornburg 1973). Motorized boats within 100 meters of shore caused all wintering waterfowl and shorebirds to flush between the craft and shore in south San Diego Bay, regardless of speed (Huffman 1999). Bow wakes of power boats have been reported to tip over free-floating grebe nests as well as other nests near the fringe of reeds (Reichholf 1976). However, disturbance to birds, in general, was reduced when boats traveled at or below the 5 mph speed limit (Huffman 1999).

The visitor use program proposed in the Comprehensive Conservation Plan (CCP) for Stone Lakes NWR (USFWS 2006) includes wildlife viewing and fishing from non-motorized boats in the South Stone Lake, Beach Lake, and North Stone Lake units, including the same portion of the Refuge currently utilized for waterskiing (Beach Lake and North Stone Lake units). High-speed boating will likely not be feasible alongside non-motorized boaters because wakes created while traveling at high speed may represent a significant safety risk to non-motorized boaters (American Canoe Association 2004). Wakes generated by high-speed boaters within SP Cut's narrow, shallow channel cannot readily dissipate and increase in height and steepness as they pass over the shallow nearshore zone that kayakers and canoeists are likely to frequent. Even in cases where high-speed boat wakes do not actually capsize smaller, non-motorized boats, the waves can create instability sufficient to

discourage other boaters using the channel and diminish their experience of the Refuge (C. Courtright, USFWS, pers. comm.). Boats traveling at high speeds in the narrow channel could experience difficulty in ceding the right of way to smaller vessels because they may lack space in which to give an adequate berth to other boats. In order to drive responsibly, previous studies have indicated that waterskiing boats should allow a safety area of 100 feet on either side of the boat (Bostian 2005. USCG 2006). Where Refuge channels are less than 250 feet wide, a high-speed boat would not be expected to be able to safely share the waterway with non-motorized craft.

Opportunities for wildlife observation and photography the Refuge proposes to offer visitors on waterways in the Beach and North Stone Lake units would also be negatively impacted by waterskiing because the noise and speed associated with high-speed boating disturbs and displaces wildlife. Moreover, visitors to wildlife refuges and natural areas typically seek a natural experience and their wildlife observation experience would be diminished by noise. Previous monitoring has indicated that non-motorized boaters find power boats to be obtrusive and disruptive of their experience (Pinto, A. 2002).

Wakes generated by power boats are also known to cause levee erosion (U.S. Army Corps of Engineers 1997). In non-flow dominated channels, such as SP Cut, boat-generated waves exert the greatest erosive energy against levee banks (Ellis 2002). As a result, concerns have been expressed regarding wakes generated by motorized boats in SP Cut causing significant erosion to the abandoned railroad levee which provides flood protection to Reclamation District 744 (Van Loben Sels 2005, Baxter 2005). Continued high-speed boat traffic could lead to the need for extensive levee repair or even levee failure. Moreover, erosion of the SP Cut levee has resulted in the undermining and toppling of mature riparian trees such as valley oaks, eliminating habitat for an array of wildlife species. Therefore, a no-wake speed limit is warranted to ensure a quality experience for visitors engaging in wildlife-dependent uses, reduce levee erosion, and prevent further loss of property and wildlife habitat.

As part of engaging in high-speed boating within Refuge waters, members of the waterski club periodically remove navigational hazards that may constitute valuable wildlife habitat. These hazards consist largely of submerged snags and floating woody debris which, while hazardous for motorized, high-speed boats, provide valuable basking habitat for western pond turtles (a State and Federal species of concern). In addition submerged snags and floating woody debris provide cover and foraging areas for fish and other wildlife.

Western pond turtle populations are declining throughout most of their range, particularly in Southern California, and the major cause of the decline appears to be the destruction of suitable habitat (Brattstrom 1988, Brattstrom and Messer 1988). The only extensive populations of turtles currently occur in Northern California and Southern Oregon. Despite its name, the western pond turtle is only rarely a pond dweller and prefers the deep, slow-flowing waters of sloughs or pools in rivers (Brury 1986). The quiet waters of SP Cut and Lower Beach Lake are ideal pond turtle habitat. Moreover, recent graduate studies have confirmed that successful nesting by western pond turtles has occurred in tributaries of Lower Beach Lake (S. Oliver, pers. comm.). Other components of optimal turtle habitat include emergent basking sites, emergent vegetation, mud, rocks and logs (Holland 1992). Research conducted on the Trinity River suggests that the preservation and restoration of structural features, such as underwater cover and emergent basking sites, is of prime importance for promoting pond turtle survival (Reese 1998). Removal of snags and floating woody debris for navigational safety purposes degrades the quality of the riparian habitat and is therefore not consistent with Stone Lakes NWR purposes or the National Wildlife Refuge System mission.

Public Review and Comment:
Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment on the CCP and this CD. Following the public review and comment period, comments and actions taken to address comments will be summarized here.

Determination:

__X____Use is Not Compatible

_____Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: Not applicable.

Justification:
High-speed boating is not a wildlife-dependent recreational public use. In light of its adverse effects on Refuge natural resources and the ability of Refuge visitors to engage in wildlife-dependent uses, high-speed boating should not be allowed on Refuge waters. Instead, it is proposed that a no-wake speed limit be enforced for the following reasons:

1) High-speed boaters represent as safety risk to non-motorized boaters within the narrow confines of this waterway.

2) High-speed boating disturbs and displaces wildlife because of noise and wake.

3) Wave action from high-speed boating, in narrow waterways, erodes shorelines and levees and causes loss of woody riparian habitat.

4) High-speed boating may adversely affect wildlife-dependent visitor uses.

5) High-speed boating within Refuge waters necessitates removal of navigational hazards that constitute valuable habitat for special status species and other fish and wildlife.

Refuge staff will cooperate with high-speed boaters to seek alternative sites for waterskiing and to phase out the incompatible use. Other waterskiing sites are available outside the approved Refuge boundary that do not have significant adverse effects on visitors to the Refuge, wildlife and their habitats, or levee integrity.

Mandatory Reevaluation Date (provide month and year): N/A.

_____ Mandatory 15-Year Reevaluation Date (for priority public uses)

_____ Mandatory 10-Year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____Conducted with Comprehensive Conservation Plan

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References Cited:

American Barefoot Club. 2005. 2002 ABC Rulebook. http://barefoot.org/documents/2002ABCRuleBook.PDF

American Canoe Association. 2004. Critical Judgment II: Understanding and Preventing Canoe and Kayak Fatalities. 1996-2002.

Baxter, R. D. 2005. Letter to Stone Lakes National Wildlife Refuge, U.S. Fish and Wildlife Service. California Department of Parks and Recreation. Sacramento, California.

Bostian, Julie. About.com Waterskiing/Wakeboarding. How to Drive a Boat and Ski Responsibly in Traffic. http://waterski.about.com/cs/driverscorner/ht/DriveRespons.html

Brattstrom, B.H. 1988. Habitat destruction on California with special reference to *Clemmys marmorata*: a perspective. pp. 13-24. *In*: H. F. DeLisle, P. R. Brown, B. Kaufman and B. M. McGurty (eds.). Proceedings of the Conference on California Herpetology. Southwestern Herpetological Society, Van Nuys, California.

Brattstrom, B.H. and D.F. Messer. 1988. Current status of the southwestern pond turtle, *Clemmys marmorata pallida*, in southern California. Final Report for California Department of Fish and Game, Contract C-2044. 47 pp. + xii.

Bury, R.B. 1986a. Feeding ecology of the turtle, *Clemmys marmorata*. J. Herpetol. 20(4): 515-521.

Burton, N.H.K., P.R. Evans, and M.A. Robinson. 1996. Effects on shorebird numbers of disturbance, the loss of a roost site and its replacement by an artificial island at Harlepool, Cleveland. Biol. Conserv. 77:193-201.

Ellis, J.T., D.J. Sherman, B.O. Bauer, and J. Hart. 2002. Assessing the Impact of an Organic Restoration Structure on Boat Wake Energy. Journal of Coastal Research. 36:256-265

Holland, D. C. 1991. Distribution and current status of the western pond turtle (*Clemmys marmorata*) in Oregon. Report to the Oregon Department of Fish and Wildlife.

Huffman, K. 1999. San Diego South Bay survey report-effects of human activity and water craft on wintering birds in South San Diego Bay. USFWS report.

Pinto, A. 2002. A case study of the nature of conflict between boaters on the lower Salmon River in Idaho. Master's Thesis. The University of Idaho. May 2002.

Kahlert, J. 1994. Effects of human disturbance on broods of red-breasted mergansers *Mergus serrator*. Wildfowl 15:222-231.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. in Wildlife and Recreationists R.L. Knight and K.J. Gutzwiller, eds.). Island Press, Covelo, California.

Reese, D.A. and H.H. Welsh. 1998a. Habitat use by western pond turtles in the Trinity river, California. Journal of Wildlife Management. 62(3): 842-853.

Reichholf, J. 1976. The influence of recreational activities on waterfowl. Pages 364-369 in M. Smart, ed. Proceedings of the International Conference on the Conservation of Wetlands and Waterfowl, Heiligenhafen, Federal Republic of Germany, 2-6 December 1974. Slimbridger, England: International Waterfowl Research Bureau.

Thornburg, D.D. 1973. Diving duck movements on Keokuk Pool, Mississippi River. J. Wildl. Manage. 37:382-389.

USA Water Ski. 2005. American Water Ski Association, Official Tournament Rules. 2005 http://www.usawaterski.org/pages/divisions/3event/2005AWSARulebook.pdf

U.S. Army Corps of Engineers. 1997. Draft Project Modification Report Prospect Island. Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2006. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment. U. S. Fish and Wildlife Service, Sacramento, California.

Van Loben Sels, R. 2005. Letter to the US Fish and Wildlife Service. Reclamation District #744 Sacramento, California.

Personal Communications

Clay Courtright, US Fish and Wildlife Service, Sacramento, California, June 4, 2003.

Refuge Determination

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for Recreational Boating on the Stone Lakes National Wildlife Refuge

Use: Recreational Boating Associated with Hunting, Fishing, Wildlife Observation, and Photography

Refuge Name:
Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority(ies):
Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the following authorities: Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b)), Fish and Wildlife Act of 1956 (16 U.S.C. 742f(a)(4)), Migratory Bird Conservation Act (16 U.S.C. 715d), and Endangered Species Act of 1973 (16 U.S.C. 1534). Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: the California Environmental License Plate Fund, the Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), the North American Wetland Conservation Act (add USC citation), the Land and Water Conservation Fund (add USC citation),, the Sacramento County Environmental Mitigation Grant/Packard Foundation, the Central Valley Improvement Act (add USC citation), the National Fish and Wildlife Fund (add USC citation), the Trust for Public Land Grant/Packard Foundation, the City of Sacramento, and CalFed Bay Delta Program (add USC citation).

Refuge Purpose(s):
Stone Lakes NWR purposes include the following.

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.' (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:
"The mission of the National Wildlife Refuge System (System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:

The visitor use program proposed in the Comprehensive Conservation Plan (CCP) for Stone Lakes NWR (USFWS 2006a) includes recreational boating that supports priority visitor uses, including hunting, fishing, wildlife observation, photography, environmental education, and interpretation. The recreational boating uses addressed in this compatibility determination consist of car-top, hand-launched boats, such as kayaks and canoes and boats with electric motors, with some restrictions.

Regulation of recreational boating on the Refuge will be managed to minimize safety risks, as well as adverse effects on wildlife, habitat, and other recreational users, particularly those engaged in wildlife-dependent uses. These restrictions will include a no-wake speed limit throughout Refuge waters, seasonal closures, and limitations on use of electric motors. No gas-powered outboard motors will be permitted. The no-wake zone is intended to protect non-motorized boaters, wildlife and wildlife habitat. The restrictions are also intended to protect levees from deterioration by wave action (Baxter 2005, Van Loben Sels 2005) and to reduce noise levels that could adversely affect wildlife.

Waterways open to boating will include South Stone Lake, Southern Pacific Railroad (SP) Cut, and Lower Beach Lake. Boat launch, access, and parking for Lower Beach Lake and SP Cut on the Beach Lake Unit will be from the west end of Elliott Ranch Road. Current facilities are limited to a gravel parking area and an unimproved boat launch. Parking for a maximum of 10 cars and an improved boat launch will be constructed at Elliot Ranch Road, contingent upon available funding. The second boat launch site is on the Sun River property of the South Stone Lake Unit where parking will be expanded to accommodate up to 20 cars. Depending on availability of staff and funding, a new boat haul-out and associated trail and observation blind will be provided at the Lodi Gun club property of the South Stone Lake Unit to be accessible only by boat.

All Refuge waterways will be open for recreational boating from June through September only. Waterways will be closed to recreational boating for the remainder of the year to minimize disturbance to nesting waterbirds and raptors such as herons, egrets, grebes, and Swainson's hawks. Waterways being treated for invasive aquatic weeds (e.g., water hyacinth, Egeria densa) will be closed to boating during herbicide applications. Temporary closures to boating may also be required during particular habitat restoration or management projects. Private vendors wishing to lead boating groups will be required to apply for a Refuge Special Use Permit. Chapter 5 of the Comprehensive Conservation Plan, Refuge Vision, Goals and Objectives, are herein incorporated by reference.

Availability of Resources:

The following funding/annual costs would be required to administer and manage boating activities as described above:

Activity	One-time Costs	Recurring Costs
Improvement of boat ramp and parking LOT	$30,000	
Maintenance of Parking Lots and Boat Launches		$5,000
Maintenance (0.50 FTE)	$26,000	$26,000
Law Enforcement (0.5 FTE)	$25,000	$25,000
Install Signs (includes all public use signs)	$10,000	
Maintain Signs		$5,000
Administration	$2,000	$2,000
TOTAL	**$93,000**	**$63,000**

Funding will be sought through the Service budget process. Other opportunities may include: expanded partnerships with the State and recreational user groups, grants, coordination with other law enforcement agencies, and additional Refuge operations. All funding will be utilized to support a safe, quality public use program as described above.

Anticipated Impacts of Use:

Stone Lakes NWR provides crucial foraging and breeding habitat for wintering migratory birds, including waterfowl, shorebirds, and other waterbirds. Great blue herons, great egrets, double-crested cormorants, and Swainson's hawks, in particular, may be affected by recreational boating since they nest in tall riparian trees adjacent to waterways used by boaters. Though motorized boats generally have a greater effect on wildlife, even non-motorized boat use can alter distribution, reduce use of particular habitats by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). In the Ozark National Scenic Riverway, green heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985). However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964, Huffman 1999, DeLong 2002) and disturbance to birds, in general, is reduced when boats travel at or below the 5 mph speed limit (Huffman 1999). To protect waterbirds and raptors that nest in riparian trees, the Beach Lake and South Stone Lake units will be closed to recreational boating from October through May, during nesting and breeding seasons. Monitoring of nesting great blue herons, Swainson's hawks and other waterbirds will be periodically conducted to assess the impact of recreational boating use.

Federally-listed species that may occur on the Refuge include the giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole, and vernal pool fairy shrimp (USFWS 2006b). No effects on the beetle or vernal pool species are anticipated because recreational boating will occur outside of the habitats of these species. However, giant garter snakes could be affected by vehicular use of the area if they happen to be crossing a roadway. Vehicular speed limits will therefore be enforced within the Refuge to reduce effects to wildlife.

Western pond turtle populations are declining throughout most of their range, particularly in Southern California, and the major cause of the decline appears to be the destruction of suitable habitat (Brattstrom 1988, Brattstrom and Messer 1988). Because of its precipitous decline in numbers, the Western pond turtle has been designated as a Federal and State species of concern. The only extensive populations of turtles currently occur in Northern California and Southern Oregon. Despite its name, the western pond turtle is only rarely a pond dweller and prefers the deep, slow-flowing waters of sloughs or pools in rivers (Brury 1986). The quiet waters of the Beach Lake and South Stone Lake units are ideal pond turtle habitat. Recent graduate studies have confirmed that western pond turtles successfully nest on the Refuge (S. Oliver, pers. comm.). Other components of optimal turtle habitat include emergent basking sites, emergent vegetation, mud, rocks, and logs (Holland 1992). Research conducted on the Trinity River suggests that the preservation and restoration of structural features, such as underwater cover and emergent basking sites, is of prime importance for promoting pond turtle survival (Reese 1998). To occur safely, high-speed boating necessitates removal of snags and other underwater hazards that also provide valuable turtle habitat. However, no such alteration of habitat is necessary to provide no-wake boating opportunities. Nevertheless, canoes, kayaks, and car-top boats with electrical motors can still be expected to have some disturbance effect on turtles by displacing them from basking sites.

Public Review and Comment:
Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and actions taken to address comments will be summarized here.

Determination:

_____ Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:
The following stipulations are required to ensure that recreational boating is compatible:

- A no-wake speed limit will be implemented throughout Refuge waters. Only human-powered canoes and kayaks, and electric-powered car-top boats (that is, non-trailered boats which can be carried on top of, inside of, or in the back of a vehicle and can be hand-launched into the water) will be permitted throughout Refuge waters.

- A seasonal closure from October through May will be implemented to reduce disturbance to wintering, nesting, resting, foraging, and breeding birds and other wildlife, their habitats, and other recreational users, especially those participating in wildlife-dependent visitor uses.

- Removal of snags and floating woody debris for navigational safety purposes will not be permitted.

- Signs will be installed and maintained to mark closed areas, convey seasonal closures, and indicate no-wake regulations on the Refuge.

- Periodic law enforcement will help ensure compliance with speed limit regulations and area closures. Regulations will be described in brochures and posted at Refuge headquarters and at boat launch sites. Recreational boaters are required to be in compliance with all applicable Refuge, U.S. Coast Guard and State of California regulations and laws.

- Boating activities and associated effects will be monitored with regard to waterfowl, shorebirds, birds of prey, other wildlife and their habitats, and other recreational users, especially those participating in wildlife-dependent visitor uses.

- Monitoring data will be used by the Refuge manager in making necessary adjustments in regulations or other aspects of the Refuge boating program and in the periodic reevaluation of this Compatibility Determination.

Justification: Boating itself is not wildlife-dependent recreation, but many wildlife dependent recreational activities (waterfowl hunting, fishing, wildlife observation, photography, and environmental education and interpretation) are associated with boating. A carefully regulated boating program would help the Refuge provide opportunities for wildlife-dependent priority visitor uses, which would contribute toward fulfilling provisions under the National Wildlife Refuge System Administration Act as amended in 1997.

Although boating has a potential to impact wildlife, implementing the prescribed stipulations listed above will reduce many of these impacts. Adequate habitat will be available for

wintering and breeding waterfowl, birds of prey, and other wetland-dependent species because high wildlife use areas will be closed to boating during critical periods. Boating regulations will be maintained and enforced in order to minimize the impact of visitor use on wildlife and wildlife habitat. Thus, migratory birds will find sufficient food resources and resting places so their abundance and use of the Refuge will not be measurably lessened; their physiological condition and production will not be impaired; their behavior and normal activity patterns will not be dramatically altered; and their overall status will not be impaired. The Refuge will also implement a monitoring program to help assess disturbance effects on wildlife and habitat. The impacts associated with boating activities can be reduced through improved outreach and educational information for Refuge visitors involved in these activities.

Mandatory Reevaluation Date (provide month and year):

_____Mandatory 15-Year Reevaluation Date (for priority public uses)

__2016__Mandatory 10-Year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

__X____CCP Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

References Cited:

Baxter, R. D. 2005. Letter to Stone Lakes National Wildlife Refuge, U.S. Fish and Wildlife Service. California Department of Parks and Recreation. Sacramento, California.

Brattstrom, B.H. 1988. Habitat destruction on California with special reference to *Clemmys marmorata*: a perspective. Pp. 13-24 *In:* H. F. DeLisle, P. R. Brown, B. Kaufman and B. M. McGurty (eds.). Proceedings of the Conference on California Herpetology. Southwestern Herpetological Society, Van Nuys, California.

Brattstrom, B.H. and D.F. Messer. 1988. Current status of the southwestern pond turtle, *Clemmys marmorata pallida*, in southern California. Final Report for California Department of Fish and Game, Contract C-2044. 47 pp. + xii.

Bury, R.B. 1986a. Feeding ecology of the turtle, *Clemmys marmorata*. J. Herpetol. 20(4): 515-521.

Burton, N.H.K., P.R. Evans, and M.A. Robinson. 1996. Effects on shorebird numbers of disturbance, the loss of a roost site and its replacement by an artificial island at Harlepool, Cleveland. Biol. Conserv. 77:193-201.

DeLong, A. 2002. Managing Visitor Use & Disturbance of Waterbirds. A Literature Review of Impacts and Mitigation Measures.

Holland, D. C. 1991. Distribution and current status of the western pond turtle (*Clemmys marmorata*) in Oregon. Report to the Oregon Department of Fish and Wildlife.

Huffman, K. 1999. San Diego South Bay survey report-effects of human activity and water craft on wintering birds in South San Diego Bay. USFWS report.

Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Wisconsin Conserv. Dep. Tech. Bull. No. 33. 212pp.

Kahlert, J. 1994. Effects of human disturbance on broods of red-breasted mergansers *Mergus serrator*. Wildfowl 15:222-231.

Kaiser, M.S. and E.K. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. J. Wildl. Manage. 48: 561-567.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. in Wildlife and Recreationists R.L. Knight and K.J. Gutzwiller, eds.). Island Press, Covelo, California.

Reese, D.A. and H.H. Welsh. 1998a. Habitat use by western pond turtles in the Trinity River, California. Journal of Wildlife Management. 62(3): 842-853.

Thornburg, D.D. 1973. Diving duck movements on Keokuk Pool, Mississippi River. J. Wildl. Manage. 37:382-389.

U.S. Fish and Wildlife Service (USFWS). 2006a. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, September 2005. U. S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2006b. Biological Opinion for the Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan (1-8-01-FW-66). U.S. Fish and Wildlife Service, Sacramento, California.

Van Loben Sels, R. 2005. Letter to Stone Lakes National Wildlife Refuge, U.S. Fish and Wildlife Service. Reclamation District #744. Sacramento, California.

Vos, D.K., R.A. Ryder, and W.D. Graul. 1985. Response of breeding great blue herons to human disturbance in North-central Colorado. Colonial Waterbirds 8:13-22.

Refuge Determination

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for Research on the Stone Lakes National Wildlife Refuge

Use: Research

Refuge Name:
Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority:
Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act and the Endangered Species Act of 1973. The approved Refuge boundary contains about 18,000 acres, of which the Service owns or manages approximately 6,200 acres. Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: California Environmental License Plate Fund, Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), North American Wetland Conservation Act, Land and Water Conservation Fund, Sacramento County Environmental Mitigation Grant/Packard Foundation, Central Valley Project Improvement Act, National Fish and Wildlife Foundation, Trust for Public Land Grant/ Packard Foundation, City of Sacramento, and CalFed Bay Delta Program.

Refuge Purpose(s):
Stone Lakes NWR purposes include:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. § 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use(s):
Stone Lakes National Wildlife Refuge (Refuge) periodically reviews proposals for scientific research to be conducted on the Refuge or may recommend possible research topics

to professors or students from nearby academic institutions. Although research is not identified as a priority public use by the National Wildlife Refuge System Improvement Act of 1997, scientific research can benefit Refuge resources and support the purpose of the Refuge and mission of the System. The Refuge proposes to give priority to studies that contribute to the conservation, enhancement, , management, or use of native Refuge fish and wildlife populations and their habitats. Research proposals would be reviewed by Refuge staff or other specialists, as appropriate. Research proposals that met the following criteria, would be given priority consideration for approval:

- Research that would contribute to Refuge conservation, enhancement, management, or visitor use programs;
- Research that would not conflict with other ongoing management, monitoring, or research programs;
- Research that could only be conducted on the Refuge;
- Research that did not result in undue disturbance to Refuge fish and wildlife and their habitats; and
- Research that could be monitored by the Refuge within existing staffing or logistical constraints.

Availability of Resources:

Adequate funding and staff exist to manage research at the Stone Lakes NWR. .

Anticipated Impacts of the Use(s):

Some level of disturbance is expected from many research activities since they commonly occur in areas normally closed to the public and may involve collecting samples or handling fish and wildlife. However, minimal impact to Refuge resources would be anticipated since research studies would be governed by a Special Use Permit (SUP) annually issued by the Refuge. SUP conditions would ensure that impacts to wildlife and habitats are minimized. All projects would be reviewed annually to assess compliance with SUP conditions. Prior to their approval, research proposals would be evaluated to ensure their study design resulted in the least possible level of disturbance to sensitive Refuge resources.

Public Review and Comment:

Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and Service responses will be summarized here.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Research applicants would be required to submit a proposal summarizing:

(1) Objectives of the study;
(2) Justification for the study;
(3) Description of study methodology and schedule;
(4) Description of potential impacts on Refuge fish and wildlife and/or habitats, including short-term and long-term disturbance, injury, or mortality;

(5) Summary of research personnel required and their qualifications/experience;
(6) Status of necessary permits (e.g., scientific collecting permits, endangered species permit),;
(7) Anticipated costs to the Refuge and any requests for Refuge staff assistance; and
(8) Planned deliverables and end products (e.g., reports, publications).

If proposed research methods adversely affect or have the potential to adversely affect Refuge resources, the researcher will be required to implement mitigation measures to minimize potential impacts. Mitigation measures will be included as conditions on the Special Use Permit. Refuge staff will monitor and inspect research projects to assess any unanticipated environmental effects and will have authority to terminate any research project, if necessary. All Refuge rules and regulations will be adhered to by researchers, unless specifically waived under a Special Use Permit issued by Refuge management.

Justification: Well-defined research projects developed in consultation with Service staff, would contribute directly to the conservation, enhancement, protection, management, and use of native Refuge fish and wildlife populations and their habitats. Adequate SUP conditions will be imposed on any research project to ensure that short and long-term impacts on Refuge resources are minimized, Only research that is compatible with the purposes of the Refuge and mission of the System would be permitted on the Refuge

Mandatory Reevaluation Date (provide month and year):

_____ Mandatory 15-Year Reevaluation Date (for priority public uses)

__2016__ Mandatory 10-Year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

Conducted with Comprehensive Conservation Plan

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X____Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References Cited:

U.S. Fish and Wildlife Service (USFWS). 2006. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, 2006. U. S. Fish and Wildlife Service, Sacramento, California.

Refuge Determination

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for Plant Gathering on the Stone Lakes National Wildlife Refuge

Use: Plant Gathering

Refuge Name:
Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority:
Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, and the Endangered Species Act of 1973. The approved refuge boundary contains about 18,000 acres, of which the Service owns or manages approximately 6,200 acres. Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: the California Environmental License Plate Fund, Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), North American Wetland Conservation Act, Land and Water Conservation Fund, Sacramento County Environmental Mitigation Grant/Packard Foundation, Central Valley Project Improvement Act, National Fish and Wildlife Foundation, Trust for Public Land Grant/ Packard Foundation, City of Sacramento, and CalFed Bay Delta Program.

Refuge Purpose(s):
Stone Lakes NWR purposes include:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. § 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "To administer a national network of lands and waters for the conservation, management and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use(s):
The gathering of plants in and around Stone Lakes National Wildlife Refuge by Native Americans occurred historically and continues to be an ongoing use today. Plants are

gathered for a variety of uses; for medicinal uses, ceremonial uses, as food stuffs and for utilitarian or artistic purposes such as basket weaving or cord making. Plants gathered for traditional uses may include; willow bark and branches (*Salix* spp.), mugwort (*Artemisia douglasiana*), tule (*Schoenoplectus acutus* var. *occidentalis*, syn. *Scirpus acutus*), Santa Barbara sedge (*Carex barbarae*), wild rose (*Rosa californica*), indian hemp (*Apocynum cannabinum*), oak acorns (*Quercus* spp.) and others. Plants are gathered during various seasons; acorns, bulbs and berries are gathered in the late summer or fall, while medicinal or ceremonial herbs and basketweaving materials may be gathered in spring. The amount of plant material being harvested is traditionally low and is not expected to increase. Special Use Permits will be issued by the Refuge for plant gathering and access regulated to ensure protection of critical habitat during nesting or breeding periods. The use of Refuge lands for collections is considered to be of vital importance to Native American cultural groups such as the California Indian Basketweavers Association.

For additional details about this proposed use, please see the Environmental Assessment (Appendix C) for the Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan (USFWS 2006) which is herein incorporated by reference.

Availability of Resources: No additional resources will be needed to support this use.

Anticipated Impacts of the Use(s):
Impacts are also discussed in the Environmental Assessment (Appendix C) for the Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan (USFWS 2006) Impacts to habitat and wildlife associated with plant gathering on the Refuge are minimal. The amount of plant material being harvested is small enough not to constitute any meaningful impact on habitat. The level of disturbance to wildlife will vary depending on the season, but is considered to be low overall. The gathering of acorns, berries, bulbs and other plant materials that occurs from late summer through fall will have little or no impact on migratory or nesting birds. Gathering of new plant growth in springtime, herbs for medicinal/ceremonial purposes and willow twigs and bark for basket weaving may coincide with use of the refuge by migratory waterfowl, but as gathering activities are limited, impact is also expected to be limited.

Disruptions to Refuge management may occur if routine herbicide applications for invasive terrestrial weeds require modification due to plant gathering activities. Refuge staff avoid application of herbicides to plants known to be valuable for food, medicinal, ceremonial, and ornamental or other cultural uses. However, this adjustment of management practices is not considered burdensome and will not adversely affect control of invasive weeds or habitat restoration projects.

Federally listed species that may occur on the Refuge include the giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole and fairy shrimp. No impacts to vernal pool species are anticipated from plant gathering since gathering activities will not be occurring on or near the vernal pool Wetland Preserve Unit of the Refuge. State listed species that inhabit the refuge include greater sandhill crane and Swainson's hawk. The primary disturbance season for Swainson's hawk is during the nesting season, typically mid-February through July. Prime nesting habitat would be closed to visitors during the nesting season.

Public Review and Comment:
Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and Service responses to address comments will be summarized here.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible With Following Stipulations

Stipulations Necessary to Ensure Compatibility:
In order to accommodate access to the Refuge for plant gathering, the following measurers will be taken:

Plant gathering activities will be reviewed as part of annual coordination with tribal representatives. If monitoring by the Refuge reveals that impacts from plant gathering have increased so the activity is adversely affecting wildlife or habitat, then permitees will be required to adjust their activities to avoid impacts. Adjustments may include reductions in harvest, changes in timing of gathering, or reductions in numbers of visitors or frequency of visitors.

The Refuge manager will have the authority to close areas within the Refuge during sensitive wildlife use periods and cancel any collecting activities deemed necessary to fulfill Refuge purposes or ensure visitor safety. Sensitive nesting areas will be protected from disturbance by visitors with signs and barriers. Visitors will be directed away from areas where major habitat restoration or management projects are under way.

Justification:
One of the goals of the National Wildlife Refuge System (System) is providing the public an understanding and appreciation of fish and wildlife ecology, wildlife habitat and the human role in the environment. The Service strives to provide priority visitor uses when compatible with the purpose and goals of the Refuge and the mission of the System. The National Wildlife Refuge System Improvement Act of 1997 identifies environmental education and interpretation as priority public uses for National Wildlife Refuges, along with hunting, fishing, wildlife observation and photography. Though plant gathering is not a wildlife-dependent recreational use, it is an activity that contributes to environmental education and awareness. An understanding of plant ecology is essential to successful plant harvesting, thus this activity helps to educate participants about Central Valley habitats, while sustaining cultural practices.

Mandatory Reevaluation Date (provide month and year):

_____ Mandatory 15-year Reevaluation Date (for priority public uses)

__2016__ Mandatory 10-Year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

Conducted with Comprehensive Conservation Plan

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X____Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References Cited:

U.S. Fish and Wildlife Service (USFWS). 2006. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, 2006. U. S. Fish and Wildlife Service, Sacramento, California.

Refuge Determination

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for Mosquito Control on the Stone Lakes National Wildlife Refuge

Use: Monitor and Control Mosquitos

Refuge Name:
Stone Lakes National Wildlife Refuge
Sacramento County, California

Establishing and Acquisition Authority(ies):
Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the authority of the Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, and the Endangered Species Act of 1973. The approved refuge boundary contains about 18,000 acres, of which the Service owns or manages 4,065 acres. Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: the California Environmental License Plate Fund, the Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), the North American Wetland Conservation Act, the Land and Water Conservation Fund, the Sacramento County Environmental Mitigation Grant/Packard Foundation, the Central Valley Improvement Act, the National Fish and Wildlife Fund, the Trust for Public Land Grant/Packard Foundation, the City of Sacramento, CalFed Bay Delta Program.

Refuge Purpose(s):
Stone Lakes NWR purposes include:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. § 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:
Stone Lakes National Wildlife Refuge (Refuge) proposes to continue to collaborate with Sacramento-Yolo Mosquito Vector Control District (District) in monitoring and controlling

mosquitos to address the human health concerns of neighboring communities. The Refuge is located within Sacramento County, 10 miles south of downtown Sacramento and bordered by the city of Elk Grove on the east. The potential for mosquito production in Refuge waters is worrisome to residents, and indeed, urbanized areas adjacent to the Refuge are within the flying range of many species of mosquitos. Because of this, Refuge staff and SYMVCD (District) entered into a Memorandum of Understanding (MOU) in 1993, to establish a framework within which the District may continue to control and abate mosquitos within the Refuge, consistent with the goals and objectives of the Refuge. Both the Refuge and the District agree that biological, cultural and physical mosquito control methods are preferred over chemical methods and that wetlands can be designed and managed to avoid or minimize mosquito breeding. In summary, the MOU provides for: 1) allowing the District to comment on planned Refuge wetland projects, 2) providing the District an annual summary of planned Refuge water management and notification of flood-ups and irrigations, 3) the District providing a proposed annual mosquito abatement operating plan to the Refuge, 4) the Refuge submitting pesticide use permits (PUP's) for mosquito control chemicals requested by the District, 5) providing access for mosquito monitoring and biological control measures such as mosquito fish planting as defined in a Special Use Permit (SUP) and 6) with notification and coordination, application of larvicides or adulticides, when specified thresholds are exceeded.

Many species of mosquitos are known vectors of serious diseases in California. Although 12 mosquito-borne viruses are known to occur in California, only western equine encephalomyelitis virus (WEE) and St. Louis encephalitis virus (SLE) have caused significant outbreaks of human disease (CDHS 2003). WEE tends to be most serious in very young children, whereas elderly people are most at risk to SLE and WNV (CDHS 2003). California is also at risk for West Nile virus (WNV) which was first detected in the summer of 2003 in adult mosquitos in Imperial County and in crows in Orange County. WNV was detected within Sacramento County in 2004, though it has principally affected birds and horses. In 2005, West Nile Virus (WNV) became established in Sacramento and Yolo counties, triggering aggressive and widespread mosquito control efforts. In August of 2005 the number of human WNV cases and rate of infected adult mosquitos were so high that the District conducted aerial applications of pyrethrin over a major portion of Sacramento County (Sacramento County 2006). WEE and WNV can cause serious diseases in horses and emus and WNV kills a wide variety of endemic and imported birds. Mosquito control is the only known practical method of protecting people and animals from WEE, SLE, and WNV (CDHS 2003). With the exception of available vaccines to protect horses against WEE and WNV, there are no known specific treatments or cures for diseases caused by these viruses (CDHS 2003).

Mosquito control at the Refuge follows an ordered succession, using nonchemical treatments first (e.g., water control strategies, vegetation management, mosquitofish, etc.), resorting to chemical treatment only when necessary, as determined through standard mosquito monitoring procedures. Among chemical treatments, adulticides will be used as a last resort. For example, wetlands that have produced large mosquito populations in the past will be flooded as quickly as possible to minimize multiple emergencies that may cause a need for adulticiding. Refuge staff work closely with the District to reduce or eliminate mosquitos on the refuge by means of biological controls and habitat management. The MOU signed by the District and the Refuge outlines an effective biological mosquito suppression program that includes wetland design, water level management recommendations, research partnerships, and the introduction of native and non-native fish that prey on mosquito larvae.

The mosquito species identified by SYMVCD for monitoring and control are *Culex tarsalis*, *Anopheles freeborni*, *Aedes vexans*, *Ochlerotatus melanimon*, *Ochlerotatus nigromaculis*, and *Aedes increpitus*. *Culex tarsalis* is the primary vector of WEE and SLE in California and is also considered to be a significant vector of WNV (CDHS 2003). *Anopheles freeborni* can transmit the malaria parasite to humans and is common in the rice growing regions of California. *Ochlerotatus melanimon* is involved in the encephalitis virus (sleeping sickness) cycle and is a severe outdoor pest (SYMVCD 2004).

Mosquito Monitoring

The District's monitoring activities are designed to estimate the abundance of immature (larvae and pupae) and adult mosquito populations. Monitoring activities that may be conducted on the Refuge include, larval sampling, adult light traps and host-seeking traps, leg counts, wild bird sera testing and chicken sera testing (off the Refuge). The wild bird sera testing is part of an ongoing cooperative program between the District and the Refuge to assess populations of resident and migratory songbirds and their role in the transmission of disease.

Monitoring visits by District staff may occur as often as 3-4 times per week during the summer irrigation (May 1 - July 31) and fall flood-up (August 1 - October 15). If temperatures are above average beyond October 15, District staff may continue to require access to the Refuge for additional monitoring.

Dip counts are used to estimate the numbers of immature mosquitos and to determine the need for mosquito control. The dipper method entails using a long-handled ladle (ca 500 ml) called a dipper to collect water samples from pools potentially serving as mosquito sources. Captured immature mosquitos would be identified taxonomically by skilled technicians. All Refuge wetland units could potentially be monitored using the dipper method. However, the areas of Refuge wetland units that are potential mosquito habitat would be targeted. Target areas would include wetland margins, shorelines and riparian areas.

Light and carbon dioxide traps are used to capture adult mosquitos for monitoring purposes. Light traps are cylinders with a light, fan and collecting jar. The mosquitos are attracted to the light and enter the cylinder. The fan creates an air current that moves the mosquitos into the collecting jar. Carbon dioxide (CO_2) baited traps are used to monitor density of adult mosquitos and to identify adults to species. The trap used is baited with 1-2 kg (2.2–4.4 lbs.) of dry ice next to the trap. A motor and fan on the three inch diameter trap sucks mosquitos down into a container like a modified gallon ice cream carton with tubular surgical stockinet attached to the bottom of the motor housing unit to retain the collected mosquitos.

As part of monitoring conducted by the District for the presence of these viruses, a sentinel chicken flock is maintained in a pen nearby, but not on, Refuge lands. Sentinel chickens are exposed to the environment and to mosquitos moving through the area that may choose to feed on them. Regular blood samples are periodically taken from the chickens to detect any mosquito-vector pathogen activity.

The monitoring activities described above are conducted under a SUP between the Refuge and SYMVCD. The Refuge proposes to allow the SYMVCD to continue these activities under an annual SUP.

Mosquito Control with larvicides/pupacides:

The District proposes to control mosquitos by treating areas infested with larval stages of *Culex tarsalis*; *Ochlerotatus melanimon*, *Oc. nigromaculis*, *Anopheles freeborni* and *Aedes* spp. The threshold for initiating a larval control response will be a density of 0.1 mosquito

larva per 350-ml dipper of water for all species. The District would use the biological larvicides *Bacillus thuringiensis isrealensis* (Bti) and *Bacillus sphaericus* (Bsp) and the insect growth inhibitor methoprene. Use of the petroleum distillate GB1111 as a pupacide was discontinued after 2000 and has been replaced with the monomolecular film Agnique. These treatments would be applied via ground methods.

Bti is a microbial insect pathogen used to control larval stages of mosquitos and black flies. It is a naturally occurring anaerobic spore forming bacteria that is mass produced using modern fermentation technology. Bti produces protein endotoxins that are activated in the alkaline mid-gut of insect species and subsequently binds to protein specific receptors of susceptible insect species resulting in the lethal response (Lacey and Mulla 1990). Bti must therefore be ingested by the target insect to be effective. It is most effective on younger mosquito larval instars but does not affect pupae or adult mosquitos. The District prefers to use Bti because of the low impacts to the environment and non-target organisms and its effectiveness in reducing the numbers of target pests. The Bti formulations Vectobac 12AS or Vectobac G would be employed at the Refuge by the District.

Like Bti, Bsp is a microbial insect pathogen with a similar mode of action (Walton, 1998). Formulated Bsp products used as mosquito larvicides consist of bacterial spores and protein endotoxins. The granular formulation of Bsp, Vectolex CG, would be applied by the District. Both Bti and Bsp may be applied as a spot treatment to small areas or broadcast over larger areas.

Methoprene is a synthetic insect growth regulator (IGR) that mimics juvenile hormones (Tomlin, 1994). It interferes with the insect's maturation stages preventing the insect from transforming into the adult stage, thereby precluding reproduction. Methoprene is a contact insecticide that does not need to be ingested. It is most effective on early larval instars but does not affect pupae or adult mosquitos (ETN 1996). Treated larvae will pupate, but will not emerge as adults. The District proposes to use the formulated methoprene product Altosid in pellets or A.L.L. Growth Regulator.

The monomolecular film, Agnique, reduces water surface tension. This interferes with larval orientation at the air-water interface and/or increases wetting tracheal surfaces, thus suffocating the organism. As the film spreads over the water surface, it tends to concentrate mosquito pupae, which may increase mortality from crowding stress (Dale and Hulsman 1990).

Applications of larvicides may occur anywhere in the wetland and moist soil units of the Refuge. The potential wetland areas for mosquito breeding and consequently mosquito treatment include managed permanent wetlands (106 acres), irrigated pastures (490 acres) and occasionally perennial wetlands (193 acres), totaling approximately 790 acres. The shorelines of open water areas may be treated. In addition, the District will treat ditches, culverts and low areas not classified as wetlands.

The total area of the Refuge that is treated varies with the conditions of each year. Annual precipitation amounts have a direct effect on mosquito populations. During drought years mosquito populations tend to be low, and during wet years mosquito populations tend to be high. The range in area treated in the last five years varied from a low of 104 acres in 2000 to a high of 477 acres in 2004. The majority of the treatments occur from August to October, but applications of larvicides can begin as early as March and extend into November.

Mosquito control with adulticides

The thresholds for adult control are 10 *Culex tarsalis* female mosquitos per light trap night or 100 per CO_2 baited trap per night. Adult mosquitos of the genus *Aedes* are generally determined by landing (leg) counts and adult light trap counts. Landing count thresholds are reached when two or more *Aedes* spp. mosquitos land on an individual during a one-minute interval. Adult mosquito thresholds are generally determined through historical levels of adult mosquitos in the area.

If efforts to control immature mosquitos fail to prevent the adult mosquito population from exceeding thresholds, and WNV and/or WEE or SLE are detected within or near the Refuge, the District proposes to treat infested areas with a mosquito adulticide. The District proposes to continue to use the adulticides Pyrocide 7338 or Scourge (resmethrin), which have synthetic pyrethrins as the active ingredient. Though the District has also proposed usage of the adulticide Trumpet (Naled) if necessary, this particular chemical has not been used at the Refuge to date.

Pyrethrins are non-systemic contact poisons which quickly penetrate the nerve system of the insect and cause paralysis and subsequent death (ETN 1994, Tomlin 1994). A few minutes after application, the insect cannot move or fly away. But, a "knockdown dose" does not mean a killing dose. Pyrethrins are swiftly detoxified by enzymes in the insect. Thus, some pests will recover. To delay the enzyme action so a lethal dose is assured, commercial products are formulated with synergists such as piperonyl butoxide, which inhibit detoxification (Tomlin, 1994). Trumpet (Naled) is a non-systemic, broad-spectrum organophosphate insecticide which affects the nervous system of adult mosquitos and other insects by cholinesterase inhibition. The products SYMVCD proposes, Pyrocide 7338, Scourge and Trumpet, are applied as an ultra-low volume (ULV) fog by ground. To minimize pesticide drift, dispersing vehicles will follow routes on existing roads set up to fog downwind or outside buffers of 300 feet from areas supporting listed or proposed special status species. All chemical applications will occur when wind speeds are between 2 and 8 mph.

Adult mosquito control measures were applied only once in 1998 to 5 acres (0.09 gallons of Scourge) and once in 1999 to 4 acres (0.05 gallons of Pyrocide 7338). Both adulticide applications were performed at the same location, at a drain in an agricultural field. That these adulticides have not been necessary in subsequent years can be attributed to the cooperation between Refuge staff and The District, working together to initiate water management procedures and larval control measures, suppressing mosquito larvae populations and preventing adult emergence.

Availability of Resources: Monitoring and control will not require refuge personnel. The District is responsible for coordination of monitoring and control through the Refuge Manager or the Assistant Refuge Manager. In order to monitor treatment of wetland, moist soil and riparian areas, it is estimated that 5% of a full-time employee's time would be required. Monitoring of treatments would include observations of sprayed areas before and after treatment and coordination of permitting, documentation and record keeping. Additional funding would be required if a detailed, long-term study were to be conducted to determine effects of mosquito treatment on Refuge resources.

Anticipated Impacts of the Use: The impacts of monitoring will be confined to pathways to shorelines where dip net samples will be taken. Small areas of vegetation may be crushed in transit to pools of water, but the vegetation will likely spring back after it has been bent under foot. Placing and checking of light or CO_2 traps may also create a transient impact from footsteps on the vegetation going to and from the traps.

Toxicity and Effects to Non-target Organisms
The dominant impact of mosquito control will relate to the toxicity and effects of the treatments on non-target organisms. The possible effects of the larvicides *Bacillus* spp. and methoprene, the pupacide Agnique, and the adulticides will be discussed separately.

Bti
Bti has practically no acute or chronic toxicity to mammals, birds, fish or vascular plants (USEPA 1998). Extensive acute toxicity studies indicated that Bti is virtually innocuous to mammals (Siegel and Shadduck, 1992). These studies exposed a variety of mammalian species to Bti at moderate to high doses and no pathological symptoms, disease, or mortality were observed. Laboratory acute toxicity studies indicated that the active ingredient of Bti formulated products is not acutely toxic to fish, amphibians or crustaceans (Brown et al. 2002, Brown et al. 2000, Garcia et al. 1980, Lee and Scott 1989, Wipfli et al. 1994). However, other ingredients in formulated Bti products are potentially toxic. The acute toxicity response of fish exposed to the formulated Bti product Teknar® HPD was attributed to xylene (Fortin et al. 1986, Wipfli et al. 1994). Field studies indicated no acute toxicity to several fish species exposed to Bti (Merritt et al. 1989, Jackson et al. 2002); no detectable adverse effects to breeding red-winged blackbirds using and nesting in Bti treated areas (Niemi et al. 1999, Hanowski 1997); and no detectable adverse effects to tadpole shrimp 48 hours post Bti treatment (Dritz et al. 2001).

In addition to mosquitos (Family Culicidae), Bti affects some other members of the suborder Nematocera within the order Diptera. Also affected are members of the Family Simuliidae (black flies) and some chironomids midge larvae (Boisvert and Boisvert 2000, Garcia et al. 1980). The most commonly observed Bti effects to non-target organisms were to larvae of some chironomids in laboratory settings when exposed to relatively high doses (Boisvert and Boisvert 2000, Lacey and Mulla 1990, Miura et al. 1980). In field studies, effects to target and susceptible nontarget invertebrates have been variable and difficult to interpret. Field study results are apparently dependent on the number, frequency, rate and aerial extent of Bti applications; the Bti formulation used; the sample type (e.g., benthic, water column or drift); the sampling interval (e.g., from 48 hrs to one or more years after treatment); the habitat type (e.g., lentic or lotic); the biotic (e.g., aquatic communities), and abiotic factors (e.g., suspended organic matter or other suspended substrates, temperature, water depth); the mode of feeding (e.g., filter feeder, predator, scraper or gatherer); the larval development stage and larval density (Ali 1981, Boisvert and Boisvert 2000, Lacey and Mulla 1990). Bti activity against target and susceptible nontarget invertebrates is also related to Bti persistence and environmental fate which are in turn affected by the factors associated with field study results (Dupont and Boisvert 1986, Mulla 1992). Simulated field studies resulted in the suppression of two unicellular algae species, *Closterium* sp. and *Chlorella* sp. resulting in secondary effects to turbidity and dissolved oxygen of aquatic habitats, with potential trophic effects (Su and Mulla, 1999). For these reasons, Bti effects to target and susceptible nontarget organisms and potential indirect trophic impacts in the field are difficult to predict.

Bsp
Bsp has slight to practically no acute mammalian toxicity, practically no acute avian toxicity, slight to practically no acute fish toxicity, and slight aquatic invertebrate toxicity (U.S. Fish and Wildlife Service, 1984, and FCCMC, 1998). Insecticidal activity may persist longer than 20 days because Bsp can reproduce and sporulate in larval cadavers and can retain its larvicidal properties after passing through the gut of a mosquito. Bsp is insoluble in water. Spores and toxin become suspended in the water column and retain insecticidal activity in water with high organic matter content and suspended solids. Because Bsp is a more recently developed larvicide than Bti, there are fewer studies that have examined the

non-target effects of this pesticide. The data available, however, indicate a high degree of specificity of Bsp for mosquitos, with no demonstrated toxicity to chironomid larvae at any mosquito control application rate (Mulla, 1984, Ali, 1986, Lacey, 1990). Therefore risks to sensitive wildlife resources resulting from direct exposure to a single Bsp application and indirect food chain effects are expected to be negligible. However, the ability for a population to re-colonize a wetland following multiple larvicide treatments would depend on the intensity and frequency of applications at different spatial scales.

Agnique (Monomolecular film)

Monomolecular film has practically no acute mammalian or avian toxicity, and slight acute fish toxicity (USEPA 2000, USFWS 1984). The risk quotient for mammals is well below the EPA endangered species level of concern (LOC) indicating negligible risk resulting from direct exposure, Table 1 (Urban and Cook 1986). Risk quotients for birds and fish exceed EPA endangered species LOCs indicating a hazard to those taxa resulting from direct exposure. Risk to fish will be limited by the insolubility of monomolecular film in water. Monomolecular film is insoluble in water, average persistence in the environment is 5 to 14 days (Borgerding 2001). Indirect effects to animals dependent on invertebrate food resources are possible resulting from a reduction of those resources caused by monomolecular film. The magnitude of the impact would depend on the aerial extent of the treatment, the number of treatments, treatment frequency and the location of the treatment relative to the areas used by invertebrate feeding animals.

Table 1. Monomolecular film risk quotients.

Animal	Acute tox (ppm)	EEC (ppm)	RQ	LOC (ES)
bird	> 5000 (8 D LC 50)	850 (short grass)	0.2	0.1
fish	98 (96 hr LC 50)	2600 (6" water)	26.5	0.05
mammal	>20,000 (LD 50)	850 (short grass)	0.004	0.1

EEC calculated using a rate of 0.5 gal/ac (3.6 lbs ai/ac)
LD 50 for mammals converted to 1 Day LC50 using a conversion factor of 0.1 for RQ calculation

Methoprene

Methoprene has moderate acute fish toxicity, slight acute avian toxicity, and practically no acute mammalian toxicity (USEPA 2000, and USFWS 1984). In mallard ducks, dietary concentrations of 30 parts per million (ppm) caused some reproductive impairment (USEPA 1991). This figure exceeds the estimated environmental concentration by a factor 10 (Table 2). Methoprene residues have been observed to bioconcentrate in fish and crayfish by factors of 457 and 75, respectively (USEPA 1991). Up to 95 % of the residue in fish was excreted within 14 days (USEPA 1991). Risk quotients for birds, fish and mammals are below EPA levels of concern for endangered species indicating negligible risk to those taxa resulting from direct exposure using maximum labeled rates for mosquito control (Table 1) (Urban et al. 1986). In field studies no detectable adverse effects to breeding red-winged blackbirds using and nesting in areas treated with methoprene were observed (Niemi et al. 1999).

Methoprene affects terrestrial and aquatic invertebrates and is used to control fleas, sciarid flies in mushroom houses; cigarette beetles and tobacco moths in stored tobacco; Pharaoh's ants; leaf miners in glasshouses and midges (Tomlin 1994). Methoprene may also be fed to livestock in a premix food supplement for control of hornfly (WHO 2006). Methoprene is highly toxic to aquatic invertebrates with a 48 hour EC50 of 0.89 ppm for Daphnia magna (USEPA 1991). Laboratory studies show that methoprene is acutely toxic to chironomids,

Table 2. Risk assessment for Methoprene.

Animal	Acute Tox (ppm)	*EEC (ppm)	RQ	LOC (ES)
Bird	> 4640 (8 D LC 50)**	3.0 (short grass)	0.0006	0.1
Fish	0.4 (96 hr LC 50)	0.01 (6 inches)	0.025	0.05
Mammal	> 34,000 (LD 50)	3.0 (short grass)	0.00001	0.1

*EEC calculated using a rate of 0.013 lbs ai/ac (1.0 fluid oz/ac Altosid 20 % methoprene)
**LD 50 for mammals converted to 1 Day LC50 using a conversion factor of 0.1 for RQ calculation

cladocerans and some decapods, (Horst and Walker 1999, Celestial and McKenney 1994, McKenney and Celestial 1996, Chu et al. 1997). In field studies, significant declines of aquatic invertebrate, mollusk and crustacean populations have been directly correlated to methoprene treatments for mosquito control (Breaud et al. 1977, Miura and Takahashi 1973, Niemi et al. 1999, Hershey et al. 1998).

Methoprene has a ten day half life in soil, a photolysis half life of ten hours, and solubility in water is 2 ppm (Zoecon 2000). Degradation in aqueous systems is caused by microbial activity and photolysis (USEPA 1991). Degradation rates are roughly equal in freshwater and saltwater systems and are positively correlated to temperature (USEPA 1991).

Adulticides

There are only two general classes of adulticides, organophosphates and pyrethroids. The pyrethroids include both natural products called pyrethrins and synthetic molecules that mimic the natural pyrethrins, such as permethrin, resmethrin, and sumithrin. One organophosphate, Trumpet (Naled), is proposed for use at the Refuge but has not been applied to date. The two pyrethroid products proposed for use at the Refuge, Pyrocide 7336 and Sourge, are both synthetic pyrethrins.

In general, pyrethroids have lower toxicity to terrestrial vertebrates than organophosphates. Although not toxic to birds and mammals, pyrethroids are very toxic to fish and aquatic invertebrates (Anderson 1989, Siegfried 1993, Milam et al. 2000). The actual toxicity of pyrethroids in aquatic habitats, however, is less than may be anticipated because of the propensity of these pesticides to adsorb organic particles in water (Hill et al. 1994). Pyrethrins are toxic to all invertebrates, but the method of application via ultra-low volume atomizer limits toxicity and contact with non-targets. To minimize pesticide drift, applications would take place during the evening hours, when wind speeds are reduced and temperatures decreased. The evening is also the period when mosquito activity is the greatest.

Naled is a fast acting, nonsystemic contact and stomach organophosphate insecticide used to control aphids, mites, flies and mosquitos. Naled is highly to moderately toxic via the oral route. It is moderately toxic through skin exposure, may cause skin rashes and skin sensitization and may be corrosive to the skin and eyes. Naled is highly to moderately toxic to birds. The reported acute oral LD50 for naled is 52 mg/kg in mallard ducks, 65 mg/kg in sharp-tailed grouse, 36-50 mg/kg in Canadian geese, 120 mg/kg in ring-neck pheasants. Naled is highly to moderately toxic to fish and may be very highly toxic to aquatic invertebrate species (ETN 1996).

However, Trumpet (Naled) is practically nonpersistent in the environment, with reported field half-lives of less than 1 day. It is not strongly bound to soils and is rapidly broken down if wet. Soil microorganisms break down most of the naled in the soil. It therefore should not present a hazard to groundwater (ETN 1996).

Threatened and Endangered Species

The Refuge provides potential habitat for the following endangered species: giant garter snake, Sacramento splittail, Delta smelt, valley elderberry beetle, vernal pool tadpole shrimp and vernal pool fairy shrimp.

Vernal Pools

The growth regulator Methoprene (Altosid or A.L.L) can have deleterious effects on vernal pool shrimp by delaying the development of adult shrimp and thus the number of eggs laid before the pools dry up (Lawrenz 1984). Because of the effects of Methoprene on fairy shrimp and a lack of information on how long the agent remains in the soil, use of the larvicide methoprene within vernal pools or swales at any time, in either wet or dry conditions, is prohibited (USFWS 2001).

The majority of vernal pools and seasonal swales will be dry during the main pesticide application period (June-October). In general, vernal pool habitats are not significant mosquito-producing habitat and should not require chemical treatments for control of mosquito larvae because they are sufficient predators in naturally functioning vernal pools to keep larval numbers below the treatment threshold. In the event that the use of a larvicide does become necessary in the vicinity of vernal pools, Bti, which is relatively specific to mosquitos and flies, will be the agent of choice.

The majority of the vernal pools at the Refuge occur on the Wetland Preserve property which became part of the Refuge under a conservation easement in 2004. During the spring of 2004, before the conservation easement went into effect, numerous vernal pools were treated with Bti. Relatively warm spring temperatures in 2004 likely contributed to elevated larval populations, but other factors may also be involved. The mosquito abatement district had increased larval monitoring in the area because the Wetland Preserve property is adjacent to a housing development and WNV had recently arrived in Sacramento county. Many of the vernal pools in the Wetland Preserve property are man made mitigation pools that may not be functioning as a naturally occurring vernal pool would. The hydrologic regime and/or diversity and number of invertebrates in man made vernal pools may create more favorable conditions for mosquito larvae in that mitigation pools may hold water longer and may harbor fewer invertebrates that prey on mosquito larvae (Stan Wright, pers. comm.). The increase in grazing that has occurred since the Service assumed management may reduce mosquito larvae populations by increasing water movement in the vernal pools due to wind action. Future mosquito abatement activities in the Wetland Preserve property will be closely monitored by Refuge staff to avoid conflicts between wildlife habitat improvement goals and mosquito control goals.

Giant Garter Snake

Mosquito control activities in giant garter snake habitat may affect giant garter snakes by harassment or injury from vehicle use. The District will only operate vehicles in existing roads; therefore, harassment or injury from vehicle use would occur only if snakes are in the roadway. Regarding the effects of the proposed pesticides, a Fish and Wildlife Service sponsored study indicated that the short-term effects of adulticides approved for mosquito control on the Sacramento NWR Complex did not significantly reduce abundance or biomass of the snake's prey items, macro-invertebrates and fish, in treated wetlands (Lawler et al. 1997). However, no information is available on the toxicity of the proposed pesticides directly to the giant garter snake. Without further information, it must be assumed that exposure of giant garter snakes to these chemicals could result in direct impacts, such as loss or sublethal effects to individual animals. Adverse effects to the giant garter snake from mosquito control activities will therefore be minimized by avoiding any wetland habitat suitable for giant garter snakes while applying chemical treatments for control of mosquitos.

The application of adulticides by dispersal vehicles will be planned to fog downwind of and outside a buffer of 300 feet away from permanent emergent wetlands.

Valley Elderberry Longhorn Beetle
Adverse effects on the valley elderberry longhorn beetle are not likely since the main mosquito abatement period (June-September) does not coincide with the period of adult beetle emergence (late April through mid-May or early June). Also, the riparian corridors that house the valley elderberry longhorn beetle, generally do not require treatment with chemical control agents. If control measures are needed in these areas, some granular applications of Bti or Altocid (Methoprene) may be used during February or March when adult beetles are not present.

Delta Smelt and Sacramento Splittail
Both Delta smelt and Sacramento splittail are not likely to be adversely affected by mosquito abatement activities. Delta smelt and Sacramento splittail have never been recorded within Refuge waterways. In addition, the open water areas of the Refuge in which these species could occur are not considered mosquito production areas and would not be subject to any chemical treatment (USFWS 2001).

In general, species of concern will not be adversely affected by mosquito control activities provided the conservation measures detailed in the Intra-Agency Formal Section 7 Consultation on Pest Management Activities and the stipulations contained herein are followed (USFWS 2001).

Wetlands and Waterfowl
The Refuge was established to provide habitat for migratory birds, in particular waterfowl. The District will continue to minimize disturbance and non-target effects to wildlife by limiting mosquito abatement activities between October 15 and February 15 when the majority of migratory bird species would be arriving on the Refuge. However, since the District continues to treat until temperatures have dropped sufficiently to reduce the abundance of mosquitos, in warmer years there may well be a longer period of overlap between the arrival of migrants and continued mosquito abatement activities. In addition, if mosquito thresholds are exceeded, or the presence of WNV is detected in or around the Refuge, then the District may need to extend mosquito surveillance and control into late fall.

In some years, most notably 2004, the District has applied Bti or planted mosquito fish as early as March when some migratory waterfowl may still be lingering before departing on their spring migration. However, Bti and Bsp have not been found to be toxic to birds (USFWS 2001). In addition, it has been found that birds are not negatively affected by utilizing foods exposed to Bti or methoprene (Niemi et al. 1999). Although physico-chemico data and environmental fate data are limiting, *Bacillus* spp. are virtually non-toxic to mammals, birds and fish. Though methoprene has not been shown to pose a threat to birds from direct exposure, it may affect insectivorous species by decreasing the invertebrate food source. During the last 8 years methoprene has not been applied prior to June and was applied as late as October in only one instance. Thus, applications of methoprene have not directly or indirectly affected migratory birds utilizing the Refuge because migratory birds have not been present during mosquito abatement activities.

There is not likely to be much impact on geese and swans from pesticides because they are year round herbivores. Geese feed mainly on grasses and agricultural lands, while swans feed mainly on roots, tubers, stems, and leaves of submerged and emergent aquatic vegetation. In contrast, ducks are known to be opportunistic feeders on both plants and invertebrates, utilizing the most readily available food sources. Invertebrates, plants,

and seeds compose the majority of their diet, varying with the season and the geographic location. A study in California's Sacramento Valley has shown that plant foods are dominant in fall diets of northern pintails, while invertebrate use increases in February and March (Miller 1987). Seeds of swamp timothy comprise the most important duck food in the summer, dry habitats of the San Joaquin Valley (Miller 1987). Waterfowl in general tend to feed on seeds when they reach their wintering areas, perhaps to regain energy lost during long flights (Heitmeyer 1988, Miller 1987). Thus any food chain impacts resulting from larvicide and adulticide treatment will have limited impacts to the mainly seed diet of newly arriving ducks. Their diet shifts to invertebrates after mosquito treatments are expected to be reduced in frequency, thereby allowing the invertebrate populations to recover.

Resident Waterfowl

Birds utilizing the Refuge during the summer months and early fall, when most of the mosquito abatement occurs, could have a greater risk of being affected by pesticide applications. These species include herons, egrets, white pelicans, mallards and wood ducks. The pesticides being applied at the Refuge have not been shown to be toxic to birds, but could potentially affect resident waterfowl indirectly by reducing invertebrate food sources. Shorebirds could also be of concern, since they feed on a wide variety of invertebrates all year, feeding which intensifies at the onset of spring migration. However, documentation of indirect food-chain effects have not come to light. Hanowski et al. (1997) studied 19 different bird species after collecting data on wetlands two years before treatment and three years after treatment of both Bti and methoprene applications and found no negative effects. Jensen et al (1999) found that no decreases were detected in the biomass or abundance of aquatic invertebrates in seasonal wetlands from ultra-low volume applications of pyrethrin, permethrin or malathion.

Public Review and Comment:

If through monitoring it is determined that targeted mosquito species; 1) are known carriers of Encephalomyelitis viruses and 2) occur in densities that warrant control, the public will be notified. However, given the nature of potential serious health risks and the rapid development of mosquito larvae, applications may occur simultaneously with public notification or before.

Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and actions taken to address comments will be summarized here.

Determination (Check One Below)

_____ Use is not compatible

___X___ Use is compatible

Stipulations Necessary to Ensure Compatibility:

1. The District will notify the Refuge manager as soon as possible when mosquito larval thresholds are exceeded and ground treatment is warranted by calling refuge headquarters.

2. When adult thresholds are exceeded, and in the event of a planned adulticiding or aerial application of any kind, the District will contact and personally coordinate with the Refuge Manager or Assistant Refuge Manager prior to conducting the treatment.

3. The District will notify the Refuge Manager in the event of detection of virus activity within or near the Refuge and the method of disease surveillance yielding positive results.

4. The District will provide the Refuge Manager with an annual report summarizing mosquito control activities during the previous year.

5. The District has and will continue to consider environmental conditions, including water temperature, density of mosquito larvae and presence of mosquito predators, when deciding mosquitos on the Refuge pose a serious threat to human health and whether to treat.

6. Access will be prohibited in closed areas on Wednesdays and Sundays during the waterfowl hunt season.

7. Application of mosquito control measures is to be conducted in accordance with approved Pesticide Use Proposals.

8. Mosquito control will be authorized on an annual basis by a Special Use Permit (SUP). The SUP conditions will stipulate that all mosquito control work will be carried out under the guidance of pre-approved Pesticide Use Proposals.

Justification:

For many years the Refuge has worked cooperatively with the District and its associated mosquito control activities. After a review of these activities, the Refuge has determined that allowing these uses to continue would not interfere or derogate from the purpose for the Refuge, nor the mission of the National Wildlife Refuge System.

The Refuge is located within a 10 mile radius of various urban and rural communities. Species of mosquito like *Culex tarsalis, Anopheles freeborni, Ochlerotatus melanimon* and *O. nigromaculis*, are found on the Refuge and are capable of dispersing various miles to obtain a blood meal. With the exception of *Culex tarsalis*, the remaining fore mentioned species are capable of dispersing 5-10 miles; *Culex tarsali*s is known to disperse over 25 miles. All species are known to be vectors for Saint Louis encephalitis, California encephalitis and western equine encephalitis; additionally, *C. tarsalis* is particularly known to transmit West Nile virus. Mosquito control is conducted on Refuge lands to prevent populations of adult mosquitos from rising to levels that could pose a public health hazard or significant nuisance to neighboring communities, following the guidance of the stipulations within this document. Cooperative efforts between the Refuge and the District have successfully controlled larval mosquito populations on the Refuge to the extent that adulticide applications have only been necessary twice over the last 8 years. Since the approved adulticides are generally more toxic to wildlife and wildlife food sources than larvicides, it is in the best interest of wildlife to minimize adulticide applications.

Because mosquito treatment occurs during the early weeks of fall flood-up before most migratory birds have arrived, and since the frequency of treatments are low and spaced apart on a per unit basis, overall effects to non-target organisms are not expected to be significant. In addition, the number of treatment days per year is fairly low, and if the applicator follows the stipulations previously outlined and within the SUP, mosquito abatement practices should not materially interfere with or detract from the Refuge purpose or the mission of the National Wildlife Refuge System. If additional biological monitoring of this activity documents substantial negative impacts to migratory birds or other wildlife, this determination would be re-analyzed on the basis on new evidence.

Mandatory Re-Evaluation Date (provide month and year):

_____Mandatory 15-year Re-Evaluation Date (for priority public uses)

__2016__Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

___X___ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

Literature Cited:

Ali, A. 1981. *Bacillus thuringiensis* serovar *israelensis* against chironomids and some non-target aquatic invertebrates. Journal of Invertebrate Pathology 38: 264-272.

Anderson, R.L. 1989. Toxicity of synthetic pyrethroids to freshwater invertebrates. Environmental Toxicology and Chemistry 8: 403-410.

Boisvert, M., and J. Boisvert. 2000. Effects of *Bacillus thuringiensis* var. *israelensis* on target and nontarget organisms: a review of laboratory and field experiments. Biocontrol Science and Technology 10: 517-561.

Breaud, T.P., J.E. Farlow, C.D. Steelman, and P.E. Schilling. 1977. Effects of the insect growth regulator methoprene on natural populations of aquatic organisms in Louisiana intermediate marsh habitats. Mosquito News. 37(4); 704-712.

Brown, M.D., T.M. Watson, S. Green, J.G. Greenwood, D. Purdie, and B.H. Kay. 2000. Toxicity of insecticides for control of freshwater *Culex annulirostris* (Diptera: Culicidae) to the nontarget shrimp, *Caradina indistincta* (Decapoda: Atyidae). Journal of Economic Entomology. 93(3): 667-672.

Brown, M.D., J. Carter, D. Purdie, D. Thomas, D.M. Purdie, and B.H. Kay. 2002. Pulse-exposure effects of selected insecticides to juvenile Australian Crimson-Spotted Rainbowfish (*Melanotaenia duboulayi*). Journal of Economic Entomology 95(2):294-298.

California Department of Health Services (CDHS). 2003. California mosquito-borne virus surveillance and response plan.

Celestial, D.M and C.L. McKenney, Jr. 1994. The influence of an insect growth regulator on the larval development of the mud crab *Rhithropanopeus harrisii*. Environmental Pollution. 85: 169-173.

Chu, K.H., Wong, C.K., and Chiu, K.C. 1997. Effects of the insect growth regulator (S)-methoprene on survival and reproduction of the freshwater cladoceran *Moina macrocopa*. Environmental Pollution. 96: 173-178.

Dale, P.E.R. and K. Hulsman. 1990. A critical review of salt marsh management methods for mosquito control, Crit. Rev. in Aquatic Science 3:281–311.

Dritz, D.A., S.P. Lawler, J. Albertson, W. Hamersky, and J.R. Rusmisel. 2001. The impact of Bti on survival of the endangered tadpole shrimp *Lepidurus packardi*. In Proceeding and Papers of the Sixty-ninth Annual Conference of the Mosquito and Vector Control Association of California. Jan. 21-24. pp. 88-91.

Dupont, C. and J. Boisvert. 1986. Persistence of *Bacillus thuringiensis* serovar. *israelensis* toxic activity in the environment and interaction with natural substrates. Water, Air, and Soil Pollution 29:425-438.

Extension Toxicology Network (ETN). 1994. Pyrethrin Pesticide information profile. http://ace.ace.orst.edu/info/extoxnet/pips/ghindex.html

Extension Toxicology Network (ETN). 1996. Methoprene Pesticide information profile. http://ace.ace.orst.edu/info/extoxnet/pips/methopre.htm

Extension Toxicology Network (ETN). 1996. Naled Pesticide information profile. http://ace.ace.orst.edu/info/extoxnet/pips/naled.htm

Florida Coordinating Council on Mosquito Control (FCCMC). 1998. Florida mosquito control: The state of the mission as defined by mosquito controllers, regulators, and environmental managers. University of Florida.

Fortin, C, D. Lapointe, and G. Charpentier. 1986. Susceptibility of brook trout (*Salvelinus fontinalis*) fry to a liquid formulation of *Bacillus thuringiensis* serovar. *israelensis* (Teknar®) used for blackfly control. Canadian Journal of Fisheries and Aquatic Science 43:1667-1670.

Garcia, R., B. Des Rochers, amd W. Tozer. 1980. Studies on the toxicity of *Bacillus thuringiensis* var. *israelensis* against organisms found in association with mosquito larvae. California Mosquito and Vector Control Association Proceedings and Papers 48:33-36.

Hanowski, J. M., G. J. Niemi, A. R. Lima, and R. R. Regal. 1997. Do mosquito control treatments of wetlands affect red-winged blackbird (*Agelaius phoeniceus*) growth, reproduction, or behavior? Environmental Toxicology and Chemistry 16(5):1014-1019.

Hershey, A. E., A. R. Lima, G. J. Niemi, and R R. Regal. 1998. Effects of *Bacillus thuringiensis israelensis* (Bti) and methoprene on non-target macroinvertebrates in Minnesota wetlands. Ecological Applications 8:41-60.

Horst, M.N., and A.N. Walker. 1999. Effects of the pesticide methoprene on morphogenesis and shell formation in the blue crap *Callinectues sapidus*. Journal of Crustacean Biology 19: 699-707.

Jackson, J. K., R.J. Horowitz, and B.W. Sweeny. 2002. Effects of *Bacillus thuringiensis israelensis* on black flies and nontarget macroinvertebratess and fish in a large river. Transactions of the American Fisheries Society 131:910-930.

Jensen, T., S. P. Lawler, and D. A. Dritz. 1999. Effects of ultra-low volume pyrethrin, malathion, and permethrin on nontarget invertebrates, sentinel mosquitos, and mosquitofish in seasonally impounded wetlands. Journal of the American Mosquito Control Association 15: 330-338.

Lacey, L.A., and Mulla, M.S. 1990. Safety of *Bacillus thuringiensis* var. *israelensis* and *Bacillus sphaericus* to non-target organisms in the aquatic environment. In Laird, M., L.A. Lacey, E.W. Davidson, eds. Safety of microbial insecticides. CRC Press.

Lawler, S. P., T. Jensen, and D. A. Dritz. 1997. Mosquito management on National Wildlife Refuges: ecosystem effects study, phase II, part 1 - Effects of ultra low volume applications of pyrethrin, malathion, and permethrin on macro-invertebrates in the Sacramento National Wildlife Refuge, California. Final rep. to U.S. Fish Wildl. Serv., Coop. Agreem. No. 14-48-0001-94582. 102 pp.

Lawrenz, R. W. 1984. The response of invertebrates in temporary vernal wetlands to Altosid ® SR-10 as used in mosquito abatement programs. Aquatic Biologist, Minnesota Dept. of Natural Resources. St. Paul, Minnesota. 50(3):31-34.

Lee, B. M. And G. I. Scott. 1989. Acute toxicity of temephos, fenoxycarb, diflubenzuron, and methoprene and *Bacillus thuringiensis* var. *israelensis* to the mummichog (*Fundulus heteroclitus*). Bulletin of Environmental Contamination and Toxicology 43:827-832.

Heitmeyer, M. E. 1988. Body composition of female mallards in winter in relation to annual cycle events. Condor 90:669-680.

Hill, I. R., J. L. Shaw, and S. J. Maund.Hill, I. R., Heimbach, F., Leeuwangh, P., and Mattiessen, P. [eds.] 1994. Review of Aquatic Field Tests with Pyrethroid Insecticides. Lewis Publishers. Boca Raton, FL (USA).

McKenney, C.L., Jr., and D.M. Celestial. 1996. Modified survival, growth, and reproduction in an estuarine mysid (*Mysidoposis bahia*) exposed to a juvenile hormone analogue through a complete life cycle. Aquatic Toxicology 35:11-20.

Merritt, R. W., E. D. Walker, M. A. Wilzbach, K. W. Cummings, and W. T. Morgan. 1989. A broad evaluation of Bti for black fly (Diptera: Simuliidae) control in a Michigan River: Efficacy, carry, and non-target effects on invertebrates and fish. Journal of the American Mosquito Control Association 5:397-415.

Millam, D.C., J.L. Farris, and J.D. Wilhide. 2000. Evaluating mosquito control pesticides for effect on target and nontarget organisms. Mosquito News 40:619-622.

Miller, M. R. 1987. Fall and winter foods of northern pintails in the Sacramento Valley, California. Journal of Wildlife Management. 51:405-414.

Miura, T., and R.M. Takahashi. 1973. Insect development inhibitors. 3. Effects on nontarget aquatic organisms. Journal of Economic Entomology. 66(4):917-922.

Miura, T.; Takahashi, R. M.; and Mulligan, F.S. 1980. Effects of the bacterial mosquito larvicide *Bacillus thuringiensis* stereotype H-14 on selected aquatic organisms. Mosquito News. 40:619-622.

Mulla, M.S. 1992. Activity, Field Efficacy, and Use of *Bacillus thuringiensis israelensis* against Mosquitos. Pp. 134-160 in de Barjac, Hugette and Donald J. Sutherland, eds. Bacterial Control of Mosquitos and Blackflies: Biochemistry, Genetics, and Applications of *Bacillus thuringiensis israelensis* and *Bacillus sphaericus*. Kluwer Academic.

Niemi, G. J., A. E. Hershey, L. Shannon, J. M. Hanowski, A. Lima, R. P. Axler, and R. R. Regal. 1999. Ecological Effects of Mosquito Control on Zooplankton, Insects, and Birds. Environmental Toxicology and Chemistry, 18(3):549-559.

Sacramento County Division of Public Health (Sacramento County). 2006. 2005 Summary of West Nile Virus Activity in Sacramento County. http://www.sacdhhs.com/article.asp?ContentID=1402 Viewed on July 21, 2006.

Sacramemento/Yolo Mosquito Vector Control District. 2004. Vector Information. http://www.sac-yolomvcd.com/vectorinfo.htm

Siegfried, B. D. 1993. Comparative toxicity of pyrethroid insecticides to terrestrial and aquatic insects. Environmental Toxicology and Chemistry 12: 1683-1689.

Siegel, Joel, P. and J. A. Shadduck. 1992. Mammalian safety of *Bacillus thuringiensis israelensis* and *Bacillus sphaericus*. Pp. 202-217 in de Barjac, Huguette and Donald J. Sutherland, eds. Bacterial control of mosquitos and blackflies: biochemistry, genetics, and applications of *Bacillus thuringiensis israelensis* and *Bacillus sphaericus*. Kluwer Academic.

Su. T., and M.S. Mulla. 1999. Microbial agents *Bacillus thuringiensis* ssp. *israelensis* and *Bacillus sphaericus* suppress eutrophication, enhance water quality, and control mosquitos in microcosms. Environmental Entomology 28:761-767.

Tomlin, C. 1994. The Pesticide Manual. Farnham: British Crop Protection Council/ Cambridge: Royal Society of Chemistry.

Urban, J. D. and N.J. Cook. 1986. Standard evaluation procedure: Ecological risk assessment. U. S. EPA. Office of Pesticide Programs. Hazard evaluation division

U.S. Environmental Protection Agency (USEPA). 1991. Re-registration eligibility document. Isopropyl (2E, 4E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate (Referred to as methoprene). List A. Case 0030. Office of pesticide Programs. Special Review and Registration Division.

U.S. Environmental Protection Agency (USEPA). 1998. Re-registration eligibility document. *Bacillus thuringiensis.* Office of Prevention, Pesticides and Toxic Substances. EPA738-R-98-004.

U.S. Environmental Protection Agency (USEPA). 2000. Ecotoxicity onliner database. Division of Environmental Fate and Effects. Office of Pesticide Programs.

U.S. Fish and Wildlife Service (USFWS). 1984. Acute toxicity rating scales. Research Information Bulletin No. 84-78.

U.S. Fish and Wildlife Service (USFWS). 2001. Intra-Agency Formal Section 7 Consultation on Pest Management Activities at the Stone Lakes National Wildlife Refuge, Sacramento, California.

Walton, W.E., M.C. Wirth, and B.A. Federici. 1998. The effect of the CytA toxin ratio on the suppression of resistance and cross-resistance to mosquitocidal *Bacillus* toxins. Mosquito Control Research Annual Report. University of California. Division of Agriculture and Natural Resources.

WHO. Undated. Data sheet on pesticides no. 47. Methoprene. World Health Organization. Food and Agriculture Organization. http://www.inchem.org/documents/pds/pds/pest47_e.htm

Wipfli, M.S., R.W. Merritt. And W.W. Taylor. 1994. Low toxicity of the blackfly larvicide Bacillus thuringiensis var. israelensis to early stages of brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and steelhead trout (*Oncorhynchus mykiss*) following direct and indirect exposure. Canadian Journal of Fisheries and Aquatic Science 41:1451-1458.

Zoecon. 2000. MSDS Altosid Liquid Larvicide Concentrate

Personal Communications:

Stan Wright, Sacramento-Yolo Mosquito Vector Control District (SYMVCD). 2005.

Refuge Determination

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Compatibility Determination for Grazing Programs on the Stone Lakes National Wildlife Refuge

Use:

Grazing program to provide (1) suitable habitat for wintering sandhill cranes, arctic nesting geese such as Aleutian cackling geese, shorebirds and breeding habitat for nesting grassland birds such as Western meadowlark; (2) expand native grasses (3) reduce fire danger by reducing thatch layer (Alternative B, Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan Environmental Assessment).

Refuge Name:

Stone Lakes National Wildlife Refuge

Establishing and Acquisition Authority:

Stone Lakes National Wildlife Refuge (NWR) was established in 1994 under the following authorities: Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b)), Fish and Wildlife Act of 1956 (16 U.S.C. 742f(a)(4)), Migratory Bird Conservation Act (16 U.S.C. 715d), and Endangered Species Act of 1973 (16 U.S.C. 1534). Additional acquisition authorities can be found in the funding sources used to acquire land. These sources include: the California Environmental License Plate Fund, the Cigarette and Tobacco Product Surtax (California Proposition 99, 1988), the North American Wetland Conservation Act (16 U.S.C. 4401-4412), the Land and Water Conservation Fund (16 USC 460l - 460l-11), the Sacramento County Environmental Mitigation Grant/Packard Foundation, the Central Valley Improvement Act (16 U.S.C 695d-695j), the National Fish and Wildlife Fund (16 U.S.C. 3701-3709), the Trust for Public Land Grant/Packard Foundation, the City of Sacramento, and CalFed Bay Delta Program.

Refuge Purpose(s):

Stone Lakes NWR purposes include the following:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.' (Migratory Bird Conservation Act of 1929)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ...@ (Endangered Species Act of 1973)

National Wildlife Refuge System Mission:

"The mission of the National Wildlife Refuge System (System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:

The Stone Lakes National Wildlife Refuge (Refuge) will administer a grazing program on the North Stone Lake (2,791 acres), Sun River (537 acres) and Gallagher Units (45 acres) of the Refuge. The North Stone Lake Unit is comprised of approximately 1,900 acres of mostly non-native grassland and 891 acres of open water, riparian and wetland habitat. The Gallagher Unit is comprised of approximately 43 acres of irrigated pasture. The Sun River Unit consists of 140 acres of irrigated pasture, and 397 acres of seasonal, permanent wetlands, open water and riparian habitats.

Grazing has been occurring on the properties for over 50 years. The Refuge will continue to administer this use as outlined in this Compatibility Determination. Although grazing is not identified as a wildlife dependent public use by the National Wildlife Refuge System Improvement Act of 1997, grazing will allow the Refuge to manage mostly non-native grassland habitats on the Refuge for the benefit of wildlife and native plants while reducing the fire danger to adjacent communities. This use will provide short grass foraging and loafing habitat to a variety of wintering migratory birds such as the greater sandhill crane (*Grus canadensis tabida*), arctic nesting geese including Aleutian cackling goose (*Branta hutchinsii leucopareia*) and white fronted goose (*Anser albifrons*), shorebirds including white faced ibis (*Plegadis chihi*), long billed curlew (*Numenius americanus*) and black bellied plover (*Pluvialis squatarola*). These grasslands also provide nesting and foraging habitat for western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), northern harrier (*Circus cyaneus*), white tailed kite (*Elanus leucurus*) and Swainson's hawk (*Buteo swainsoni*), and have the potential to provide habitat for nesting and wintering burrowing owls (*Athene cunicularia*), Savannah sparrows (*Passerculus sandwichensis*) and grasshopper sparrows (*Ammodramus savannarum*). Habitat consists of introduced (> 70% annual rye [*Lolium multiflorum*]) and native grasses (including creeping wildrye [*Leymus triticoides*], saltgrass [*Distichlis* spp.] and meadow barley [*Hordeum branchyntherum*])as well as other forbs and associated native plant food resources.

Only the grazing of cattle is to be considered on the Refuge; grazing by sheep (*Ovis aries*), goats (*Capra hircus*), or other creatures such as bison (*Bison bison*) will not be considered. During drought years or years of low rainfall, cattle will not be allowed to graze on the Refuge.

The timing of the placing of cattle on the Refuge are termed "turn in dates" (November 1 or slightly later) and are adjusted year to year based upon the date of the first effective germinating rainfall, and the amount of dry forage available in the fall (Stechman 1995). The timing of removing cattle from the Refuge is termed "turn out dates" and is determined solely on the amount of residual dry matter (RDM) within the unit, but will be no later than July 15th. If and when 800 lbs per acre, of RDM, or less is achieved cattle will be removed from the unit.

The unit of measure used to summarize the quantity of cattle grazing on the Refuge is termed Animal Unit Month (AUM). AUM is defined as the amount of forage needed by an "animal unit" (AU) grazing for one month (USDA-NRCS 2004). An AU is defined as one mature 1,000 pound cow and her sucking calf. An assumption in this definition is that a cow nursing her calf will consume about 26 pounds of dry matter per day. Other types of livestock are assigned AUM equivalents based on body size and consumption of dry matter.

The optimal time for grazing in the Central Valley begins in November and may continue through mid July depending on winter and spring rainfall. Prior to the beginning of the grazing season, an assessment is made to determine the amount of residual dry matter (RDM) available to the cattle. The number of cattle allowed to graze on the Refuge, for a

specific amount of time, varies with the amount of local rainfall. Because grazing on the Refuge supports various wildlife populations, this RDM level is linked to the needs of wildlife and not the needs of the cattle. The RDM is determined by clipping, drying, and then weighing the amount of RDM in representative samples from the unit cattle are to graze and varies upon temperature, monthly rainfall and the density of new grass/forb growth.

The Refuge has developed a 5-year grazing management plan with the assistance of the Natural Resource Conservation Service that promotes variability in grass height and density among the five dry pasture units to provide habitat for a suite of grassland dependent species. This plan rotates grazing pressure (low, medium and high) in five pastures (see Figure 1) resulting in a range of grass heights and densities (see Table 1). The rotational grazing should result in higher quality habitat for species that inhabit short grasses such as burrowing owls, without impacting other grassland dependent species. A monitoring program will be implemented to determine if increasing grazing rates and rotating grazing pressure through the units will have the desired effects of providing a variety of nesting, foraging and breeding cover for a variety of birds and other wildlife. If the RDM level drops below 800 lbs/acre, prior to or anytime during the grazing season, the Refuge manager may request that the grazing permit holder reduce the number of cattle grazing in that unit or remove them all together in order to prevent degradation of the resources in the unit.

Table 1. Residual Dry Matter (RDM) targets over a five year period on the North Stone Lake Unit of the Stone Lakes National Wildlife Refuge in California.

	RDM Value at the End of the Grazing Season (Nov – June)*				
Pasture	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A	Medium	Low	Medium	High	Low
B	High	Medium	Low	Medium	Medium
C	Low	Medium	High	Low	Medium
D	Medium	High	Low	Medium	High
E	Low	Low	Medium	Low	Low
F**	Medium	Medium	Medium	Medium	Medium

*RDM values – Low(1200-1750 lbs/acre), Medium (1750-2500 lbs/acre), High (+2500 lbs/acre).

** Southwestern portion of South Irrigated Pasture (Fig. 1). Cattle will be in unit for 30-60 days from March-May to control weeds.

Grazing in the irrigated/wet meadow units (371 acres) on the North Stone Lake, Gallagher and Sun River units begins in mid summer, corresponding to the removal of cattle from the dry pasture and continues until approximately November 1. Grazing rates typically range between 1.1 – 1.3 acres per AUM. These pastures, which are not grazed during the winter season, are heavily used by cranes, geese and shorebirds.

The grazing cooperator is chosen following guidance in U.S. Fish and Wildlife Service Refuge Manual under heading 5 RM 17. At the time of this writing, there are no anticipated changes to grazing on the Refuge.

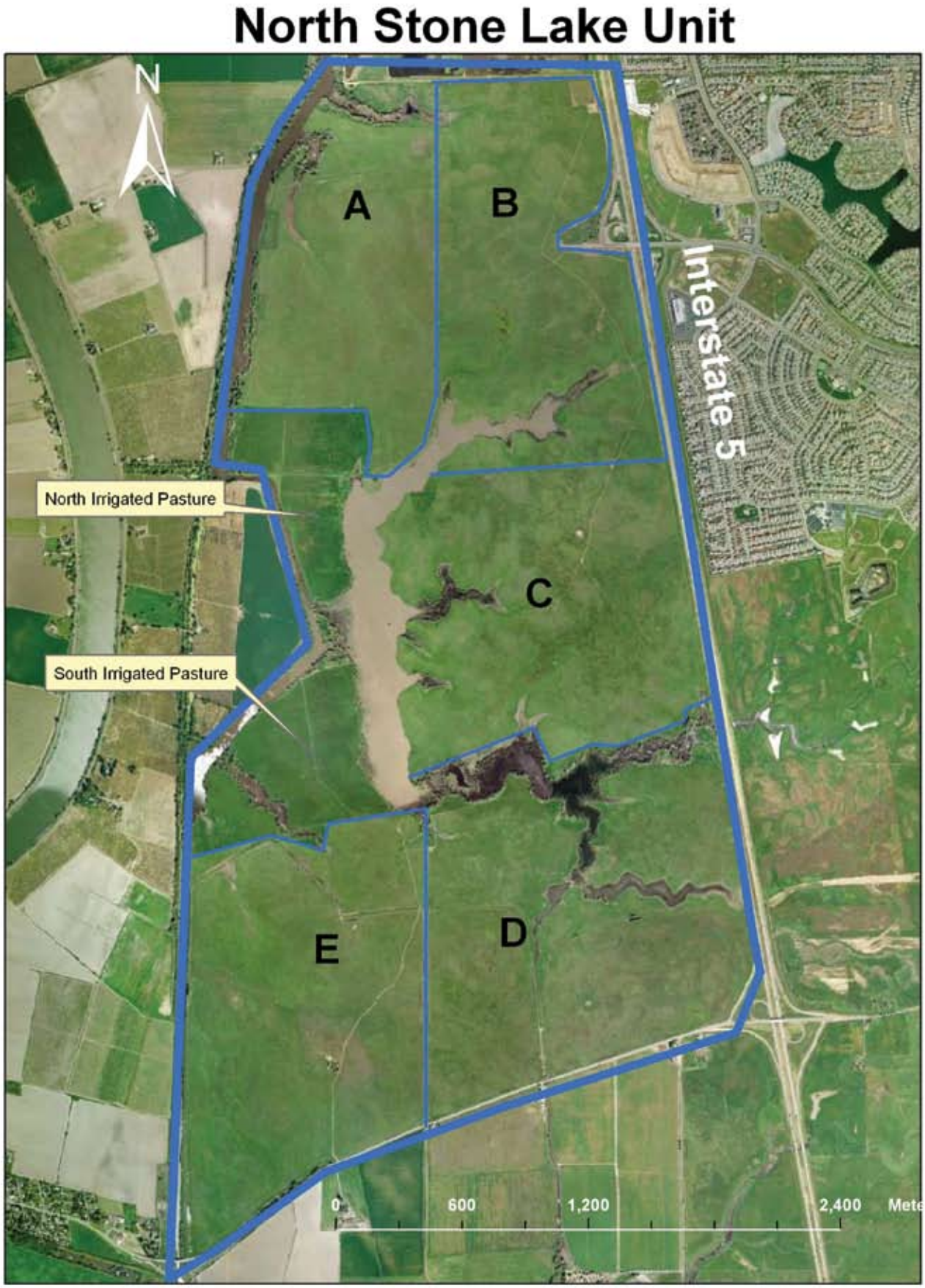


Figure 1. Map of the North Stone Lake Unit of the Stone Lakes National Wildlife Refuge showing the designation of pasture units and location of perimeter and cross fences in blue.

Availability of Resources:

The assistant refuge manager, under the direction of the project leader, will manage the grazing program. The permittee, working under a Cooperative Land Management Agreement, will accomplish certain facility management and improvement projects under the direction of the assistant manager. Accomplishments will be in direct support of the Refuge grazing program; these projects may include maintenance or improvements of existing facilities or installation of new facilities. Projects may include: deep well construction and maintenance; installing and/or maintaining water control structures, watering troughs; fence installation, repair, and/or removal; sign repair, removal, or installation; gate installation; noxious weed control; road building and maintenance; parking lot maintenance; and vegetation control around facilities. Facilities that are installed primarily for Refuge purposes are constructed or maintained at Refuge expense. All projects will be agreed upon before the beginning of the grazing season and will directly support the unit being grazed.

Rates charged per AUM are based on a survey of grazing rates in the area and were done on an upward sliding scale. Rates are now fixed until the end of the current grazing contract with the County of Sacramento which ends in 2008. Rates will then be renegotiated based on a survey of grazing rates in the area.

At the end of each grazing season, the permittee submits information that includes AUMs per month per grazing unit and the cost of various projects completed on the unit that year. The project list is then revised for the following year. Work contributions of this type will be associated with improvement projects for the particular grazed unit.

The Refuge receives adequate funding to cover the costs associated with management of the grazing program including the RDM assessment conducted at the end of every grazing season. Staff costs associated with this use emanates from the annual review of Special Use Permits, Cooperative Land Management Agreement and monitoring the impacts of this use as outlined in the grassland management plan. Annual costs to manage the grazing programs averages $25,000, which includes all costs associated with monitoring, weed control, law enforcement, improvements and planning activities.

Anticipated Impacts of the Use:

To provide this use, the Refuge has adequate staff which includes biological, administrative and managerial personnel. The grazing program results in both long and short term effects, both negative and positive. The following is a list of possible short and long-term negative impacts to wildlife resources from grazing: trampling of desirable vegetation, disturbances to ground nesting species, trampling of rodent burrows, soil compaction especially during wet periods and erosion of the bank along North Stone Lake. The following activities can minimize these negative impacts associated with grazing: fencing off sensitive habitats, development of alternative watering sources for cattle to drink from, allowing the use in years of adequate rainfall only and supporting grazing within the same unit areas and not moving animals to un-grazed or sensitive areas.

Conversely, short and long-term positive impacts of the grazing program include: an overall reduction of undesirable, non-native vegetation; re-establishment of native grass, forb, and shrub communities; reduced fire danger to surrounding communities; and increased habitat for grassland dependent species. Prior to reestablishment of a grazing program by the Refuge, the North Stone Lake Unit was left idle for approximately 12 years. Over that time, the grass became dense with vegetation reaching 6-8 feet tall. Bird surveys revealed no use by sandhill cranes, arctic nesting geese or shorebirds, although these birds used the area historically. Once the grazing plan was implemented, these birds returned within two years,

and the, California State Endangered Species Act, listed greater sandhill crane now number over 300 birds. Native grass stands have also benefited from the grazing program and are expanding (Huitt 2003). Adjacent landowners are also satisfied with the decrease in thatch and the fire break that further reduces the threat of fire spreading across the property and onto neighboring lands.

The impact of cattle to existing water supplies is negligible and being diminished as alternative watering sources are being developed. Alternative watering sources help keep cattle from watering in the lake where they can erode the bank in high use areas. A solar powered well now brings water to cattle in Pastures A and B, and a pipeline from the well at the HQ will bring water to cattle in Pasture E. A well already exists in Pasture D and plans are being finalized to construct an additional well in pasture C.

Much of the topography is flat with little sedimentation and erosion entering the two arms of North Stone Lake. The south arm of the lake which is surrounded by riparian vegetation has been fenced off to cattle, as have the other sensitive riparian zones on the property.

Bird surveys indicate the grazing program provides a significant benefit to various species of concern that winter in the Central Valley including the greater sandhill crane, white faced ibis, long billed curlew, Aleutian cackling goose and white fronted goose. Furthermore initial studies of nesting songbirds found that western meadowlarks nested in a wide range of grass heights below 3.5 feet, but were not found in areas where the grass exceeded this height.

Cowbirds (*Molothrus ater*) are found over the entire Refuge and parasitize nests of various species in riparian areas. Therefore 85% of existing riparian areas have been fenced off to decrease suitable habitat for cowbirds. Whether the grazing program will contribute to increases in the cowbird population by providing additional foraging areas is unknown. Large mixed flocks of blackbirds are seen in the spring and fall, but no cowbirds were recorded during point count surveys done the spring of 2006. Efforts to fence off riparian remaining riparian areas will continue.

Impacts to known cultural resources from this use are negligible. Tremaine and Associates (2006) completed a survey of the entire property in 2005, and all cultural resource sites that could be impacted by cattle were fenced off. Furthermore, the grazed units are closed to the public, further protecting these sites. Any ground-disturbing activities will be coordinated with the Service's Regional Archaeologist, in order to preserve the Refuge's archaeological and historic resources.

The Draft Comprehensive Conservation Plan (USFWS 2006) identifies the need to develop additional information relating to the effects of grazing on resident and migratory species. While the effects have been determined to be generally positive, additional research and evaluation will allow the Refuge to refine its management strategies and objectives for grassland management.

Public Review and Comment:

Public review and comments will be solicited in conjunction with distribution of the Draft CCP for Stone Lakes NWR. The public will be provided 30 days to review and comment upon the CCP and this CD.

Following the public review and comment period; comments, Service responses and actions taken to address comments will be summarized here.

Determination: (Check One Below)

_____ Use is not compatible

__X__ Use is compatible, with Stipulations

Stipulations Necessary to Ensure Compatibility:
The Cooperator is operating under the terms and conditions of a Cooperative Land Management Agreement (2001), special use permit and a Refuge Grazing Plan. These documents provide the necessary information and assistance from the Refuge to determine start and end dates for cattle placement and removal.

Additional Stipulations are as follows:
- It is the responsibility of the Refuge Manager to determine fair market value of grazing, to issue special use permits, monitor permittee compliance and maintain up-to-date files on all grazing activities.
- All cattle grazing on the Refuge would be removed no later than July 15th.

Monitoring:
A monitoring program will be established to provide data on residual dry matter, cover density, bird use, and noxious weeds. These data will establish guidelines for making management decisions concerning the grazing program. Maps of RDM will be compiled using the comparative yield method (Dudley, pers. comm.) in September or October of each year. The comparative yield method measures the residual dry matter by clipping the grass in a 1 meter square and then weighing the dried sample. This is repeated until the observer can determine the residual dry matter by observation rather than clipping grass samples. Samples are still collected to ensure accuracy of the observations. Maps are then compiled from the data and visual observations. Data on grass height and density is collected during the nesting season (March-April) using the Robel Pole Method (Harmoney et al. 1997). These data will be used to guide grazing rates the following year. Photo plots for each grazing unit will also be established and photos will be taken each year at the end of the grazing season (July – August). Wildlife surveys will include bimonthly waterfowl and shorebird surveys (November – March), greater sandhill crane surveys (September – March), and rookery surveys (March – June). Noxious weed surveys will include mapping noxious weed infestations using a hand-help GPS unit and developing and implementing integrated pest management techniques to control and/or eliminate target species.

Justification:
The primary management goals guiding the grazing of the Refuge are to conserve, enhance, restore, and manage Central Valley wetland, riparian, grassland, and other native habitats to benefit their associated fish, wildlife, plants and special status species, and to conserve, enhance, and restore high quality migrating, wintering, and breeding habitat for migratory birds within the Sacramento-San Joaquin Delta of the Central Valley. The mission of the National Wildlife Refuge System also includes the conservation, management and restoration of wildlife resources. When evaluating the appropriate management direction for refuges, Refuge Managers are required to use sound professional judgment to determine their refuge's contribution to biological integrity, diversity and environmental health at multiple landscape scales as called for in (601 FW 3[3.7B]). The grazing program is designed to enhance habitat for a variety of special status species including greater sandhill crane, Swainson's hawk and Aleutian cackling geese. The regulated use of grazing to benefit these and other species clearly supports both the System mission and the purpose for which the Refuge was established.

With the dramatic changes to the plant communities in California over the past 150 years, has come an increase in the density of ground cover due to the introduction of nonnative grasses and forbs (Kuchler 1988). A limited grazing season can benefit the recovery of native perennials by reducing annual plant biomass, increasing seed production and stimulating native perennial production (Huitt 2003).

Prior to the management of the property by the Refuge, the uplands were altered from their original native condition by the introduction of non-native grasses and intensive grazing practices. In order to maintain the biological integrity and diversity of the Refuge, species of special concern must be provided for. The use of moderate grazing to reduce the build-up of annual introduced grassland biomass is viewed as beneficial to species such as greater sandhill crane, Aleutian cackling geese and others. By restricting the intensity and duration of grazing, and by adhering to the stipulations for this use, the environmental health of the Refuge will be maintained.

Mandatory Re-evaluation Date (provide month and year):

_____Mandatory 15 year Re-evaluation Date (for priority uses)

2016 _Mandatory 10 year Re-evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

__X__Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

Literature Cited

Dudley, Dennis. 2004. Personal Communication. Natural Resource Conservation Service, Madera, California.

Harmoney, K.R., K.J. Moore, J.R. George, E.C. Brummer, and J.R. Russell. 1997. Determination of Pasture Biomass Using Four Indirect Methods. Agronomy Journal. 89: 665-672.

Huitt, C.C. 2003. Effects Of Grazing And Burning On Three Perennial Grassland Species In The Central Valley Of California: *Hordeum Brachyantherum Californicum*, *Leymus Triticoides*, And *Carex Praegracilis*. Masters Thesis, Univ. California, Davis. 65 pp.

Kuchler, A.W. 1988. The Map of the Natural Vegetation of California. 909-938 pp. *In:* M.G. Barbour and J. Major (editors); Terrestrial Vegetation of California. Calif. Native Plant Society Special publication No. 9.

Tremaine and Associates. 2006. Draft Pedestrian and Geophysical Archaeological Surveys of North Stone Lakes: Stone Lakes National Wildlife Refuge. Tremaine and Associates. 30 pp.

Stechman, J. 1995. Grazing assessment and management recommendations, Fort Hunter Liggett, California. Consult. Rpt. for U.S. Army and the Nature Conservancy, Seattle, WA. 178p. Dec.

U.S. Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 2004. Technical Note No. 31. Montana Grazing Animal Unit Month (AUM) Estimator. Bozeman, MT. http://www.mt.nrcs.usda.gov/technical/ecs/range/technotes/rangetechnoteMT32.html Viewed on July 5, 2006.

USFWS. 2004. Stone Lakes National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment. CA/NV Refuge Planning Office, Sacramento, California.

Refuge Determination

Prepared by: _____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Manager,
Refuges,
California/Nevada
Operations: _____ _____
(Signature) (Date)

California/Nevada
Operations Manager: _____ _____
(Signature) (Date)

Appendix B. Environmental Assessment

Stone Lakes
National Wildlife Refuge
Draft Comprehensive Conservation Plan Environmental Assessment

U. S. Fish and Wildlife Service
California/Nevada Refuge Planning Office
2800 Cottage Way, Room W-1832
Sacramento, CA 95825

September 2006

Contents

Chapter 1. Purpose of and Need for Action 174

Introduction 174
Proposed Action....174
Purpose of and Need for the Proposed Action 174
Project Area 174
Decisions to be Made 174
Issue Identification....174
Public Involvement 177
U.S. Fish and Wildlife Service and the National Wildlife Refuge System 177
- Refuge Purposes 177
- Refuge Goals....178

Chapter 2. Alternatives, Including the Proposed Action....179

Introduction 179
Current Management 179
Features Common to All Alternatives 180
- Mosquito Control 180
- Weed Control 180
- Riparian Habitat Maintenance/Restoration on North Stone Lake Unit....180
- Vernal Pool Management 190
- Hunting....190
- Boating 190
- Cultural Resources 190

Alternatives Removed From Further Consideration 190
- Auto Tour Route on North Stone Lake Unit and Associated Trails 190
- Equestrian Use 191
- Upland Game and Deer Hunting 191
- Fishing Derbies....191

Alternative A: No Action 191
- Habitat Restoration....191
- Migratory Birds 191
- Monitoring....192
- Special Status Species 192
- Wetland, Grassland, Riparian Habitats 192
- New Lands....192
- Visitor Services....192

Alternative B....193
- Habitat Restoration....193
- Migratory Birds 193
- Monitoring....193
- Special Status Species 194
- Wetland, Grassland, and Riparian Habitats....194
- New Lands....194
- Visitor Services....194

Alternative C....195
- Habitat Restoration....195
- Migratory Birds 195
- Monitoring....196
- Special Status Species 196
- Wetland, Grassland, Riparian Habitats 196

New Lands 196
Visitor Services....196
Proposed Action Criteria....197

Chapter 3. Affected Environment 198

Chapter 4. Environmental Consequences 199
Overview of NEPA Analysis Parameters....199
Soils 199
Water Quantity and Quality 200
Air Quality 200
Plant Communities....201
Wildlife....202
Special Status Species 204
Diseases and Toxins 205
Cultural Resources....206
Visitor Services....207
Socioeconomics 208

Appendix 1: References 210
Personal Communications....212

Chapter 1. Purpose of and Need for Action

Introduction

This draft environmental assessment (EA) evaluates the environmental effects of three alternatives for managing the Stone Lakes National Wildlife Refuge (Refuge). The U.S. Fish and Wildlife Service (Service) will use this EA to solicit public involvement in the Refuge planning process and to determine whether implementation of the Comprehensive Conservation Plan (CCP) will have a significant effect on the quality of the human environment. This EA is part of the Service's decision-making process in accordance with the National Environmental Policy Act (NEPA).

Proposed Action

The Service proposes to implement Alternative B, as described in this EA. More information is provided about Alternative B in the CCP.

Purpose of and Need for the Proposed Action

The Refuge needs this CCP to guide Refuge management. In addition, the National Wildlife Refuge System Improvement Act of 1997 requires that within 15 years of its enactment, a CCP must be in place for all refuges established prior to 1997.

Project Area

The Refuge was established in 1994, becoming the 505th refuge in the National Wildlife Refuge System. The Refuge boundary encompasses about 17,640 acres, including a core Refuge of about 9,000 acres, and a 9,000-acre "Cooperative Wildlife Management Area" (USFWS 1992). The Service actively manages about 6,000 acres. The Refuge is located in the Sacramento/San Joaquin River Delta (Figure 1). It is in the Beach-Stone Lakes Basin, found within the Sacramento Valley in the southwestern part of Sacramento County. It lies about ten miles south of the city of Sacramento, straddling Interstate Five from the town of Freeport south to Lost Slough (Figure 2). The Refuge provides wintering habitat for migratory waterfowl and other waterbirds in the Pacific Flyway (Figure 1). It is surrounded by privately owned nonnative grassland used for pasture, agricultural croplands and dense urban development.

Decisions to be Made

Based on the analysis documented in this draft EA, the California/Nevada Operations Manager must determine the type and extent of management and visitor access that will occur on the Refuge and whether the selected management alternative would have a significant effect on the quality of the environment.

Issue Identification

The Service identified issues, concerns and opportunities through early planning discussions and the public scoping process. This process began with the mailing of the first planning update in July 2002. The public also provided comments in writing and through personal communications. For a discussion of the planning process and issues raised, please see Chapter 2 of the CCP.

The planning team helped to further define the issues. The planning team includes Service employees from the Stone Lakes National Wildlife Refuge Complex office and the California/Nevada Refuge Planning Office.

Oregon
Pacific Flyway
Area Enlarged
MODOC NWR
Redding
SACRAMENTO RIVER NWR
SACRAMENTO NWR
DELEVAN NWR
COLUSA NWR
SUTTER NWR
SAN PABLO BAY NWR
MARIN ISLANDS NWR
Sacramento
Stone Lakes National Wildlife Refuge
Morrison Creek
Sacramento/ San Joaquin Delta
Cosumnes River
Local Watersheds
San Francisco
SAN JOAQUIN RIVER NWR
Modesto
SAN LUIS NWR
MERCED NWR
DON EDWARDS SAN FRANCISCO BAY NWR
ANTIOCH DUNES NWR
Fresno
BLUE RIDGE NWR
KERN NWR
PIXLEY NWR
Bakersfield
BITTER CREEK NWR
Nevada
California
Pacific Ocean
Los Angeles
101
99
80
5
580
Figure 1. Watershed and Ecosystem Setting
Stone Lakes
National Wildlife Refuge
Sacramento River Watershed
Central Valley-San Francisco Bay Ecoregion
0 Miles 100
0 Kilometers 100

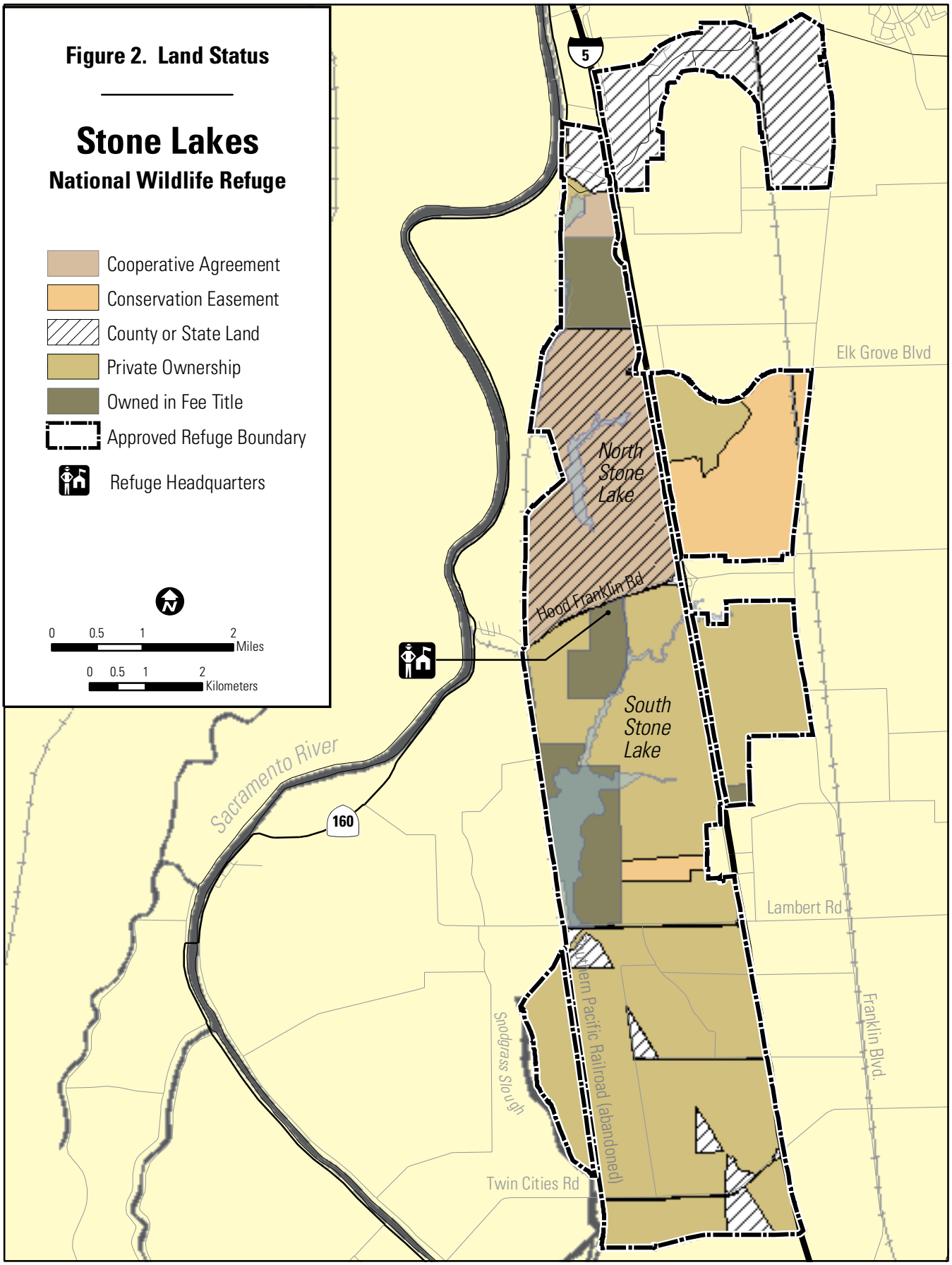


Figure 2. Land Status
Stone Lakes
National Wildlife Refuge
Cooperative Agreement
Conservation Easement
County or State Land
Private Ownership
Owned in Fee Title
Approved Refuge Boundary
Refuge Headquarters
0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
5
Elk Grove Blvd
North Stone Lake
Hood Franklin Rd
South Stone Lake
Sacramento River
160
Lambert Rd
Snodgrass Slough
Western Pacific Railroad (abandoned)
Franklin Blvd.
Twin Cities Rd

Public Involvement

The planning team distributed three planning updates to a mailing list of about 210 individuals, groups and agencies in July 2002, September 2002 and December 2002. The team held four public workshops during August and September 2002, one each in; Elk Grove, Sacramento, Walnut Grove and Davis, California.

The planning staff has incorporated public input received in response to these updates and workshops into the CCP and EA; a summary of these comments is included in Chapter 2 of the CCP. The original comments are available for review in planning administrative files at the California/Nevada Refuge Planning Office in Sacramento, California.

U.S. Fish and Wildlife Service and the National Wildlife Refuge System

The mission of the Service is to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people. The Service is the primary Federal agency responsible for migratory birds, endangered plants and animals, certain marine mammals and interjurisdictional fish. The responsibility to conserve our nation's fish and wildlife resources is shared with other Federal agencies, State and Tribal governments.

As part of this responsibility, the Service manages the National Wildlife Refuge System (Refuge System). The Refuge System is the only nationwide system of Federal lands managed and protected specifically for wildlife and their habitats. The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

The Refuge is managed as part of the Refuge System in accordance with the National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, and other relevant legislation, Executive Orders, regulations, and policies. Chapter 1 of the CCP summarizes these major laws, regulations, and policies and describes the goals of the Refuge System.

Refuge Purposes

The Emergency Wetlands Resources Act of 1986, the Fish and Wildlife Act of 1956 and the Migratory Bird Conservation Act are the establishing authorities for the Refuge.

The primary Refuge purposes are:

"... for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..." 16 U.S.C. §§ 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. §§ 742f(a)(4) (Fish and Wildlife Act of 1956)

"... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. §§ 742f(b)(1) (Fish and Wildlife Act of 1956)

"... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. §§ 715d (Migratory Bird Conservation Act)

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. §§ 1534 (Endangered Species Act of 1973)

Further refinements in the Refuge purposes can be found in the funding sources used to acquire land. Grants have been provided by: City of Sacramento, County of Sacramento, California Wildlife Conservation Board, California Environmental Enhancement Mitigation Fund, California Environmental License Plate Fund, Cigarette and Tobacco Product Surtax, Department of Transportation-TEA 21 Fund, CALFED Bay Delta Program, North American Wetlands Conservation Act, Land and Water Conservation Fund, Central Valley Project Improvement Act, National Fish and Wildlife Foundation, David and Lucille Packard Foundation, The Trust for Public Land and other private donations.

Refuge Goals

Goal 1. Conserve, enhance, restore, and manage Central Valley wetland, riparian, grassland and other native habitats to benefit their associated fish, wildlife, plants and special status species.

Goal 2. Conserve, enhance and restore high quality migrating, wintering and breeding habitat for migratory birds within the Sacramento San Joaquin Delta of the Central Valley.

Goal 3. Provide visitors with wildlife-dependent recreation, interpretation and education opportunities that foster an understanding of the Refuge's unique wildlife and plant communities in an urban setting.

Goal 4. In cooperation with tribal representatives, identify and protect cultural resources on the Refuge and educate the public regarding Native American people and the history of the region.

Chapter 2. Alternatives, Including the Proposed Action

Introduction

This chapter describes three alternatives for managing the Refuge: Alternative A (No Action), Alternative B and Alternative C. These alternatives are described below. Figures 3 and 4 show a graphical representation of Refuge areas described in the alternatives. The Service's proposed action is Alternative B. Two of the three alternatives presented in this chapter are "action alternatives" that would involve a change in the current management of the Refuge. Under Alternative A, the No Action alternative, the Service would continue managing the Refuge as it currently does.

Current Management

The primary management focus of the Refuge is providing habitat for migrating, wintering and nesting migratory and resident birds with an emphasis on waterbirds, and a variety of special status species by restoring and maintaining wetland, riparian woodland, grassland habitats and valuable agricultural lands.

Restoration and management of seasonal and permanent wetland habitats has been a major emphasis since the inception of the Refuge due to loss or conversion of this habitat in the Central Valley. The Refuge promotes water management regimes on managed wetland impoundments involving specific water draw down dates, spring irrigations and fall flood-up periods to produce quality habitat, primarily for wintering waterbirds. Seasonal wetlands are irrigated in summer to stimulate the growth of high quality waterfowl foods. Wetland vegetation is also manipulated periodically to maintain desired habitat conditions for feeding, loafing and breeding waterfowl, waterbirds and other birds. These manipulations can include mowing, prescribed burning, discing and noxious weed control. The Refuge works cooperatively with local and State agencies and private landowners throughout open water aquatic habitat in the Stone Lakes Basin to control mosquitos and water hyacinth (*Eichhornia crassipes*), a non-native invasive aquatic plant.

Riparian restoration has included planting riparian trees, such as Fremont cottonwood (*Populus fremontii*), willow species (*Salix* sp.), box elder maple (*Acer negundo* var. *californicum*), valley oak (*Quercus lobata*) and associated understory shrubs and grasses and irrigating restoration areas on the Beach, North Stone, and South Stone Lake, and Headquarters units for three to five years to establish the plants.

Large scale grassland management such as on the North Stone Lake Unit, includes promoting remnant native grasslands through use of cattle grazing, small scale prescribed burns, and invasive weed control. Increased use by sandhill cranes (*Grus canadensis*), long billed curlews (*Numenius americanus*), white fronted geese (*Anser albifrons*), burrowing owls (*Athene cunicularia*), and other raptors has been recorded on the unit since the grazing program was implemented in 1999.

The Refuge cooperative farming program on the Headquarters Unit benefits a variety of migratory birds, including waterfowl, shorebirds, and sandhill cranes, that depend on small grains, alfalfa, tomatoes and invertebrates for a significant portion of their diet. The farming program maintains approximately 80 acres in corn, wheat, or grass to provide wildlife habitat and reduce weeds until the Service can implement expanded restoration plans.

Service staff, cooperators, and volunteers periodically conduct biological surveys and monitoring within a variety of Refuge habitat, including surveys of: (1) colonial nesting waterbirds; (2) mistnetting of landbirds (in cooperation with the Sacramento-Yolo Mosquito and Vector Control District); (3) nesting success and survival of song sparrows; (4) wintering

(October-May) waterfowl populations; (5) invasive weed mapping; and (6) range monitoring through surveys of residual dry matter.

For a complete description of the current management practices, please see "Current Management" in Chapter 3 of the CCP. Table 1 summarizes the alternatives analyzed in this Environmental Assessment.

Features Common to All Alternatives

All of the alternatives contain some common features. These common features are presented in the following pages to reduce the length and redundancy of the individual alternative descriptions.

Mosquito Control

In 1993, the Service and Sacramento-Yolo Mosquito and Vector Control District (SYMVCD) signed a Memorandum of Understanding (MOU). According to the MOU, both parties agreed to cooperate to limit production and harboring of mosquitos on Refuge habitats. The Service, in cooperation with SYMVCD, manages wetlands and other habitats on the Refuge to discourage mosquitos by: adopting wetland design features, managing water regimes, planting mosquitofish (*Gambusia affinis*), and applying larvicides or adulticides, as needed. In addition, the Service and SYMVCD collaborate on other mutually beneficial projects, such as landbird monitoring and water hyacinth control. The Service will continue to participate in ongoing studies of Refuge landbirds, related to mosquito borne viruses, in cooperation with SYMVCD. When considering the burgeoning population immediately down wind of the Refuge and the recent establishment of West Nile Virus in the Central Valley, it is essential that the Refuge and SYMVCD continue to build on their successful partnership

Weed Control

Since 1995, the Refuge has adopted an active aquatic and terrestrial weed management program in the Beach-Stone Lakes Basin, particularly as a founding member of the Stone Lakes Water Hyacinth Control Group and the Sacramento Weed Management Area. The Refuge and the Sacramento Regional County Sanitation District conduct treatments for control of water hyacinth (*Eichhornia crassipes*) under a Statewide National Pollution Discharge Elimination System (NPDES) General Permit (No. CAG990005) for discharge of aquatic pesticides. The Refuge and SRCSD utilize Reward (Diquat) and Aquamaster (glyphosphate) to control water hyacinth in the basin. Another aquatic species, Brazilian elodea (*Egeria densa*), is also abundant in waterways and may emerge as a management concern as opportunities for recreational boating are developed on the Refuge.

The Integrated Pest Management methods that the Refuge uses to control weeds include burning, mowing, discing and herbicide application. The Refuge uses Transline® (clopyralid), Telar® (chlorsulfuron), Roundup (glyphosphate), and 2, 4-D, to control the upland weeds such as yellow starthistle (*Centaurea solstitialis*) and perennial pepperweed (*Lepidium latifolium*). To date, the Refuge has found chemical control to be the most effective method of managing water hyacinth and perennial pepperweed. Stone Lakes NWR is a member of the Sacramento County Weed Abatement Team.

Riparian Habitat Maintenance/Restoration on North Stone Lake Unit

Ongoing and planned improvements to the grazing program on the North Stone Lake Unit will continue under all alternatives and include developing alternative watering sources for the cattle in each pasture, bank stabilization along the SP Cut in the north irrigated pasture, invasive weed control, and continued monitoring of migratory bird responses.

Table 1. Summary of Alternatives

	Alternative A	Alternative B	Alternative C
	No Action/Current Management	**Wetland, Riparian and Grassland Restoration with Facilitated Public Use**	**Restore to Natural Conditions with Self-Directed Public Use**
HABITAT MANAGEMENT			
Riparian restoration and management	• 0 acres or riparian habitat restored	• Same as Alternative A but:	• Same as Alternative A but:
	• Maintain 360 acres of riparian and oak woodland habitat	• Maintain 425 acres of riparian and oak woodland habitat	• Maintain 385 acres of riparian and oak woodland habitat
	• 25 acres of riparian and oak woodland habitat actively restored	• 65 acres of riparian and oak woodland habitat actively restored	• 65 acres allowed to restore through natural process restoration
	N/A	• 40 acres of riparian understory restored	• 25 acres of riparian understory restored
	N/A	• Establish a native plant nursery at HQ office	• No native plant nursery
	N/A	• Intensify control efforts for perennial pepperweed in riparian areas using a variety of methods	• Same as Alternative B
	• Maintain existing fencing along SP Cut on the North Stone Lake Unit to exclude cattle from riparian areas	• Maintain and expand fencing along SP Cut on the North Stone Lake Unit to exclude cattle from riparian areas	• Same as Alternative A
Wetlands restoration and management	• 200 acres of wetland restored at Headquarters Unit	• Same as Alternative A	• Same as Alternative A
	• 452 acres of seasonal wetlands maintained	• 452 acres of seasonal wetlands manipulated to improve vegetation conditions	• 133 acres of seasonal wetlands manipulated to improve vegetation conditions
	• 136 acres of vernal pool seasonal wetlands manipulated to improve vegetation conditions	• Same as Alternative A	• Same as Alternative A
	• 715 acres of permanent wetlands managed to provide habitat for a variety of wetland dependent species	• Same as Alternative A	• Same as Alternative A
	N/A	• 50 acres wetlands enhanced on Lewis Unit	• Same as Alternative B
Grassland restoration and management	• 1,900 acres of non-irrigated grassland maintained and enhanced	• Same as Alternative A	• Same as Alternative A
	• 0 percent high residual dry matter	• 20 percent high residual dry matter	• Same as Alternative B

Table 1. (continued)

	Alternative A	Alternative B	Alternative C
	• Implement a long term grazing management plan developed in collaboration with range management experts	• Same as Alternative A	• Same as Alternative A
	• 0 acres planted to restore the native grassland community	• 30 acres planted to restore the native grassland community	• Same as Alternative B
	N/A	• Enhance and create habitat for burrowing owls by reintroducing ground squirrels to the North Stone Lake Unit and constructing and maintaining artificial burrows	N/A
Wet meadow/pasture management	• 460 acres of irrigated pasture/wet meadow maintained	• Same as Alternative A.	• Same as Alternative A.
	N/A	• If feasible, sheet flood irrigated pastures to a depth of less than six inches every two weeks from November through March on the North Stone Lake Unit	• Same as Alternative B
	N/A	• Maintain grasslands by periodic disturbance (eg., mowing, grazing, burning, or discing)	• Same as Alternative B
Moist soil habitat management	• 529 acres of seasonal wetlands managed as moist soil habitat	• Same as Alternative A and:	• Same as Alternative A but:
	• Flood moist soil units early Sept – May	• Same as Alternative A.	• Begin floodup concurrent with first rainfall after Sept. 1
	• Stagger timing of drawdown starting in March	• Same as Alternative A.	• Drawdown beginning in mid-March to mimic natural rainfall conditions
	• Irrigate 1-2 times from May – Aug to promote desired vegetation	• Same as Alternative A	• No irrigation from May - Aug
	• Disc and/or mow 25-50% of units to stimulate plant growth and maintain equal ratio of open water to emergent vegetation	• Same as Alternative A	• Same as Alternative A
	N/A	• Drawdown one permanant wetland in August to provide shorebird habitat and flood again in September with other wetlands	• Begin flooding seasonal wetlands concurrent with the first rainfall

Table 1. (continued)

	Alternative A	Alternative B	Alternative C
	N/A	• Explore reverse cycle wetlands management on an experimental basis to benefit shorebirds	• Same as Alternative B
Sandhill crane habitat management	• 2,500 acres of Refuge lands managed to support a population of 400 to 700 sandhill cranes	• 2,950 acres of Refuge lands managed to support a population of 400 to 700 sandhill cranes	• 2,700 acres of Refuge lands managed to support a population of 400 to 700 sandhill cranes
	N/A	• Periodically sheet-flood irrigated pastures on North Stone Lake Unit in winter	• Same as Alternative B
	N/A	• Maintain 40 to 60 acres of agriculture fields (eg., corn, winter wheat and other small grains) on the Headquarters Unit of the Refuge for foraging cranes	• Same as Alternative
Pest control	• Use integrated pest management techniques to control weeds	• Same as Alternative	• Same as Alternative A
	• Continue cooperative water hyacinth control efforts	• Survey for and control Brazilian elodea	• Same as Alternative B
	• Continue using prescribed fire, where appropriate	• Depending on restrictions, employ prescribed burns to reduce nonnative annual grasses and replicate the historical fire regime	• Same as Alternative B
	• Drawdown managed permanent wetlands every two to four years to control carp populations and improve germination of desirable wetland plants	• Same as Alternative A	• Same as Alternative A
	N/A	• Cooperate with other entities to conduct weed control	• Same as Alternative B
HYDROLOGY MANAGEMENT			
Water Quality	• Develop a long-term water quality monitoring plan	• Same as Alternative A and:	• Same as Alternative B
	N/A	• Within 10 years of CCP approval, work toward achieving the water quality supply standard set forth by the USEPA, CDFG and the RWQCB	• Same as Alternative B

Table 1. (continued)

	Alternative A	Alternative B	Alternative C
	N/A	• Develop a water quality monitoring program to track contaminant concentrations, and water quality parameters resulting from current and future land use patterns around the Refuge within five years	• Same as Alternative B
	N/A	• Develop strategies to educate local landowners, businesses, and neighborhood organizations within the watershed about nonpoint sources of pollution	• Same as Alternative B
	N/A	• Expand outreach and education effort to inform upstream urban residents and businesses about the sensitivity of downstream water uses	• Same as Alternative B
Floodplain management	• Manage Refuge floodplain in a manner consistent with regional water quality objectives, as described in the EIS establishing the Refuge	• Same as Alternative A	• Same as Alternative A
	N/A	• Develop Refuge levee and flood control channel maintenance program	• Same as Alternative B
VISITOR USE			
Visitors	• 3,000 wildlife observation visits per year	• 10,500 wildlife observation visits per year	• 15,000 wildlife observation visits per year
Trails	• One trail	• 4.0 miles of foot trails open to the public 7 days a week with seasonal restrictions	• 6.0 miles of foot trails open to the public 7 days a week with seasonal restrictions
	N/A	• 2.0 miles of universally accessible trail to be constructed on the Headquarters Unit and named the Blue Heron Trails System	• 2.5 miles of universally accessible trail to be constructed on the Headquarters Unit and named the Blue Heron Trails System
	N/A	200 feet of boardwalk on Headquarters unit as part of the Blue Heron Trails System	• 140 feet of boardwalk on Headquarters unit as part of the Blue Heron Trails System
	N/A	• 40 vehicle parking capacity on Headquarters unit	• 40 vehicle parking capacity on Headquarters unit

Table 1. (continued)

	Alternative A	Alternative B	Alternative C
	N/A	• 1.5 miles of foot trails to be constructed on the South Stone Lake unit open to the public seven days a week with seasonal restrictions	• Same as Alternative B
	N/A	• 200 feet of boardwalk to be constructed on the South Stone Lake Unit open to the public seven days a week with seasonal restrictions	• Same as Alternative B
	N/A	• Develop a boat-accessible haul-out site, walking trail, and viewing blind on the South Stone Lake Unit	• Same as Alternative B
	N/A	• Provide parking and boat launch capacity for a maximum of 10 cartop boats on the Beach Lake unit	• Same as Alternative B
	N/A	• Restrict land-based visitor use near habitat suitable for heron/egret rookeries, nesting Swainson's hawks, and other areas used by nesting migratory birds during sensitive periods	• Same as Alternative B
	N/A	• Minimize disturbance to sandhill crane habitats by restricting public access during October through March	• Same as Alternative B
	N/A	• Reduce potential spread of invasive species by visitors by restricting access to paved or graveled trails	• Same as Alternative B
	N/A	N/A	• Develop two mile trail system on Lewis and North Stone Lake tracts to be open to the public seven days a week, with seasonal closures, and improve associated parking
	N/A	N/A	• Resolve access issues and develop a parking area for five to ten cars and walking trails on Lodi Gun Club
Hunting	• The 912-acre South Stone Lake Unit open to waterfowl hunting for up to 22 hunters, 2-3 days per week	• Same as Alternative A	• Same as Alternative A

Table 1. (continued)

	Alternative A	Alternative B	Alternative C
Fishing	• No legal fishing	• Within five years provide safe, boat-only fishing with day use parking facilities to accommodate a maximum of twenty boats on South Stone Lake and a minimum of ten boats on SP Cut from June through September	• Same as Alternative B
	N/A	• Fishing will be in accordance with all State regulations, will not include take of frogs or crayfish and will only be done with rod and reel	• Same as Alternative B
Wildlife Viewing and Photography	N/A	• Minimum of two photography blinds to be constructed	• Same as Alternative B
	N/A	• Construct a viewing platform on the Headquarters Unit	• Same as Alternative B
	N/A	• Construct a vehicular access point, parking area for 15 cars, a trail and a wildlife observation platform on southern North Stone Lake Unit	• Same as Alternative B
	N/A	• Provide parking for up to 20 cars at the boat launch on the South Stone Lake Unit	• ame as Alternative B
Environmental Education and Interpretation	N/A	• Develop a self-guided trail as part of the Blue Heron Trails System with hands-on learning stations within two years	• Same as Alternative B
	N/A	• Develop a class/group staging area and 5 open air interpretive shelters with one kiosk and exhibits as part of the Blue Heron Trails System to accommodate approximately 40 children	• Same as Alternative B
	N/A	• Develop interpretive displays on the Headquarters Unit to illustrate traditional dwellings, various subsistence strategies, and the overall lifestyle of local American Indians	• Same as Alternative B
	N/A	• Develop self-guided trail and interpretive displays for the Wetland Preserve Unit	N/A

Table 1. (continued)

	Alternative A	Alternative B	Alternative C
	N/A	N/A	• Develop interpretive panels and exhibits on South Stone Lake Unit
Boating	• High speed boating (waterskiing) occurs as a non-sanctioned use, but has been allowed to continue pending compatibility determination. High speed boats (waterskiers) launch from off the refuge and ski through the Refuge.	• No-wake speed limit	• Same as Alternative B
	N/A	• Develop and maintain a safe public parking lot and boat launch facilities to accommodate a maximum of 20 cartop boats on the South Stone Lake Unit	• Same as Alternative B
	N/A	• Provide a launch for pre-registered canoe/kayak groups in SP Cut on the Beach Lake Unit from June through September	• Same as Alternative B
	N/A	• Restrict water-based visitor use near habitat suitable for heron/egret rookeries and Swainson's hawks during sensitive periods	• Same as Alternative B
	N/A	• Develop facilities for mobility impaired persons to enter and exit canoes and kayaks safely	• Same as Alternative B
Cultural resources management	• Develop additional measures to protect, stabilize and/or remediate past damages if necessary	• Same as Alternative A and:	• Same as Alternative B
	• Meet annually with the Ione Band of Miwok Indians and other concerned tribal groups to discuss land management and restoration activities planned for the upcoming field season	• Within 15 years evaluate conditions of known cultural resource sites on Refuge managed lands and conduct seasonal monitoring of known sites	• Same as Alternative B
	N/A	• Develop a minimum of two interpretive panels and exhibits to be located on various units to share with the public the importance of cultural resources on the Refuge and American Indian cultural practices	• Same as Alternative B

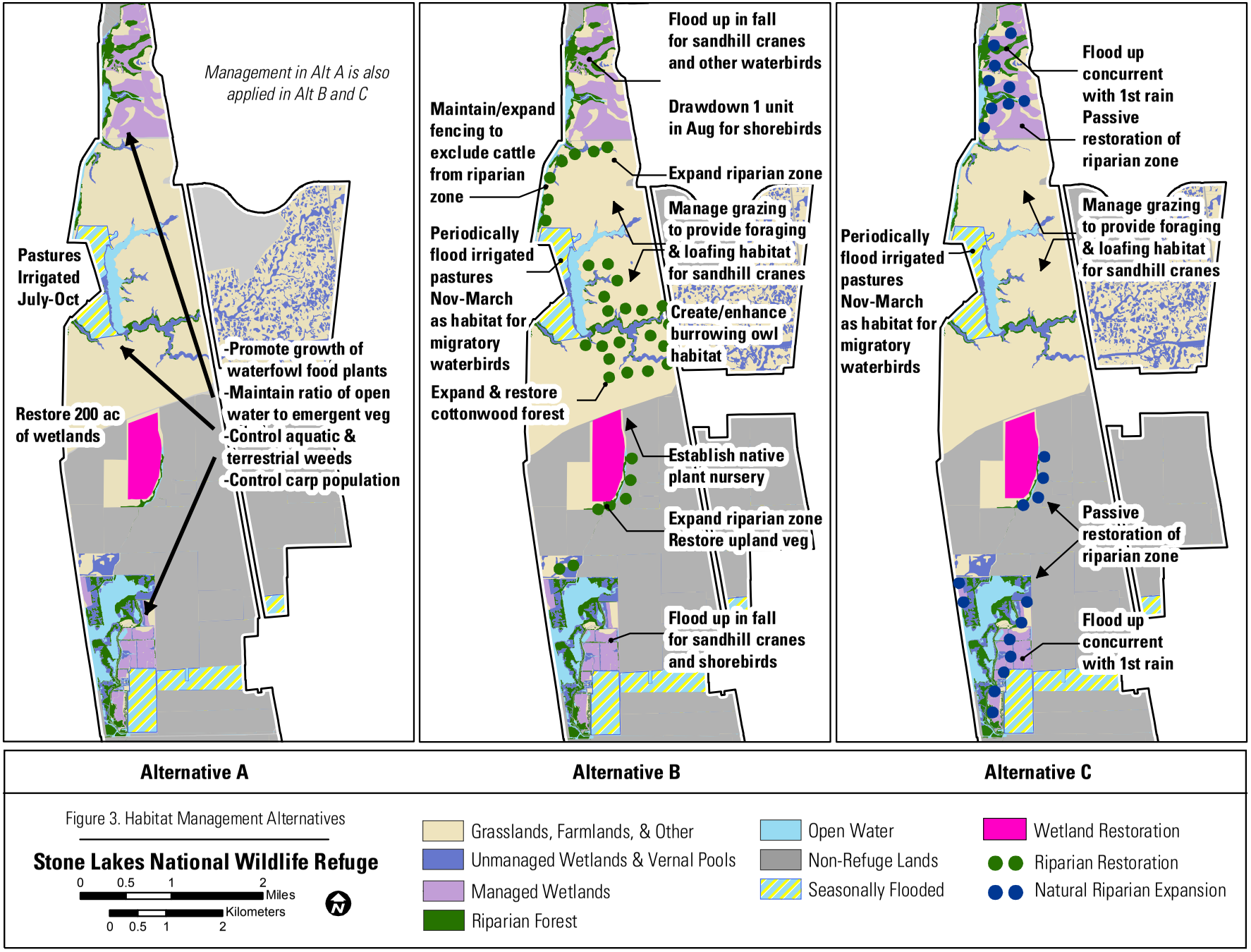


Figure 3. Habitat Management Alternatives

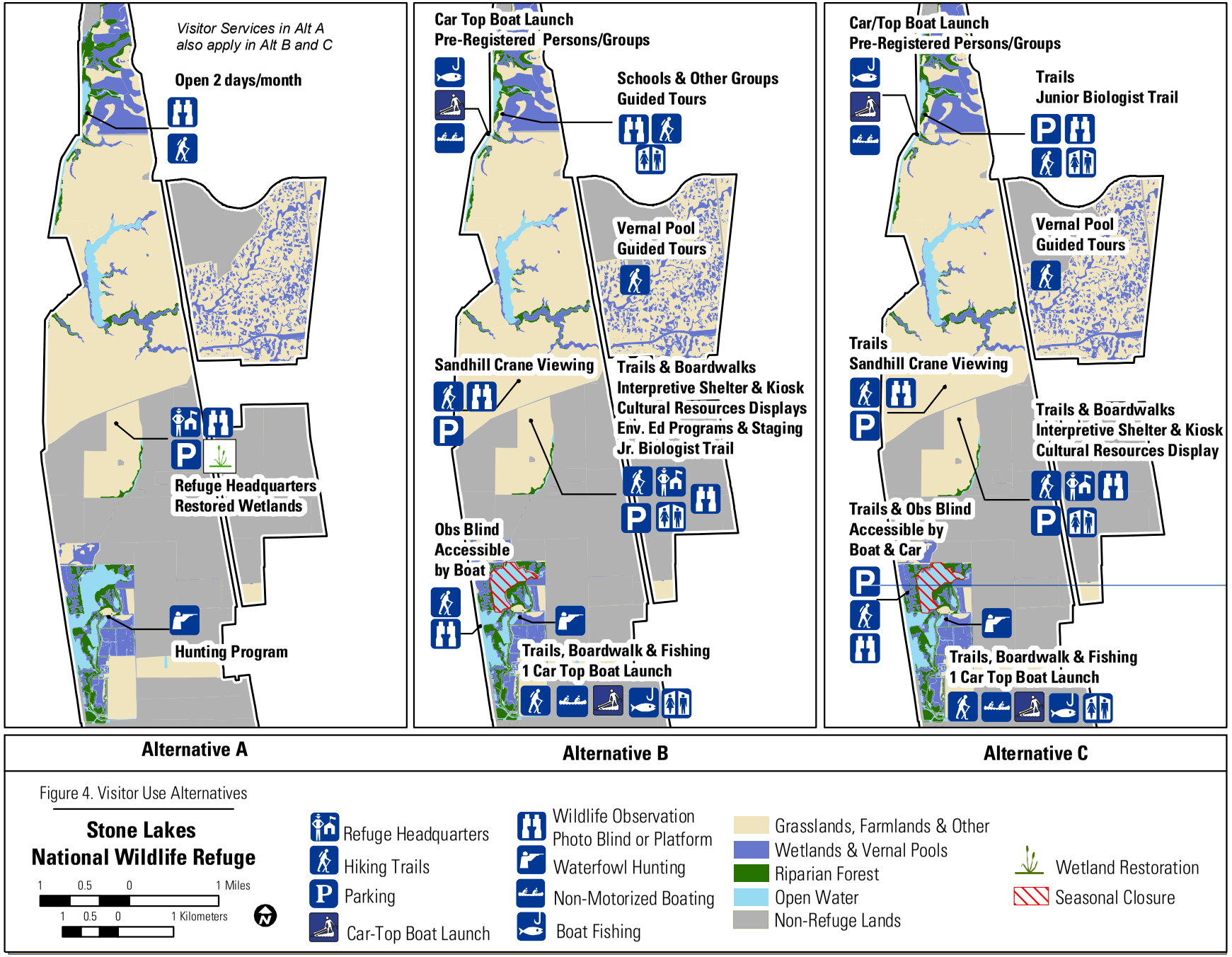


Figure 4. Visitor Use Alternatives

Vernal Pool Management
Vernal pools are present on the North Stone Lake and Wetland Preserve units. The Wetland Preserve Unit contains the highest concentration of vernal pools (98 percent of all Refuge vernal pools) that harbor the Federally-listed vernal pool fairy shrimp (*Branchinecta lynchi*) and vernal pool tadpole shrimp (*Lepidurus packardi*) and many vernal pool plant and animal species of concern (USFWS 2005). Only 12 percent of the vernal pools located on the Refuge are naturally occurring. The majority have been created over the last 15 years as mitigation for vernal pool loses elsewhere.

Hunting
Through a separate planning process from the Refuge CCP, the Service has implemented a waterfowl hunting program on the Refuge that will remain in effect under all Alternatives. Currently, the program is offered two days per week on the South Stone Lake Unit and consists of seven spaced blinds, with an emphasis on youth and handicap hunters. Over the next five years, the program will expand to provide hunting opportunities for up to 22 hunters. Hunting occurs currently only on the Sun River property of the South Stone Lake Unit but as more resources become available for the Refuge, the program will expand to include more of South Stone Lake. The Service currently emphasizes youth hunting by reserving at least two blinds for youth hunters and by providing two youth hunts before and after the waterfowl season in accordance with State regulations. Currently, the entire program is operated by the Refuge but the California Department of Fish and Game may assume a more active role, in cooperation with the Service, as hunting expands.

Boating
A number of private landowners with property adjacent to the Refuge have allowed access to waterways in the Stone Lakes Basin for a variety of different boating activities (e.g., waterskiing, fishing, waterfowl hunting). The Service has allowed boating to continue on Refuge waters within the Beach Lake and North Stone Lake units pending finalization of compatibility determinations for visitor uses. Under all alternatives, the Service will continue to allow some boating on the Refuge.

Cultural Resources
To preserve and minimize disturbance to Refuge archaeological and historic resources, all undertakings, including but not limited to ground disturbance and prescribed burns, will be coordinated with the Service's Regional Archaeologist. In consultation with the State Historic Preservation Office and local tribal representatives, the Service will ensure that Refuge activities comply with all relevant cultural resource protection laws, including Section 10 of the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act. Any cultural resources overviews or site surveys for properties or monitoring of ground disturbing activities will be conducted by qualified professional archaeologists. The Refuge will continue to consult regularly with the Ione Band of Miwok Indians and other concerned tribal organizations on management and restoration projects, as well as plant-gathering activities and interpretive projects.

Alternatives Removed From Further Consideration

Auto Tour Route on North Stone Lake Unit and Associated Trails
The Service considered creating an automobile tour route and associated walking trails on the North Stone Lake Unit. Developing an auto tour route was rejected because since the entire unit lies within the 100-year floodplain, accommodating vehicle traffic would necessitate construction of new roads involving major grading and gravel placement on a unit where preservation of natural topography and hydrology and native grass communities are management priorities. Furthermore, greater sandhill cranes (*Grus canadensis tabida*) and white-fronted geese use the area for foraging during winter and are highly sensitive

to automobile and pedestrian traffic. An auto tour route would also further fragment the, already limited crane habitat on the Refuge. Walking trails and a viewing platform on the North Stone Lake Unit are still components of the alternatives considered in this CCP.

Equestrian Use
After receiving inquiries from selected members of the public, the Service evaluated accommodation of equestrian use on the Refuge. However, this is considered a non-wildlife-dependent use and there are no trails suitable for riding that would not conflict with other priority visitor uses. Moreover, there are no adequate parking facilities for horse trailers and the Service determined that the limited parking areas available should be primarily for priority visitor uses such as wildlife observation and fishing that do not require trailers. Horses traveling through the Refuge may be a source for the introduction and spread of exotic and invasive plants . Many trails are primarily on levees and use by horses, particularly after precipitation, could accelerate the erosion of these levees. Other nearby areas have more extensive horse trails and are better able to accommodate horse use. These areas include the American River Parkway and Auburn State Recreation Area.

Upland Game and Deer Hunting
Refuge Staff considered the inclusion of upland game and deer hunting in formulating the alternatives. However, since such a program would be limited to land that the Service owns in fee (1,740 acres in four isolated areas; only two of which support upland habitat), not enough acreage is in Refuge ownership to provide quality, safe upland game or deer hunting with a reasonable chance of hunter success. If additional lands are added to the Refuge, upland game and deer hunting could be reconsidered.

Fishing Derbies
Some of the public suggested the Service consider fishing derbies on the South Stone Lake Unit. Fishing derbies typically involve fast moving, gas powered boats that conflict with other non-motorized boats, such as canoes or kayaks, used for wildlife observation. Furthermore, South Stone Lake is a small body of water with underwater hazards and dense, submerged vegetation and is too small for a quality fish derby. Other nearby locations, such as reservoirs, are better suited for this activity.

Alternative A: No Action

Under this alternative, the Service would continue to manage Stone Lakes Refuge as it has in the recent past. Management would be consistent with the "Current Management" section in Chapter 3 of the CCP. Current staffing and funding needs would remain the same.

Habitat Restoration
Under this alternative, the 330-acre Headquarters Unit would be restored primarily to wetland habitat (200 acres), with 50 acres of native grassland habitat and 80 acres of farmed land.

Migratory Birds
Flood up, drawdown and summer irrigations will continue to be scheduled to provide habitat for migrating, wintering and breeding birds. These actions will occur on 840 acres of wetlands, 360 acres of riparian habitat, 3,320 acres of grassland habitat, 400 acres of open water/aquatic bed habitat, 460 acres of irrigated pasture and 305 acres of cropland. Seasonal wetlands will be managed to provide feeding and loafing habitat for wintering migratory waterbirds. Water would continue to be carefully managed to produce food and to create habitat for nesting waterbirds. The Service would continue to maintain water through most of the summer in permanent wetlands to provide rearing habitat for waterbirds and year-round habitat for other species, such as bitterns, herons and marsh wrens (*Cistothorus*

palustris). Drawdowns will continue to vary to stimulate production of a variety of plants and to provide habitat for nesting shorebirds. Wildlife friendly farming practices would be continued to supply grain and other forage for birds on about 320 acres.

Monitoring
The Service would continue its ongoing monitoring programs, including colonial waterbird nesting, landbird, song sparrow, weekly waterfowl, plant, noxious weed and residual dry matter (dry grass remaining after the growing season) surveys.

Special Status Species
Sandhill crane. Under this alternative, the Service would continue to manage the Refuge to benefit sandhill cranes by managing 460 acres of irrigated pasture, 540 acres of seasonally flooded wetlands, 305 acres of cropland, and 3,320 acres of grassland habitat.

Swainson's hawk. The Refuge would continue to provide breeding and foraging habitat for Swainson's hawks (*Buteo swainsoni*). However, there would be no increase in these habitats since no additional acres of riparian, grassland, or wetland habitat would be restored.

Valley elderberry longhorn beetle (VELB). Although there are no documented occurrences of the Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*, VELB) on the Refuge, suitable VELB habitat is present on the Refuge. All existing elderberry shrubs (*Sambucus* sp.), the host plant for the VELB, are mapped. Shrubs that may be affected by the water hyacinth control program are monitored during the water hyacinth control season to minimize disturbance during water hyacinth control operations.

Giant garter snake. The most recent documented occurrence of the giant garter snake (*Thamnophis gigas*) on the Refuge was in 1992 at Beach Lake. Recent surveys have not located any, although the snake is presumed to be present on the Refuge. Aside from avoidance, no specific measures have been taken to manage for the snake.

Wetland, Grassland, Riparian Habitats
Wetlands would continue to be managed for the benefit of migratory birds. Wetlands (moist soil units) would be flooded from September to May for the benefit of migratory waterbirds. Grassland habitat would continue to be mowed and grazed. Grazing would occur on about 1,900 acres of the Refuge on the North Stone Lake Unit. No attempts to restore native grassland would be pursued. The Service would continue to allow researchers to conduct research on the Refuge but would not actively encourage or support research.

The Service would continue to manage the existing riparian habitat and would continue, sporadically, to plant riparian vegetation up to one mile from the edge of the SP Cut and adjacent to lakes on the Refuge where soils are appropriate and as time and funding allow. Little or no active riparian restoration would occur.

New Lands
Additional lands within the approved Refuge boundary that come under Refuge management would be evaluated and either maintained in agriculture beneficial to wildlife or developed into natural habitats, such as wetlands, grasslands and riparian areas, depending on site-specific conditions.

Visitor Services
Under alternative A, the Refuge visitor services program would continue as described under "Visitor Services" in Chapter 3 of the CCP. The Refuge would continue its current

wildlife observation and photography program, limited to two Refuge tour days per month. Environmental education would not change on the Refuge. Twenty-five groups would continue to visit the Refuge at their current level, with a limited number of presentations by Refuge staff at schools, public service and conservation group meetings. The Refuge would continue to host Walk on the Wildside, an annual special event held on the Refuge. The Refuge would continue to offer a waterfowl hunting program on the South Stone Lake Unit. Sixteen hunters would be accommodated two days a week. Under this alternative, an emphasis would be placed on youth and disabled hunters. In addition to blinds reserved for youth and disabled hunters, the Refuge would hold two youth hunts before the hunting season and two after the season.

Alternative B

Alternative B is the preferred alternative because it meets the criteria described in the Proposed Action Criteria section at the end of this chapter. Under Alternative B, the Refuge would continue its current focus of providing wintering habitat for migratory birds and management for the benefit of special status species. Management programs for migratory birds and other Central Valley wildlife would be expanded and improved, as described below. Visitor use opportunities would also be expanded as described below.

Habitat Restoration

Alternative B would include the same elements as Alternative A. The Service would also restore Refuge lands based on the habitat requirements of migratory birds and special status species, which includes 65 acres of riparian habitat, 40 acres of wetland habitat and 30 acres of native grassland habitat.

Migratory Birds

Alternative B would include the same elements as Alternative A. Additional riparian and seasonal and permanent wetlands would be restored. Measures would be implemented to increase the food supply and provide additional migratory bird habitat, such as sheet flooding irrigated pastures, habitat manipulations, grazing to promote native grasses and forbs and exploring reverse-cycle wetland regimes. Reverse-cycle wetlands are flooded during the spring/summer and are dry during the fall/winter. Additional coordination is planned with other agencies and nongovernmental organizations under Alternative B. Visitor use would be restricted during heron and Swainson's hawk nesting and sandhill crane roosting. A portion of South Stone Lake would also be closed to boating seasonally to protect nesting waterbirds and giant garter snake habitat.

Monitoring

Under this alternative, monitoring would be the same as for alternative A. In addition, the Service would monitor wetland, riparian and oak woodland habitats each spring for invasive species, such as cocklebur, yellow starthistle and perennial pepperweed. The Service would develop a Refuge water-quality monitoring program, expand migratory bird monitoring and develop surveys on the South Stone Lake, Headquarters, Wetlands Preserve units and other lands as they come under Refuge management.

The Service would continue to collaborate with Sacramento-Yolo Mosquito Vector Control District (SYMVCD) on the ongoing landbird monitoring program and pursue funding for a seasonal employee or graduate students to assist with the banding program and data analysis to assess population trends and assist with developing associated habitat restoration and management plans. This expansion is not included in Alternative C.

Special Status Species
Sandhill crane. Under this alternative, the Service would continue to manage for cranes as in Alternative A. In addition, there would be an increase of 80 acres of foraging and resting habitat with 50 acres of wetland and 30 acres of native grasslands habitat restored. In addition, when possible, Refuge staff would begin flooding moist soil units in early September to provide shallow water for cranes earlier in the season.

Swainson's hawk. Under this alternative, there would be an increase in 65 acres of breeding habitat since 65 additional acres of riparian habitat would be restored. In addition, 30 acres of native grassland would be restored, adding to existing foraging habitat.

Valley elderberry longhorn beetle (VELB). The Refuge would continue to map and monitor elderberry shrubs as in Alternative A. In addition, the Service would restore 40 acres of riparian understory, to include elderberry shrubs, which would benefit the VELB.

Giant garter snake. Same as Alternative A.

Wetland, Grassland, and Riparian Habitats
Wetland habitat would be expanded on 50 acres of the South Stone Lake Unit. The Service would use the same tools and techniques to manage wetland units under Alternative B as it does under Alternative A. However, some fields would be flooded in early September to provide habitat for cranes earlier in the year. Under Alternative B, seasonal marsh management activities would be the same as described under Alternative A. In addition, one permanent wetland unit would be drawn down in August to provide habitat for migrating shorebirds. Vernal pools on the Wetland Preserve Unit would be grazed.

Portions of the Beach Lake, North Stone Lake, and South Stone Lake units would be closed as a sanctuary. The Lewis property of the Beach lake Unit and the Wetland Preserve and portions of the Headquarters units would be subject to seasonal closure to provide wildlife sanctuaries.

Grassland habitat would be restored on 30 acres. For this alternative only, burrowing owl habitat would be improved by reintroducing ground squirrels (*Spermophilus beecheyi*) and constructing artificial burrows. Irrigated pasture would be grazed from July through October to promote native grasses and forbs and shortgrass conditions.

Riparian habitat would be expanded along lower Morrison Creek on the Beach Lake Unit, the south arm of North Stone Lake and the Sacramento drainage canal and South Stone Lake on the Headquarters and South Stone Lake units. In addition, riparian habitat would be managed for a variety of different successional stages for the benefit of neotropical migrants, colonial nesting birds and raptors.

New Lands.
Same as alternative A.

Visitor Services
Visitor Services would be improved and expanded under alternative B. For example, the number of units open to visitors would increase from one to five. In addition, environmental education, interpretation, wildlife observation, wildlife photography, hunting and fishing programs would be expanded, as described below. Visitor Services would be offered on the South Stone Lake, Headquarters, Beach Lake, Wetland Preserve and North Stone Lake units. The South Stone Lake, Headquarters, and a portion of North Stone Lake units would be open to visitors seven days a week from sunrise until sundown.

Visitor services would be concentrated south of Hood-Franklin Road at the Headquarters and South Stone Lake Units. A trail system with boardwalks, interpretive displays, parking for 40 cars and an environmental education center would be constructed on the Headquarters Unit. A trail system and observation platform overlooking South Stone Lake would be constructed. The environmental education and interpretive programs would be facilitated by Refuge staff or volunteers.

A boat launching area would be provided on the Sun River property of the South Stone Lake Unit for fishing, wildlife observation and photography from boats. Only non-motorized, hand-launched boats (e.g., canoes, kayaks) or non-trailered boats with electric motors would be allowed. A no-wake zone with boat speeds of less than five mph will be enforced for all Refuge waters. All fishing would be from boats only. A boat haul-out site would be constructed on the Lodi Unit upstream from Sun River. Non-motorized boating by pre-registered groups, including commercial outfitters who engage in fishing, and wildlife observation, would also be allowed on SP Cut on the Beach Lake and North Stone Lake units at the west end of Elliott Ranch Road.

Safe access to the North Stone Lake Unit would be constructed to a parking area for 25 cars on the north side of Hood-Franklin Road. A short trail would lead to an observation platform overlooking North Stone Lake to provide visitors an opportunity to view sandhill cranes and other wildlife. Schools and other groups would use the Beach Lake Unit for guided tours only.

The Wetland Preserve Unit would be open to the visitors for guided tours and via a self-guided trail.

The volunteer and outreach programs would expand and become more defined.

The hunt program would be the same as alternative A.

Other major new visitor services projects under this alternative include: developing new interpretive signs, displays and interpretive brochures for the Wetland Preserve and Headquarters units; and constructing and making accessible on a daily basis, a kiosk, boardwalk, and four miles of walking trails on the Headquarters Unit; and constructing two photo blinds and additional hunting blinds on the South Stone Lake Unit.

Alternative C

Under this alternative, the Service would continue to focus on providing wintering habitat for migratory birds and managing for endangered species while placing a greater emphasis on historic conditions in management and habitat restoration activities as described below. Opportunities for the six priority public uses would be expanded from both alternatives A and B.

Habitat Restoration

Management of newly acquired Refuge lands would focus on the restoration of historic native plant communities rather than maintaining lands in agriculture or constructing wetlands. Under this alternative, 40 acres of riparian, 25 acres of understory shrub, 50 acres of wetland and 30 acres of native grassland habitat would be restored.

Migratory Birds

Alternative C would be similar to alternative B, however, more emphasis would be placed on restoration of natural conditions. Riparian restoration would be accomplished by natural process restoration. Flood up would not occur in early September as in alternatives A and B, but would begin with the first rainfall.

Monitoring
Same as Alternative B, except that there would be no expansion of the SYMVCD monitoring.

Special Status Species
Sandhill crane. Same as alternative B.

Swainson's hawk. Same as alternative B, except that restored breeding habitat would be increased by 40, rather than 65, acres. Restored foraging habitat would remain the same as in Alternative B.

Valley elderberry longhorn beetle (VELB). Same as alternative B, except with fewer acres of riparian understory shrubs planted. In alternative B, 40 acres of shrubs would be restored; under alternative C shrub habitat would increase naturally by approximately 25 acres.

Giant garter snake. Same as Alternative A.

Wetland, Grassland, Riparian Habitats
Grassland and wetland habitat will be restored as in alternative B. Although seasonal wetlands would still be managed to provide feeding and loafing habitat for waterbirds, they would not be managed as intensely as the moist soil units in alternatives A and B. would In addition, flood-up for seasonal wetlands would begin with the first rainfall in fall rather than beginning in early September.

Riparian habitat restoration would be through natural process-based restoration only. Vegetation would not be planted, but would be allowed to expand naturally. In addition, the Service would allow riparian habitat to expand naturally into managed seasonal and permanent wetland units.

New Lands
Under this alternative, new lands brought under the protection of the Refuge System would be restored to historic conditions, where feasible. Restoring new lands to natural historic conditions would probably result in restoration of grassland habitat and to a lesser extent, wetland and riparian habitats. By contrast, alternatives A and B would likely result in more wetland habitat than grassland habitat.

Visitor Services
Under this alternative, visitor service facilities would be expanded as in alternative B. In addition, the Beach Lake Unit would be open to visitors seven days a week from sunrise to sunset, subject to seasonal closure.

Visitor Services provided at the Headquarters Unit would be similar. However, the environmental education and interpretive programs would de-emphasize programs facilitated by Refuge staff or volunteers and tours would be self-guided.

Visitor services for the South Stone Lake Unit would be similar to those offered in Alternative B. In addition to the facilities for South Stone Lake described in Alternative B, the Service would create vehicle access to a parking area for up to ten cars. The parking area would be connected to the trail system.

Visitor services for the north side of Hood-Franklin Road would be the same as Alternative B.

In addition to the guided tours and canoe and kayak groups described in Alternative B, visitor services concentrated in the Beach Lake Unit would include environmental education, interpretation, wildlife observation and photography. The parking area near the corral on the North Stone Lake Unit would be improved and include restrooms, trails, interpretive displays, and an environmental education kiosk.

Visitor services for the Wetland Preserve Unit would be the same as alternative B.

The hunt program would be the same as alternative A.

The volunteer and outreach programs would be the same as alternative B.

Proposed Action Criteria

The planning policy that implements the Improvement Act of 1997 requires the Service to select a preferred alternative that becomes its proposed action, as required by the NEPA. The written description of this proposed action is effectively the draft CCP. Alternative B is the proposed action for the Refuge because it best meets the following criteria:

- achieves the mission of the National Wildlife Refuge System;
- achieves the purposes of the Refuge;
- provides guidance for achieving the Refuge's 15 year vision and goals;
- maintains and restores the ecological integrity of the habitats and populations on the Refuge;
- addresses the important issues identified during the scoping process;
- addresses the legal mandates of the Service and the Refuge; and
- is consistent with the scientific principles of sound fish and wildlife management and endangered species recovery.

The proposed action described in this EA is preliminary. The action ultimately selected and described in the final CCP will be determined, in part, by the comments received on this version of the EA. The proposed action presented in the final CCP may or may not be the preferred alternative presented in this version. The final CCP may propose a modification of one of the alternatives presented here or a combination of elements from more then one alternative. Alternative B is the preferred alternative.

Chapter 3. Affected Environment

Chapter 3 of the CCP provides a detailed description of the affected environment for Stone Lakes.

Chapter 4. Environmental Consequences

Overview of the NEPA Analysis Parameters

This chapter describes the direct, indirect and cumulative impacts of the three alternatives. The purpose of this analysis is to provide the context and intensity of the impacts of each action, such that a determination of significance can be made by the deciding official.

In 1978, the Council on Environmental Quality promulgated regulations for implementing the NEPA. These regulations include a definition of significantly as used in the NEPA (40 CFR 1508.27). The elements of this definition are critical to reducing paperwork through use of a Finding of No Significant Impact (FONSI) when an action will not have a significant effect on the human environment and is therefore exempt from requirements to prepare an environmental impact statement (EIS). Human environment is a comprehensive phrase that includes the physical and natural environments and the relationship of people with those environments. Many of the analyses focus on the different resource areas such as soils, air quality, water quality, plant communities, wildlife, visitor services and others. It is important to note that for each of these criteria all of these resources, or human environments, have been considered.

The significance of an action must be analyzed in several contexts, such as the whole of society; affected region; affected interests and locality. Significance varies with the setting. In the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

The regional context of the action alternatives is the Beach–Stone Lakes Basin. Even in a local context, the action alternatives would not pose significant short- or long-term effects. The action alternatives are designed to minimize and avoid adverse impacts to the extent that such impacts are less than significant, even a the local level.

Alternative A, the No Action Alternative, is a continuation of current management practices; it serves as the baseline against which Alternatives B and C are compared. Discussion of the action alternatives, Alternatives B and C, follow each discussion of No Action.

Soils

Common to all Alternatives. Under all alternatives the Refuge would continue to use, Service-approved aquatic herbicides, such as Aquamaster and Remedy and terrestrial herbicides such as Roundup and 2, 4-D, for weed control. Glyphosate, the active ingredient in Aquamaster and Roundup, is considered nonmobile in soils and sediments because it rapidly and strongly adheres to soil particles and degrades in the soil. Glyphosate is moderately persistent in the soil, with an estimated half-life of 47 days. Glyphosate has no known effect on soil microorganisms. The World Health Organization (1984) concluded that 2, 4-D does not accumulate or persist in the environment. The primary degradation mechanism is microbial metabolism, but mineralization and possibly photolysis may also play a role. The average half-life of 2, 4-D is ten days (Tu, M. et al 2001).

Alternative A. Under Alternative A, the Service would complete construction of wetlands and grasslands on the Headquarters Unit and would redesign the Headquarters entrance; as described in a previous draft Environmental Assessment (EA), issued March 4, 2005. Construction activities could result in large areas of bare soil that could be subject to erosion. Erosion is expected to be minor and localized because construction will occur only during the dry season, the terrain is flat and the Refuge will employ dust control measures.

Alternative B. In addition to the potential soil impacts related to construction on the Headquarters Unit, Alternative B could also result in similar impacts due to restoration activities, including restoration or enhancement of 105 acres of riparian and oak woodland habitat, 30 acres of grasslands and 50 acres of wetlands. Developing visitor facilities on the South Stone Lake, Headquarters, North Stone Lake, Beach Lake and Wetland Preserve Units could result in impacts, as well. These impacts are expected to be minor and localized for the same reasons described above. Additional short-term disturbance would result from mechanical removal of nonnative weeds from the seasonal marsh, riparian and upland habitats.

Alternative C. In addition to the soil impacts described under Alternative B, Alternative C also includes other Refuge improvements that could result in the same type of impacts. These improvements include natural process-based restoration of 65 acres of riparian habitat in addition to the same construction, weed removal and wetland and grassland restoration as in Alternative B.

Water Quantity and Quality

Common to all Alternatives. Under all alternatives, the conversion of 200 acres of former agricultural lands on the Headquarters Unit to wetlands would add to the region's floodwater storage capacity and help maintain water quality by trapping sediments and removing some excess nutrients.

Alternative A. No impacts on water quality or quantity are anticipated under Alternative A. Under all alternatives, glyphosate will be used in the form of Roundup and Aquamaster to control aquatic and terrestrial weeds. In most cases, glyphosate will dissipate rapidly from natural water bodies through adsorption to organic substances and inorganic clays, degradation and dilution (Folmar et al. 1979, Feng et al. 1990).

Alternatives B and C. Under Alternatives B and C, periodic flooding of irrigated pastures would begin earlier each fall, adding to groundwater recharge. The restoration and natural expansion of riparian vegetation would help to stabilize shorelines; this would reduce erosion and the resulting sediment loads in Refuge waters, improving water quality. The prohibition of gas-powered boats within the Refuge under Alternatives B and C would contribute to better water quality by removing a source of turbidity, potential petroleum leaks and inadvertently transported aquatic nuisance species. As new lands come under Refuge management and are either converted from agricultural uses or removed from urban development pressures, further benefits to water quality would accrue through reductions in: erosion, sedimentation and nonpoint source pollution.

Air Quality

Alternative A. Under all alternatives, soil disturbance and/or use of heavy equipment would cause short-term increases in dust (particulate matter less than 10 microns [PM10]) and tailpipe emissions of PM10, nitrogen oxide (NO_X) and reactive organic gasses (ROG), including those activities associated with the restoration of wetland habitat on the Headquarters Unit. However, implementation of Alternative A (No Action Alternative) would not substantially increase pollutant emissions related to Refuge management in the long term. Since no increase in the level of visitor services is proposed, visitor use levels and vehicle trips to and from the Refuge are expected to increase only moderately as the population of the surrounding region grows.

Alternatives B and C. In addition to the short-term impacts to air quality from wetland restoration on the Headquarters Unit, under Alternatives B and C, there would be both short and long-term increases in pollutant emissions. Short-term increases in PM10 and

tailpipe PM10, NO_X and ROG would result from restoring riparian habitat on the North Stone Lake, Headquarters, and South Stone Lake units and constructing trails, parking areas and observation platforms. Tailpipe emissions (ROG, NOX, and PM10) would result from the use of combustion engines in construction equipment and employee vehicles during trips to and from the job sites. Dust emissions and generation (PM10) would result from the excavation, transport and grading of large amounts of soil.

Long-term increases in emissions would result from the growing number of vehicular trips to, from and on the Refuge as visitation increases. This increase is expected to be similar under both action alternatives, at about 10,500 to 15,000 more visitors per year by 2012. However, there would be a slight decrease in emissions from gasoline powered boats since only non-motorized and electric motor boats would be allowed.

Plant Communities

Common to all Alternatives. Discing, mowing, chemical treatments, and occasionally grazing would be periodically used to maintain cover of emergent vegetation in seasonal wetland impoundments at 45-55 percent of total wetland surface area. The Service would continue to physical and chemical means to control undesirable plants such as cocklebur and joint grass. These same techniques would be used to manage vegetation in about 25 percent of the moist soil impoundments each year to reduce the cover of emergent vegetation and encourage the growth of annuals that provide food for waterfowl, maintaining an equal ratio of open water to emergent vegetation. The Service would continue to mow and graze grassland habitat to reduce the cover of non-native annual grasses and promote native species.

All applications of aquatic herbicides (e.g., glyphosphate, diquate dibromide) will be from properly calibrated and maintained ground or boat-mounted spray apparatus. In keeping with product labels, no applications will occur when wind speeds exceed 10 miles per hour. All applications will occur in compliance with best management practices identified in the Aquatic Pesticide Application Plan for the Statewide National Pollution Discharge Elimination System (NPDES) General Permit (No. CAG990005) for discharge of aquatic pesticides administered by the Central Valley Regional Water Quality Control Board.

Alternative A. Under Alternative A (no action), current vegetation management would continue unchanged. Wetlands would be flooded from early September through May for the benefit of migratory waterbirds and would continue to be mowed, grazed, disced and sprayed with pesticides. In addition, under all alternatives, the Service would maintain 360 acres of riparian and oak woodland habitat, 529 acres of moist soil seasonal wetlands, 136 acres of vernal pool seasonal wetlands, 715 acres of permanent wetlands, 460 acres of irrigated pasture/wet meadow and restore 25 acres of riparian habitat on the Headquarters Unit.

Alternative B. Alternative B would include the same vegetation management measures as described under Alternative A. In addition, the Service would increase the cover of native seasonal marsh plants on the Refuge by controlling nonnative weeds. In addition, the Service would restore 65 acres of riparian and oak woodland habitat, along the North Stone Lake, Headquarters and South Stone Lake units, as well as enhancing 40 acres of understory shrub and herbaceous vegetation in existing riparian areas. Planting riparian vegetation and restoring seasonal wetland and grassland habitat would have a beneficial effect on local and regional biodiversity because the vast majority of the historic riparian vegetation in the Central Valley has been lost or degraded. Under both Alternatives B and C, 30 acres would be planted to restore native grasslands throughout the Refuge. This would have a beneficial effect on the Refuge's vegetation because it would restore a larger diversity of the Refuge's native plant cover.

Enhancement and restoration of native grasslands, wetlands, and riparian habitats on the Refuge would not exacerbate threats of weed infestations to adjacent properties because Refuge staff and cooperators would continue to promote desirable vegetation and control invasive weeds as part of ongoing management programs. Some weed species of concern that will require ongoing control include: perennial pepperweed or whitetop, yellow star thistle, Johnson grass, and fennel or anise. Control of invasive weeds would be part of an integrated pest management program that would include physical (e.g., mowing, discing, grazing, and burning) and chemical (herbicide) treatments.

Alternative C. Impacts under Alternative C would be similar to those described under Alternative B, with a few differences. Riparian habitat expansion would be allowed to proceed through natural succession and volunteering by riparian woody species. There would be no active planting of riparian vegetation. However, riparian vegetation would be allowed to expand into wetland habitat on the Beach Lake and South Stone Lake units. Under Alternative C, the Service would restore 65 acres of riparian vegetation as under Alternative B. This would have a beneficial effect on the Refuge's vegetation because it would restore a larger diversity of the Refuge's native plant cover.

Wildlife

Common to all Alternatives. Under all alternatives, the Service would continue to allow the Sacramento Yolo Mosquito Vector Control District (SYMVCD) to monitor and control mosquitos on the Refuge. The typical monitoring and control period is March through October. The mosquito species identified by SYMVCD for monitoring and control at the Refuge are *Culex tarsalis, Anopheles freeborni, Ochlerotatus vexans, Ochlerotatus melanimon, Ochlerotatus nigromaculis,* and *Aedes increpitus*. The SYMVCD would use the biological larvicides *Bacillus thuringiensis isrealensis* (Bti) and *Bacillus sphaericus* (Bsp) and the insect growth inhibitor methoprene. The bacterium Bti is a microbial insecticide that, when ingested, is toxic to mosquitos, black flies and several other members of the Nematocera suborder within the order Diptera. Methoprene is an insect growth regulator that interferes with the normal maturation process of mosquitos. In the event, adulticide applications become necessay, SYMVCD will utilize synthetic pyrethrins or the organophosphate Naled, applied from an ultra-low volume ground rig.

See Appendix P: Integrated Pest Management Plan for Mosquito-Associated Threats and Appendix A: Compatibility Determination, Use: Monitor and Control Mosquitos, for detailed descriptions of mosquito control on the Refuge and the potential impacts to target and non-target organisms.

Under all alternatives, control of invasive weeds, particularly aquatic weeds such as water hyacinth, currently require the application of herbicides (i.e., Diquat dibromide and Glyphosate). Glyphosate has low acute toxicity, is not a carcinogen, does not adversely affect reproduction and development, and does not bioaccumulate (build up) in mammals (Monsanto 2001). When applied properly, Glyphosate is of relatively low toxicity to birds, mammals and fish (Evans and Batty 1986). However, amphibians may potentilly be negatively affected by Glyphosate that enters aquatic systems (Smith 2001).

All alternatives identify herbicide use to control invasive terrestrial or aquatic weeds. Glyphosate and diquat dibromide herbicides could have short-term negative effects on aquatic wildlife and waterbirds, but removal of invasive weeds favors native plants and ultimately improves the quality of wildlife habitat. Refuge staff will continue to comply with National Pollution Discharge Elimination System general permit protocols and best management practices for aquatic herbicide applications and water quality monitoring that were developed by the Central Valley Regional Water Quality Control Board to

avoid adverse effects on water quality and and aquatic wildlife. Glyphosate, found in both Roundup® and Rodeo®, does not bioaccumulate in fish. The Rodeo® formulation is practically non-toxic to freshwater fish and aquatic invertebrates, while the Roundup® formulation is moderately to slightly toxic to freshwater fish and aquatic invertebrate animals. However, in laboratory studies, Roundup® has been shown to cause high rates of mortality to juvenile North American tadpoles (Relyea 2005). Clopyralid is of low toxicity to fish, aquatic invertebrate animals, birds, and mammals, is not toxic to bees and has very low acute mammalian toxicity. It does not bioaccumulate in fish. Triclopyr is low in toxicity to fish, does not bioaccumulate in fish, and is slightly toxic or nontoxic to invertebrates; however, it has not been tested for chronic effects in aquatic animals. Triclopyr is slightly toxic to mammals, however, in mammals, most triclopyr is excreted unchanged in urine. Triclopyr and its formulations have very low toxicity to birds and is nontoxic to bees. Sethoxydim is practically nontoxic to birds, has low toxicity to wildlife, and is nontoxic to bees. It is moderately to slightly toxic to aquatic species. Only herbicides that are approved for use near water, such as Rodeo®, Reward ®, or Garlon 3a®, would be used on Refuge lands that are within 100 feet of surface waters. In addition, to prevent further water contamination and effects to aquatic species, the Refuge would not spray when wind velocities exceed five miles per hour, when vegetation is wet, or when precipitation is occurring or forecasted in the following 24 to 36 hours. Herbicide applications are not expected to significantly affect wildlife.

Some negative effects to reproductive success of late-nesting ground nesting birds, such as mallards (*Anas platyrhynchos*), and meadowlarks may occur during prescribed fires and mowing operations

Alternative A. Under Alternative A, current management of the Refuge would continue unchanged. The Refuge would continue to manage water for migratory waterfowl, shorebirds, water birds and other migratory birds. Grasslands and agricultural lands would continue to be managed to provide foraging and loafing habitat. Under this alternative, no new riparian or wetland habitat would be restored or created beyond the restoration of 25 acres of riparian habitat on the headquarters unit, but existing habitat would be maintained and fostered. Maintaining and fostering habitat would benefit the variety of wildlife that uses the Refuge, including birds of prey, songbirds, waterfowl and colonial nesting birds, such as egrets and herons as well as many species of mammals and reptiles..

Because visitor use is currently limited to bimonthly tour days and hunting for 16 hunters two days per week during waterfowl season, human disturbance to wildlife would be minimal under Alternative A. By contrast, Alternatives B and C both would increase visitor use and implement a recreational fishing program. Potential impacts of visitor use include: flushing of birds, disruption of feeding and roosting activity, reducing use of preferred habitat, and increasing bioenergetic demands (DeLong 2002).

Alternative B. Alternative B would result in mostly beneficial and some adverse impacts on wildlife. Recreational use of the Refuge is expected to increase dramatically under Alternative B. Most of these new users are expected to participate in wildlife observation. This growth in recreational use could adversely affect birds using the Refuge wetlands, resulting in flushing, disruption of feeding and roosting, increased demands on the birds' available energy and reduced use of preferred habitat (DeLong 2002).

Under Alternative B, visitor use facilities such as parking areas, kiosks, trails and new buildings would be developed. This could result in the temporary disturbance and/or displacement of wildlife due to construction activities. The riparian portion of the unit would not be directly affected by construction but wildlife would, nonetheless, experience

disruption because of the nearby construction activity. Once construction is completed, substantial numbers of waterfowl, shorebirds and other waterbirds would be expected to utilize the restored and enhanced wetlands of the Headquarters Unit.

Sixty-five acres of riparian vegetation would be restored throughout the Refuge, an additional 40 acres of riparian understory vegetation would be enhanced, 50 acres of wetlands near South Stone Lake would be enhanced and planting native grasses over 30 acres in various portions of the Refuge would begin. Once established, this new habitat would provide a long-term benefit to a variety of wildlife, including migratory songbirds and birds of prey. In addition, existing grassland habitat would be maintained through grazing, mowing and/or burning for the benefit of grassland dependent species. Riparian habitat would be further protected by further exclusion of cattle from riparian areas. Shorebirds would benefit from exploring reverse-cycle wetlands and by drawing down one permanent wetland until August to provide food. The Refuge would also enhance and create habitat for burrowing owls by reintroducing ground squirrels to the North Stone Lake and Wetland Preserve units and constructing artificial burrows, as needed.

Under Alternative B, the Refuge would be opened to fishing from non-motorized, hand-launched boats (e.g., canoes, kayaks) or non-trailered boats with electric motors only. A boat launching area would be provided on the Sun River property of the South Stone Lake Unit Non-motorized boating by pre-registered groups, including commercial outfitters who engage in fishing, and wildlife observation, would also be allowed on SP Cut on the Beach Lake and North Stone Lake units at the west end of Elliott Ranch Road.

No native game fishes remain in Refuge waters but introduced game fish species are abundant, so the direct impact of recreational fishing on fish populations is not expected to be detrimental. Fishing may even benefit native fish species by reducing habitat competition from introduced species. Indirect effects of fishing and boating, such as disturbance to waterfowl, reptiles and amphibians, would be controlled by restricting shoreline fishing, by allowing access only during the summer before winter migrants have arrived and by providing sanctuary to species that are present during the summer.

Alternative C. Alternative C would result in primarily beneficial impacts on wildlife and few adverse impacts. The effects on wildlife under this alternative would be similar to those described under Alternative B, with the following exceptions.

Implementation of Alternative C would have similar effects on the Headquarters Unit as would Alternative B. Under this alternative, riparian vegetation would be allowed to expand naturally into managed wetland units. Though some riparian restoration along North Stone Lake would occur, no new riparian restoration would take place in the Sun River, Headquarters or Lewis units. The more limited and gradual increase in riparian habitat would still benefit wildlife over a longer period than under Alternative B. The reduction in wetland restoration and construction under Alternative C would result in reduced disturbance for wildlife. The effects on wildlife from the hunting and fishing programs are similar to Alternative B.

Special Status Species

Suitable habitat exists on the Refuge for federally-listed the giant garter snake, valley elderberry longhorn beetle VELB), vernal pool tadpole shrimp and fairy shrimp . Vernal pool tadpole and fairy shrimp are the only federally-listed species whose presence has been verified on the Refuge within the last 13 years. California Endangered Species Act-listed species that inhabit the Refuge include greater sandhill crane and Swainson's hawk.

Alternative A. Under Alternative A, continuation of current management activities will have beneficial effects on special status species. The Service will continue to manage the Refuge to support sandhill cranes by providing irrigated pasture, seasonally flooded wetlands, grain crops and grasslands. Breeding and foraging habitat would also be provided for Swainson's hawks in the Refuge's riparian forests and grasslands. Though there are no documented occurrences of VELB on the Refuge, all existing elderberry shrubs are mapped and protected from herbicides intended to control invasive weeds.

Alternative B. No significant adverse effects on special status species are anticipated. Beneficial effects to special status species would result from expansion and enhancement of riparian, wetland and grassland habitats. However, increases in human disturbance due to the increased number of visitors may also occur. Human disturbance would most likely affect sandhill cranes and Swainson's hawks.

Swainson's hawks would benefit from increased riparian habitat under Alternative B, including the expansion of riparian vegetation along the North Stone Lake, Headquarters, South Stone Lake, and Beach Lake units and the Sacramento Drainage Canal. Access for recreational fishing allowed between June and September could affect nesting Swainson's hawks, because their nesting season typically lasts from mid-February through July. As a result, the Service will prohibit visitor access within a 0.25-mile radius of any occupied hawk nest until the young have fledged.

Under Alternative B, the Refuge would enhance habitat management for sandhill cranes by flooding earlier in the fall (mid-September) than under Alternative A, by periodically flooding irrigated pastures and by developing a grazing program near North Stone Lake to provide foraging and loafing habitat adjacent to roosting sites. The Refuge also plans to construct a new observation platform for viewing sandhill cranes north of Hood Franklin Road on the North Stone Lake Unit. Alternative B's net effect is expected to be beneficial for sandhill cranes because while visitor disturbance will increase, habitat will also increase and greater foraging opportunities will be available.

No impact to vernal pool species is anticipated under Alternative B. The majority of the vernal pools at the Refuge occur in the Wetland Preserve Unit. This area will be opened for guided tours and via a self-guided trail that will be routed to avoid impacts to wetlands. Therefore, visitor use is not expected to affect the vernal pool tadpole shrimp or fairy shrimp.

The VELB would benefit under Alternative B by planting early successional upland vegetation, including elderberry bushes, on the South Stone Lake Unit. Riparian and grassland restoration will also benefit the Swainson's hawk.

Alternative C. The effects of Alternative C on special status species are largely the same as in Alternative B except that less riparian habitat would be restored. The Refuge would continue its sandhill crane habitat management as in Alternative B. The natural expansion of riparian vegetation allowed under Alternative C would ultimately benefit Swainson's hawks.

Diseases and Toxins

Common to all Alternatives. Under each alternative, the Service would continue current botulism control practices, including keeping all units dry between June 1 and August 1; patrolling historically problematic wetlands on the Refuges and in the surrounding areas in cooperation with the California Department of Fish and Game; and removing sick birds and carcasses from wetlands. As a result of these coordinated activities, the potential for an outbreak of botulism would be minimized.

Increased wetland habitat under Alternative B, increases the potential for breeding mosquitos and hence, could lead to an incremental increase in the potential spread of mosquito-borne diseases. In accordance with their 1993 Memorandum of Understanding, Refuge staff will continue efforts to minimize mosquitos in cooperation with SYMVCD through wetland design, efficient water management, vegetation manipulations through mowing, discing, and burning, biological control such as planting of mosquitofish, and applying larvicides and adulticides, as needed. See Appendix P, Integrated Pest Management Plan for Mosquito-Associated Threats for a detailed description of mosquito control on the Refuge.

Under all alternatives, the Service would continue to prohibit lead shot for waterfowl hunting as it has been Refuge system policy for over 15 years.

Cultural Resources

Common to all Alternatives. Under all alternatives, including the No Action alternative, Refuge management activities have the potential to disturb cultural resources. To preserve Refuge archaeological and historic resources, all undertakings, including but not limited to ground disturbance and prescribed burns, will be coordinated with the Service's Regional Archaeologist. Under each alternative: a cultural resources overview would be prepared; baseline data on all cultural resource sites collected; an attempt made to locate and delineate all unrecorded cultural resource sites; appropriate buffers zones established to ensure their protection; and updated or new site records forwarded to the California North Central Information Center. Also, an attempt would be made to locate any human remains, covered under the Native American Grave Protection and Repatriation Act (NAGPRA) (25 USC 3001 et seq. or 43 CFR 10), removed in the past from within the Refuge boundary

When it is determined after consultation with the Service's Regional Archaeologist and local professional archaeologists, that a consultation with the State Historic Preservation Office (SHPO) under Section 10 of the National Historic Preservation Act is warranted for a planned undertaking, the Refuge will ensure that appropriate procedures to protect cultural resources and provide necessary mitigation are identified and implemented, in accordance with the Service Programmatic Agreement for cultural resources with the SHPO. All monitoring of ground-disturbance will be performed by a professional archaeologist who may request assistance from tribal representatives. The Refuge will provide copies of SHPO correspondence and monitoring reports to the Regional Archaeologist and any concerned tribal organizations.

A cultural resources survey may not be required if burning is proposed entirely within a flood zone, in a previously disced or plowed area, or if burning has been an ongoing practice on the site. However, cultural resources surveys will likely be necessary for all burns on upland sites, and for burns that require excavation (scraping, plowing, or discing) to establish a fire line. In some cases, it may be appropriate to conduct cultural resources survey work after a prescribed burn is completed, because the visibility of artifacts or other resources may be increased after burning and artifacts may be more vulnerable to vandalism or theft when exposed by burning.

As required by the NAGPRA, any construction or ground-disturbing activity with the potential to disturb human remains, burial objects, sacred objects, or objects of cultural patrimony will be planned and implemented in consultation with affected Tribes. If potentially significant artifacts are found during any activity, work will cease within 100 feet of the find and access will be restricted until a qualified archaeologist and members of local Tribes can assess the significance of the find and propose appropriate methods of treatment, as required by NAGPRA. If human remains are found during any activity, work will cease

within 100 feet of the find, access will be restricted and the Sacramento County Coroner will be informed of the discovery, as required under Public Resources Code Section 5050.5. If no investigation of the cause of death is required, remains will be treated in accordance with the requirements of NAGPRA.

With assistance from the Service's Regional Archaeologist and local professional archaeologists, the Refuge has identified the Ione Band of Miwok Indians as the nearest tribal organization with whom the Refuge should consult on management and restoration projects. As a result, the Refuge intends to meet with the tribal liaison at least annually to discuss any planned project that may result in ground disturbance of prehistoric or historic sites.

Visitor Services

According to California State Department of Finance projections, the population of the Delta Region (Sacramento, Solano, Yolo, San Joaquin and Contra Costa Counties) is expected to grow by about 19 percent between 2005 and 2020. The State as a whole is expected to grow by 24 percent over the same period. In the western states, participation in hunting is predicted to decline by 21 percent in the period between 1995 and 2020. For example, statewide hunter use days declined in four out of five years, through 2004 (USFWS 2004). The trend for non-consumptive recreation shows an opposite trend. Participation in non-consumptive recreation is expected to increase by 37 percent over the same period (Cordell et al. 1999).

Common to All Alternatives. Under each alternative, hunting on the South Stone Lake Unit is expected to continue at 16 hunters per day, for two days per week throughout the hunt season, with two youth only hunts held both before and after the regular hunt season. Non-consumptive recreation will increase at a rate proportional to the predicted population growth for the five county Delta/Sacramento metropolitan region. Currently, Stone Lakes receives about 3,500 visits per year consisting of 3,000 wildlife observation visitors and 25 environmental education groups of 20 each.

Alternative A. Under the No Action alternative, the Refuge is expected to receive 4,200 visits annually by 2020. This projected increase in visitor use under the no action alternative serves as a baseline against which to compare the action alternatives. Figure 5 shows the current visitor use levels and predicted use levels under each alternative. Under the No Action alternative, the Service would maintain current Refuge visitor services and facilities. However, overall Refuge use is expected to increase as the population of the Sacramento metropolitan area and the rest of the State continues to grow over the next 15 years.

Alternative B. Visitor services would be improved and expanded under Alternative B. Volunteer opportunities would be expanded, including at least one comprehensive volunteer training per year. Opportunities for wildlife observations would expand to a capacity of 10,500 visits per year. Four miles of foot trails would be open to visitors seven days a week, with seasonal restrictions. Two miles of universally accessible trails would be constructed on the Headquarters Unit and named the Blue Heron Trails System. Two new photography blinds would be constructed, on the North Stone Lake and Headquarters Units. Two hundred feet of boardwalk, on the Headquarters Unit, would be constructed as part of the Blue Heron Trails System. One and one-half miles on foot trails would be constructed on the South Stone Lake Unit and would be open to visitors seven days a week, with seasonal restrictions. Two hundred feet of boardwalk would be constructed on the South Stone Lake Unit and would be open to visitors seven days a week, with seasonal restrictions. Parking facilities and a car top boat launch, for a maximum of ten cars, would be provided on the Lewis Unit. The number of supported environmental education groups would expand to 80

per year. Two new interpretative programs would be developed within five years, including displays illustrating traditional dwelling and subsistence strategies on the Headquarter Unit.

Within five years the Refuge would provide safe, boat only fishing with day use parking facilities that could accommodate up to 20 boats per day. Refuge staff would expand community outreach and would expand the number of presentations given to schools, conservation groups and public service organizations.

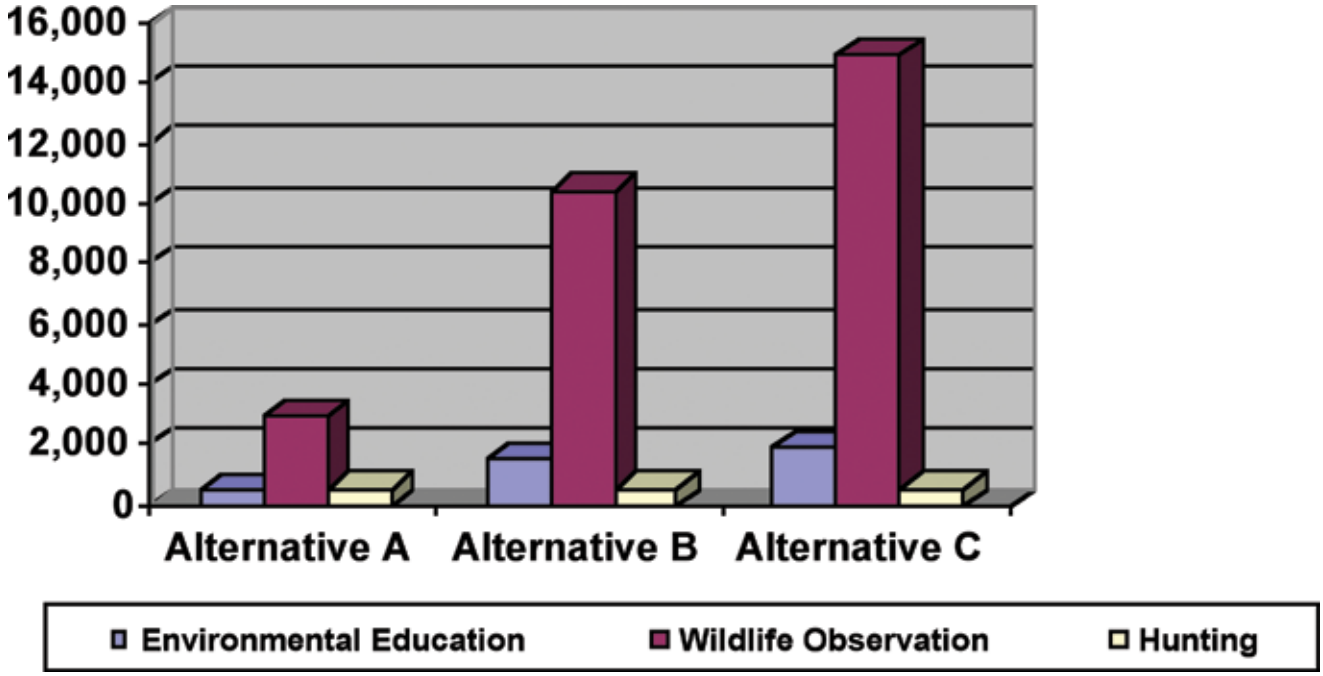


Figure 5. Current and Projected Visitation (15 years).

Alternative C. Under this alternative, visitor service facilities would be similarly expanded as in Alternative B. Opportunities for wildlife observations would expand to a capacity of 15,000 visitors per year. Six miles of foot trails would be open to visitors seven days a week, with seasonal restrictions. Less boardwalk would be constructed at the Headquarters Unit (140 feet). An additional two miles of trails would be developed on the Lewis and North Stone Lakes Units and would be open to visitors seven days a week, with seasonal closures. Four new interpretative programs would be developed within the next five years.

Socioeconomics

Alternative A. Under the No Action alternative, current management practices would continue to be followed and no change in Refuge staffing would be required. The No Action alternative would thus have no impact on local employment conditions or the local economy.

Alternatives B and C. Under Alternatives B and C, fish and wildlife management and visitor services programs would be substantially expanded. This may lead to increases in Refuge budget and staffing. Additional funding and staff proposals related to implementation of the CCP will be entered into the Service's agency budget systems, including Refuge Operating Needs System and Maintenance Management System. Additional Refuge staff required under these alternatives may be hired from local communities and would likely live in and contribute to the local communities.

Refuge visitation under Alternatives B and C is expected to substantially increase over the life of the CCP. This increase could benefit the local economy and employment conditions if Refuge visitors supported local businesses, such as gas stations, restaurants, hotels, and sporting good stores. No projects proposed under any of the Alternatives would have a disproportionate negative impact on low-income or minority populations.

The elimination of high-speed boating in Refuge waterways is expected to have limited socioeconomic impact on small businesses in the local community when compared with the growing volume of boating occurring on the adjacent Sacramento River. Use of the Refuge by high-speed boats is limited to one to three boats per weekend, primarily during May-July and is comprised of the approximately 25 members of the Beach Lake Ski Club. Re-location of this activity outside of the Refuge will result in a reduction of revenue to landowners who provide the waterskiers and gas-powered fishermen with a launch site to access the Beach and North Stone lake units.

The expanded wildlife-dependent visitor uses opportunities proposed under Alternatives B and C could potentially result in increased instances of trespass, vandalism, and littering and some minor disruption of farming practices of adjacent to nearby landowners.

Appendix 1: References

Boisvert, M., and J. Boisvert. 2000. Effects of *Bacillus thuringiensis* var. *israelensis* on target and nontarget organisms: a review of laboratory and field experiments. Biocontrol Science and Technology 10: 517-561.

Breaud, T.P., J.E. Farlow, C.D. Steelman, and P.E. Schilling. 1977. Effects of the insect growth regulator methoprene on natural populations of aquatic organisms in Louisiana intermediate marsh habitats. Mosquito News. 37(4): 704-712.

California Department of Fish and Game (DFG). 2000. The status of rare, threatened, and endangered animals and plants of California, Annual Report for 2000. California Department of Fish and Game. Sacramento, CA. 226 pp.

California Department of Fish and Game (DFG). 2006. California Wildlife: Conservation Challenges (California's Wildlife Action Plan). Prepared by Bunn, David, Andrea Mummert, Roxie Anderson, Kirsten Gilardi, Marc Hoshovsky, Sandra Shanks and Kiffanie Stahle. Wildlife Health Center, University of California, Davis.

Charbonneau, C.S., R.D. Drobney, and C.F. Rabeni. 1994. Effects of *Bacillus thuringiensis* var. *israelensis* on nontarget benthic organisms in a lentic habitat and factors affecting the efficacy of the larvicide. Environmental Toxicology and Chemistry 13 Vol. 2:267-279.

Cordell, H.K., C, Betz, J.M. Bowker, and others. 1999. Outdoor recreation in American life: a national assessment of demand and supply trends. Sagamore Publishing, Champaign, IL. 219-321.

Dale, P.E.R. and K. Hulsman. 1990. A critical review of salt marsh management methods for mosquito control. Crit. Rev. in Aquatic Science 3:281–311.

DeLong, A.K. 2002. Managing visitor use and disturbance of water birds–a literature review of impacts and mitigation measures–prepared for Stillwater National Wildlife Refuge. Stillwater National Wildlife Refuge Complex final environmental impact statement for the comprehensive conservation plan and boundary revision (Vol. II), Appendix L. Department of the Interior, U.S. Fish and Wildlife Service, Portland, OR. 114 pp.

Extension Toxicology Network (ETN). 1996. Naled Pesticide information profile. http://ace.ace.orst.edu/info/extoxnet/pips/naled.htm

Euliss, N.H., and S.W. Harris. 1987. Feeding ecology of northern pintails and green-winged teal wintering in California. Journal of Wildlife Managment 51: 724-732.

Evans, D.D., and M.J. Batty. 1986. Effects of high dietary concentrations of glyphosate on a species of bird, marsupial and rodent indigenous to Australia. Environmental toxicology and chemistry 5: 399-401.

Feng, J.C., D.G. Thompson, and P.E. Reynolds. 1990. Fate of glyphosate in a Canadian forest watershed: 1. Aquatic residues and off-target deposit assessment. Journal of Agricultural Food Chemistry 38: 1110-1118.

Folmar, L.C., H.O. Sanders, and A.M. Julin. 1979. Toxicity of the herbicide glyphosate and several of its formulations to fish and aquatic invertebrates. Archives of Environmental Contamination and Toxicology 8: 269-278.

Hansen, G.W., F.E. Oliver, and N.E. Otto. 1984. Herbicide manual. A Water Resources Technical Publication. U.S. Department of the Interior, Bureau of Reclamentation, Denver, CO. 346 pp.

Heady, H. F. 1977. Valley grassland. P ages 491-514 In M. G. Barbour and J. Major, eds. Terrestrial vegetation of California. John Wiley and Sons, New York.

Lacey, L.A., and M.S. Mulla. 1990. Safety of *Bacillus thuringiensis* var. *israelensis* and *Bacillus sphaericus* to non-target organisms in the aquatic environment. In Laird, M., L.A. Lacey, E.W. Davidson, editors. Safety of microbial insecticides. CRC Press.

Merritt, R.W., E.D. Walker, M.A. Wilzbach, K.W. Cummins, and W.T. Morgan. 1989. A broad evaluation of Bti for black fly (Diptera: Simuliidae) control in a Michigan River: efficacy, carry and nontarget effects on invertebrates and fish. Journal of the American Mosquito Control Association 5: 397-415.

Miura, T., and R.M. Takahashi. 1974. Insect developmental inhibitors. Effects of candidate mosquito control agents on nontarget aquatic organisms. Environmental Entomology 3: 631-636.

Miura, T., and R.M. Takahashi. 1973. Insect developmental inhibitors. Effects on nontarget organisms. Journal of Economic Entomology 66: 917-922.

Monsanto. 2001. Aquamaster Technical Fact Sheet.

Niemi, G.J., A.E. Hershey, L. Shannon, J.M. Hanowski, A. Lima, R.P. Axler, and R.R. Regal. 1999. Ecological Effects of Mosquito Control on Zooplankton, Insects, and Birds. Environmental Toxicology and Chemistry 18(3): 549-559.

Norland, R.L., and M.S. Mulla. 1975. Impact of Altosid on selected members of an aquatic ecosystem. Environmental Entomology 4: 145-152.

Stebbins, G. Ledyard. 1965. Colonizing species of the native California flora. In The Genetics of Colonizing Species. Academic Press, NY, pp. 173-191.

U.S. Fish and Wildlife Service (USFWS). 1992. Environmental impact statement with appendices for Stone Lakes National Wildlife Refuge Project, Sacramento County, California; Final. With technical assistance provided by Jones & Stokes Associates, Inc. (JSA 91-047). Sacramento, CA.

U.S. Fish and Wildlife Service (USFWS). 2004. Kern and Pixley National Wildlife Refuges Comprehensive Conservation Plan. Sacramento, CA.

U.S. Fish and Wildlife Service (USFWS). 2005. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Portland, OR. http://www.fws.gov/sacramento/es/recovery_plans/vp_recovery_plan_links.htm

Relyea, Rick A. 2005. The Lethal Impact of Roundup on Aquatic and Terrestrial Amphibians. Ecological Applications: 15 (4): 1118–1124.

Riparian Habitat Joint Venture (RHJV). 2004. Version 2.0. The Riparian Bird Conservation Plan: a Strategy for Reversing the Decline of Riparian Associated Birds in California. California Partners in Flight. http://www.prbo.org/calpif/pdfs/riparian.v-2.pdf.

Smith, G.R. 2001. Effects of Acute Exposure to a Commercial Formulation of Glyphosate on the Tadpoles of Two Species of Anurans. Bulletin of Environmental Contaminant Toxicology: 67(4): 483-488.

State of California, Department of Finance. 2001. Interim County population projections. Sacramento, California, June 2001.

Thomas, C.M., and T.C. Maurer. 2003. Toxicity of Stormwater Runoff at Stone Lakes National Wildlife Refuge, 1999-2000, Final Report, Investigation No.: 199910003, U.S. Department of the Interior, Fish and Wildlife Service, Portland, Oregon.

Tomlin, C. 1994. The Pesticide Manual. Farnham: British Crop Protection Council/ Cambridge: Royal Society of Chemistry.

Tu, M., C. Hurd, and J.M. Randall. 2001. Weed Control Methods Handbook, The Nature Conservancy, http://tncweeds.ucdavis.edu version: April 2001.

World Health Organization. 1984. 2,4-Dichlorophenoxyacetic acid (2,4-D), Environmental Health Criteria 29. United Nations Environment Programme, Geneva. 151 pp.

Personal Communications

Ivey, G. 2002. Wildlife and Habitat Review.

Marty, J. 2004. The Nature Conservancy (TNC). September, 2004.

Van Loben Sels, R. 2005. Subject. RD 744.

G. Geupel, Point Reyes Bird Observatory (PRBO). 2004.

Appendix C. Fire Management Plan

Wildland Fire Management Plan
Stone Lakes National Wildlife Refuge
September 2001

Prepared: _____ _____

Michael Brady — Date
Wildlife Biologist
Stone Lakes NWR

_____ _____

Perry Grissom — Date
Zone Assistant Fire Management Officer
Central Valley Ecoregion

Reviewed: _____ _____

Thomas Harvey — Date
Project Leader
Stone Lakes NWR

Concurred: _____ _____

Pam Ensley — Date
Regional Fire Management Coordinator
Pacific Region, U.S. Fish and Wildlife Service

Approved: _____ _____

Steve Thompson — Date
or Acting Manager
California/Nevada Operations, U.S. Fish and Wildlife Service

Contents

Introduction **216**

Compliance with USFWS Policy **218**

Fire Management Objectives **220**

Description of Refuge **220**
Climate 220
Cultural Resources 220
Visitor Use 221
Fish and Wildlife 221
Threatened and Endangered Species 221
Habitats 221
  Grasslands 221
  Riparian Woodlands 222
  Seasonal and Permanent Wetlands 222
Physical Resources 222
Structures and Facilities 222

Wildland Fire Management Situation **224**
Historic Role of Fire 224
  Pre-settlement fires 224
  Post-settlement Fire History 224
  Prescribed fire history 224
Responsibilities 224
  Project Leader (PL) 224
  Biologist 225
  Zone Fire Management Officer (FMO) 225
  Zone Assistant Fire Management Officer (AFMO) 225
  Fire Management/Suppression Personnel 225
  Incident Commander 226
Interagency Operations 226
Protection of Sensitive Resources 226

Wildland Fire Activities **228**
Fire Management Strategies 228
Preparedness 228
  Historical Weather 228
  Fire Prevention 229
  Staffing Levels 229
  Training 229
Detection 230
Communications 230
Pre-Attack Plan 230
Fire Management Units 230
  Fuel Types and Fire Behavior 231
Suppression Tactics 231
  Suppression Conditions 232
  Wildland Fire Situation Analysis 232
Aircraft Operations 232

Rehabilitation and Restoration 233
Required Reporting 233
Fire Investigation....233

Prescribed Fire Activities 234
Prescribed Burn Program Objectives 234
Fire Management Strategies....234
Prescribed Fire Planning 235
Annual Activities 235
Prescribed Fire Burn Plan 235
Strategies and Personnel 235
Monitoring and Evaluation....236
Required Reports....237
Prescribed Burn Critique 237

Air Quality / Smoke Management Guidelines 238

Fire Research 239

Public Safety 240

Public Information And Education 241

Fire Critiques And Annual Plan Review....242
Fire Critiques 242
Annual Fire Summary Report....242
Annual Fire Management Plan Review 242

Consultation and Coordination 243

Appendices....244
Appendix C.1: References Cited 244
Appendix C.2: Definitions....245
Appendix C.3: Compliance Documents 248
Appendix C.4: Cooperative Agreements....251
Appendix C.5: Species List 260
Appendix C.6: Delegation of Authority 283
Appendix C.7: Dispatch Plan 285
Appendix C.8: Equipment Inventory 286
Appendix C.9: WFSA....287
Appendix C.10: Sample Burn Plan....288
Appendix C.11: Air Quality Burn Permit....297
Appendix C.12: Request for Cultural Resource Compliance 298

List of Figures

Figure 1: Watershed and Ecosystem Setting....217
Figure 2: Stone Lakes NWR Land Status....223

Introduction

The Stone Lakes National Wildlife Refuge (NWR) was established to preserve and enhance native Central Valley plant communities and their associated fish, wildlife and plant species. It currently consists of 4,000 acres within an approved project boundary of 18,129 acres (Figure 1). Approximately 5,000 acres within the boundary are owned by a number of state and county agencies. Through a cooperative agreement, the U.S. Fish and Wildlife Service (Service) manages over 2,700 acres of these lands as part of the National Wildlife Refuge System. The Refuge land base protects important habitats that have largely been eliminated in the Central Valley of California. The Refuge supports essential habitats for numerous federal and state listed-threatened and endangered species, such as giant garter snake, Swainson's hawk, and California hibiscus. One of the goals of the Refuge is to reduce non-native grasses and forbs and restore native habitats. A fire management program will assist the Refuge in reaching that goal. Cultivation, livestock overgrazing, disturbances, and years of neglect have converted Refuge grasslands to a condition where primarily annual non native grasses and forbs predominate. There is also a significant fire hazard due to heavy accumulations of flashy fuels immediately adjacent to an urban setting.

When approved, this document will become the Stone Lakes National Wildlife Refuge (NWR) Fire Management Plan. Major components include:

- Refuge policy documents referenced (grazing management plan, CCP when completed.).
- Format changes under the direction of Fire Management Handbook.
- Continue a program of prescribed burning and full suppression of all wildland fires.

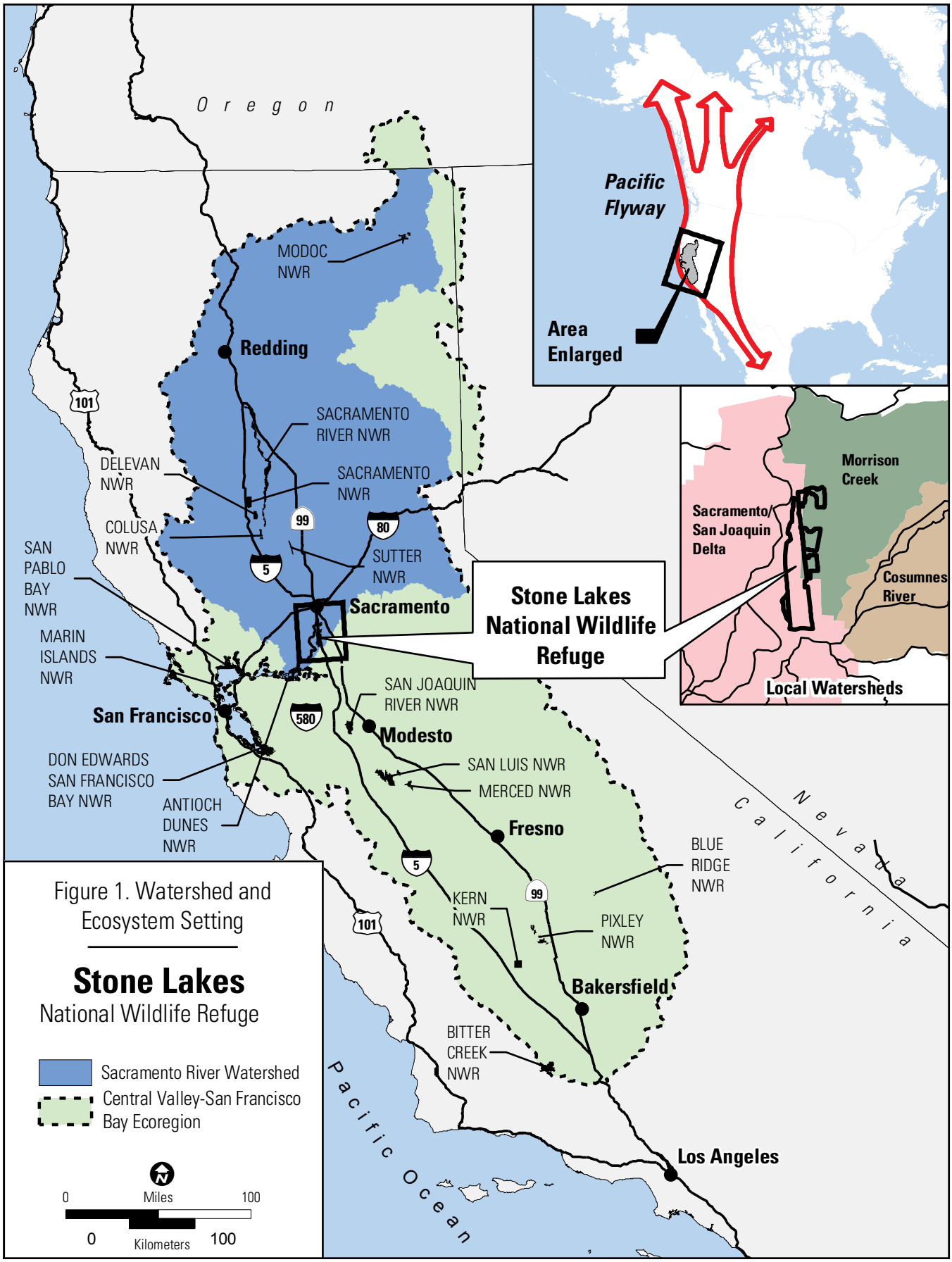
This plan is written to provide guidelines for appropriate suppression and prescribed fire programs at Stone Lakes NWR. Prescribed fires may be used to reduce hazard fuels, restore the natural processes and vitality of ecosystems, improve wildlife habitat, remove or reduce non-native species, and/or conduct research.

This Fire Management Plan (FMP) will help achieve resource management objectives by enabling the Refuge to utilize prescribed fire, as one of several tools, to control non-native vegetation and reduce fire hazards in grassland and riparian habitats. It will be used in conjunction with other management tools that are currently applied on Refuge properties (i.e., grazing, mowing, and herbicide applications) to meet resource objectives.

This plan will meet the requirements of the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA). An Environmental Action Statement for a Categorical Exclusion was completed and signed by the Project Leader (Appendix C). This FMP meets the guidelines established by the Intra-service Section 7 Handbook for Endangered Species Consultation; the Project Leader determined that wildland and prescribed fire activities will have "no effect" on Threatened and Endangered species on the Refuge.

There are significant archaeological resources on the Refuge, including burial sites. Theses resources will be protected during all fire activities except in the case of threats to life.

There is currently no dedicated fire staff located at Stone Lakes NWR. An agreement (Appendix D) is in place with Elk Grove Community Service District (CSD) to provide suppression services to the Refuge. Fire staff located at Sacramento National Wildlife Refuge Complex (NWRC) will respond when requested to any wildland fire and will be responsible for implementing the prescribed fire program. Collateral firefighters located at the Refuge will assist, as needed and qualified, on all fires.


Oregon
Pacific Flyway
Area Enlarged
MODOC NWR
Redding
101
SACRAMENTO RIVER NWR
DELEVAN NWR
SACRAMENTO NWR
COLUSA NWR
99
80
5
SUTTER NWR
SAN PABLO BAY NWR
Sacramento
Stone Lakes National Wildlife Refuge
MARIN ISLANDS NWR
SAN JOAQUIN RIVER NWR
San Francisco
580
Modesto
DON EDWARDS SAN FRANCISCO BAY NWR
SAN LUIS NWR
MERCED NWR
ANTIOCH DUNES NWR
Fresno
BLUE RIDGE NWR
KERN NWR
PIXLEY NWR
Bakersfield
BITTER CREEK NWR
Pacific Ocean
Los Angeles
Nevada
California
Morrison Creek
Sacramento/ San Joaquin Delta
Cosumnes River
Local Watersheds
Figure 1. Watershed and Ecosystem Setting
Stone Lakes
National Wildlife Refuge
Sacramento River Watershed
Central Valley-San Francisco Bay Ecoregion
0 Miles 100
0 Kilometers 100

Compliance With USFWS Policy

Stone Lakes NWR was established in 1994 to preserve, restore, and manage disappearing Central Valley habitats. Specific habitats to be managed under this program include permanent and seasonal wetlands, grasslands, and riparian corridors for the benefit of waterfowl and other wildlife. The primary objective of the fire management program is to protect and enhance the necessary habitats native species while controlling non-native vegetation.

No Refuge master plan or Comprehensive Conservation Plan (CCP) has been prepared for Stone Lakes NWR. However, the Refuge will begin the planning process for preparation of a CCP during the second half of FY 2001. Through cooperative agreement with Sacramento County the Refuge manages the 2,700-acre North Stone Lake property according to the Draft North Stone Lake Restoration and Management Master Plan until a CCP for the entire Refuge is completed. The Cooperative Agreement for Grassland Management on North Stone Lake Wildlife Refuge authorizes the Service to manage Sacramento County's North Stone Lake property as part of the National Wildlife Refuge System, as directed in Title 50, United States Code, as well as other laws, regulations and policies for the administration of the National Wildlife Refuge System (Appendix D). The Service has full management responsibilities for the North Stone Lake property, including fire management.

Service policy mirrors Departmental policy (620 DM 1.4) relating to wildland fire and prescribed fire, and Departmental policy states:

- Firefighter and public safety is always the first priority. All Fire Management Plans and activities must reflect this commitment.

- Every area with burnable vegetation must have an approved Fire Management Plan. Fire management plans must be consistent with firefighter and public safety, values to be protected, and land, natural, and cultural resource management plans and must address public health issues. Fire management plans must also address all potential wildland fire occurrences and include the full range of wildland fire management actions. Bureau fire management plans must be coordinated, reviewed, and approved by responsible agency administrators, to insure consistency with approved land management plans.

- Fire, as a critical natural process, will be integrated into land, natural, and cultural management plans and activities on a landscape scale, across bureau boundaries, and will be based upon best available science. All use of fire for natural and cultural resource management requires an approved plan which contains a formal prescription.

- Wildland fire will be used to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, be allowed to function in its natural ecological role.

- Bureaus will ensure their capability to provide safe, cost-effective fire management programs in support of land, natural, and cultural resource management plans through appropriate planning, staffing, training, and equipment.

- Management actions taken on wildland fires must be cost effective, consider firefighter and public safety, benefits, and values to be protected, and be consistent with natural and cultural resource objectives.

- Bureaus will work together and with other affected groups and individuals to prevent unauthorized ignition of wildland fires.

- Protection priorities are (1) human life and (2) property and natural/cultural resources. If it becomes necessary to prioritize between property and natural/cultural resources, this is done based on relative values to be protected, commensurate with fire management costs. Once people have been committed to an incident, these human resources become the highest value to be protected.

- Fire management planning, preparedness, wildland fire and prescribed fire operations, monitoring, and research will be conducted on an interagency basis with the involvement of all partners.

- Bureaus will use compatible planning processes, funding mechanisms, training and qualification requirements, operational procedures, values-to-be-protected methodologies, and public education programs for all fire management activities.

- Fire management programs and activities will be based on economic analyses that incorporate commodity, non-commodity, and social values.

- The operational role of the bureaus as a partner in the wildland/urban interface is wildland firefighting, hazard fuels reduction, cooperative prevention and education, and technical assistance. Structural fire protection is the responsibility of Tribal, State, and local governments. Federal agencies may assist with exterior structural protection activities under formal Fire Protection Agreements that specify the mutual responsibilities of the partners, including funding. (Some Federal agencies have full structural protection authority for their facilities on lands they administer and may also enter into formal agreements to assist Tribes, State and local governments with full structural protection.)

- Employees who are trained and certified will participate in the wildland fire program as the situation demands; non-certified employees with operational, administrative, or other skills will support the wildland fire program as needed. Agency Administrators will be responsible, and will be held accountable, to make employees available to participate in the wildland fire program.

The authority for funding (normal fire year programming) and all emergency fire accounts is found in the following authorities:

Section 102 of the General Provisions of the Department of Interior's annual Appropriations Bill provides the authority under which appropriated monies can be expended or transferred to fund expenditures arising from the emergency prevention and suppression of wildland fire.

P.L. 101-121, Department of the Interior and Related Agencies Appropriation Act of 1990, established the funding mechanism for normal year expenditures of funds for fire management purposes.

31 US Code 665(E)(1)(B) provides the authority to exceed appropriations due to wildland fire management activities involving the safety of human life and protection of property.

Authorities for procurement and administrative activities necessary to support wildland fire suppression missions are contained in the Interagency Fire Business Management Handbook.

The Reciprocal Fire Protection Act of May 27, 1955 (42 USC 815a; 69Stat 66) provides Authorities to enter into agreements with other Federal bureaus and agencies; with state, county, and municipal governments; and with private companies, groups, corporations, and individuals regarding fire activities.

Authority for interagency agreements is found in A Inter-agency Agreement between the Bureau of Land Management, Bureau of Indian Affairs, National Park Service, U.S. Fish and Wildlife Service of the United States Department of the Interior and the Forest Service of the United States Department of Agriculture@ (1996).

Fire Management Objectives

Refuge fire management objectives include:
- Protect life, property, and natural and cultural resources.
- Safely suppress wildland fires using strategies and tactics appropriate for the situation.
- Use of heavy equipment will be prohibited except in cases of threats to life and/or property or by specific approval of the Refuge Manager.
- Off-road travel will be limited to areas outside fenced-off archaeological sites.
- Use prescribed fire as a tool to control non-native vegetation and reduce fuel loads.
- Integrate prescribed fire into the mix of habitat restoration, in conjunction with other management tools already utilized such as grazing, mowing, and spraying of herbicides.
- Protect wildlife, with special emphasis on endangered, threatened and species of special concern.

Description of Refuge

The Stone Lakes NWR is located approximately 1.5 miles east of the Sacramento River and two miles south of the town of Freeport in Sacramento County, California (Figure 1). The Refuge is located along the I-5 Corridor, and is largely surrounded by state and county highways and waterways (to the west). The Refuge consists of a combination of fee title, easement, and county and state-owned properties. The Refuge ranges from 2.8-12.9 feet in elevation. The Refuge is surrounded by agricultural and urban lands. Urban development and vineyards are encroaching on the eastern and southern borders.

Climate

The climate is classified as Mediterranean with cool, wet winters and hot, dry summers. Rainfall is fairly well distributed throughout the winter, occurring in steady but gentle 2-3 day storms. The annual average precipitation is 16-18 inches. Heavy fogs are common during the winter months, while thunderstorms, hail and snow are a rare occurrence. The mean annual temperature is 62EF with extremes of 118EF and 15EF. Southerly winds are associated with storms in the winter and cooling trends in the summer. North winds are usually dry following winter storms and hot and dry in the summer when the most hazardous wildland fire conditions occur. Winds during summer are generally west or southwesterly coming from the Sacramento-San Joaquin River Delta. High winds and gusts are frequent during summer.

Cultural Resources

Numerous archaeological and historic properties are located throughout the Refuge, since many higher elevation areas are former Plains Miwok Indian village and burial sites. Due to historic farming practices, many of these sites have human remains and artifacts at or near the surface. Therefore, ongoing coordination and consultation to ensure protection of these resources will continue, as needed, between Refuge staff and the State Historic Preservation

Office, California Native American Heritage Commission, local tribal representatives, and Service archaeologists with the assistance of private archaeological consultants. As properties are acquired for the Refuge, they are surveyed by archaeologists and historic sites are identified and delineated. Refuge staff consult annually with archaeological experts and local tribal representatives to ensure that all legal responsibilities under the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act are observed and historic properties are protected during any habitat management activities. Any ground disturbance associated with firelines that may be necessary will only be constructed when considered absolutely necessary.

Visitor Use

Along the eastern Refuge boundary, Refuge lands are immediately adjacent with urban residential and commercial development. As a result, there is substantial community interest in visitor use opportunities on the Refuge. At present a Refuge hiking trail and wildlife observation platform are only open every other Saturday and other visitation is limited.

Fish and Wildlife

The Refuge provides habitats for migratory and resident bird species. The Refuge also contains aquatic habitats for species such as the western pond turtle. The Refuge has a large rookery (great blue heron, great egret and double crested cormorant). A species list for the Refuge is attached (Appendix E).

Threatened and Endangered Species

Stone Lakes NWR currently supports habitat for six threatened and endangered species. The fire management program will be implemented in accordance with the Endangered Species Act of 1973 and will take appropriate action to identify and minimize adverse effects on any threatened or endangered species.

Threatened and endangered species include:

- Vernal pool fairy shrimp (*Branchinecta lynchi*)(Threatened)
- Vernal pool tadpole shrimp (*Lepidurus packardi*)(Endangered)
- Giant garter snake (*Thamnophis gigas*)(Threatened)
- Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)(Threatened)
- Delta smelt (*Hypomesus transpacificus*)(Threatened)
- Sacramento splittail (*Pogonichthys macrolepidotus*)(Threatened)

All of these species, except the valley elderberry longhorn beetle, occur in aquatic habitats. The beetle occurs only on elderberry.

Service Endangered Species Division staff from the Sacramento Fish and Wildlife Office were informally consulted on the Refuge grassland habitat management program including the use of prescribed burning as a management tool. As result of this verbal consultation and the small scope of the Refuge burn program , the Project Leader determined that this management program will have “no affect” on listed, proposed, and/or candidate species or designated critical habitat.

Habitats

The major natural habitats of the Refuge are: (1) grasslands, (2) riparian woodlands, and (3) seasonal and permanent wetlands. Portions of the Refuge remain as agricultural lands (vineyards and crops), although restoration of these areas is planned.

Grasslands

The grasslands on the Refuge occur on clay-rich soils that are moist in winter and very

dry in summer. These areas are open habitats supporting grasses and forbs and little in the way of woody vegetation. Grasslands are composed of a mix of native and non-native grasses and forbs. They are currently dominated by exotic annual grasses such as wild oat (*Avena fatua*), soft chess (*Bromus mollis*), annual rye (*Lolium perenne*), and ripgut brome (*Bromus diandrus*). However, one native, creeping wild rye (*Leymus triticoides*) still occurs abundantly. Some perennials such as meadow barley (*Hordeum brachyantherum*) and other native wild flowers cannot compete as well with the non-natives. Vernal pools occur within the grassland habitat, and may contain water from December through April. These pools may contain the Vernal pool fairy shrimp, the Vernal pool tadpole shrimp, as well as a unique assemblage of plants.

Riparian Woodlands
The riparian woodlands are very diverse, multilayered communities which experience occasional flooding. The canopy is very diverse consisting of mostly willow species, cottonwood, and valley oak. This habitat supports a rich array of native wildlife as well as an extensive colonial bird rookery. The rookery is one of the largest in the Central Valley and supports nesting by the great blue heron, great egret, snowy egret, black-crowned night-heron and double crested cormorant.

Seasonal and Permanent Wetlands
Refuge wetlands contain a wide variety of plants (Appendix E) some of which have special state status. These include: dwarf downingia (*Downingia humilis*), Legenere (*Legenere limosa*), California hibiscus (*Hibiscus lasiocarpus*), and Sandford's arrowleaf (*Sagittaria sanfordii*). The seasonal and permanent wetlands on the Refuge occur in low lying areas that are inundated with water for long periods during the year and may contain water for at least part of the summer. The seasonal wetlands mostly consist of rushes, sedges and smartweeds. The permanent wetlands consist of cattail, tule and water primrose.

Physical Resources

The Refuge has a gentle slope from east to west, with the east being the higher elevation. There are twelve soil types in the North Stone Lakes area. These types can be classified into three general categories: 1) alluvial flood basins bordering natural levees of the Sacramento River, 2) low terraces of the valley plain composed of old alluvium, and 3) transitional areas.

There are two lakes on the Refuge, North and South Stone Lake (Figure 2). The Lewis property is bordered by a slough to the north. The Southern Pacific (SP) cut is a major waterway used to divert water from the Sacramento River to private and public lands for irrigation purposes. It forms the western edge of the Refuge and flows year-round. Irrigation on the Refuge is managed by Refuge staff. All other water levels are managed by non-Refuge entities or through natural water fluctuations (e.g., tidal influences).

The Refuge is located in the Sacramento Metropolitan Air Quality Management District (SMAQMD), which is identified by Environmental Protection Agency (EPA) as a non-attainment area.

Structures and Facilities

The Refuge has two management sites, each with two buildings. Other structures on the Refuge are in the process of being removed. The main office at 1624 Hood-Franklin Road in Elk Grove. The maintenance shop is located on Fogg Road in Point Pleasant.

A viewing platform exists on the Lewis property and is located at the end of the hiking trail. A kiosk, which is not currently used, is located at the start of the trail.

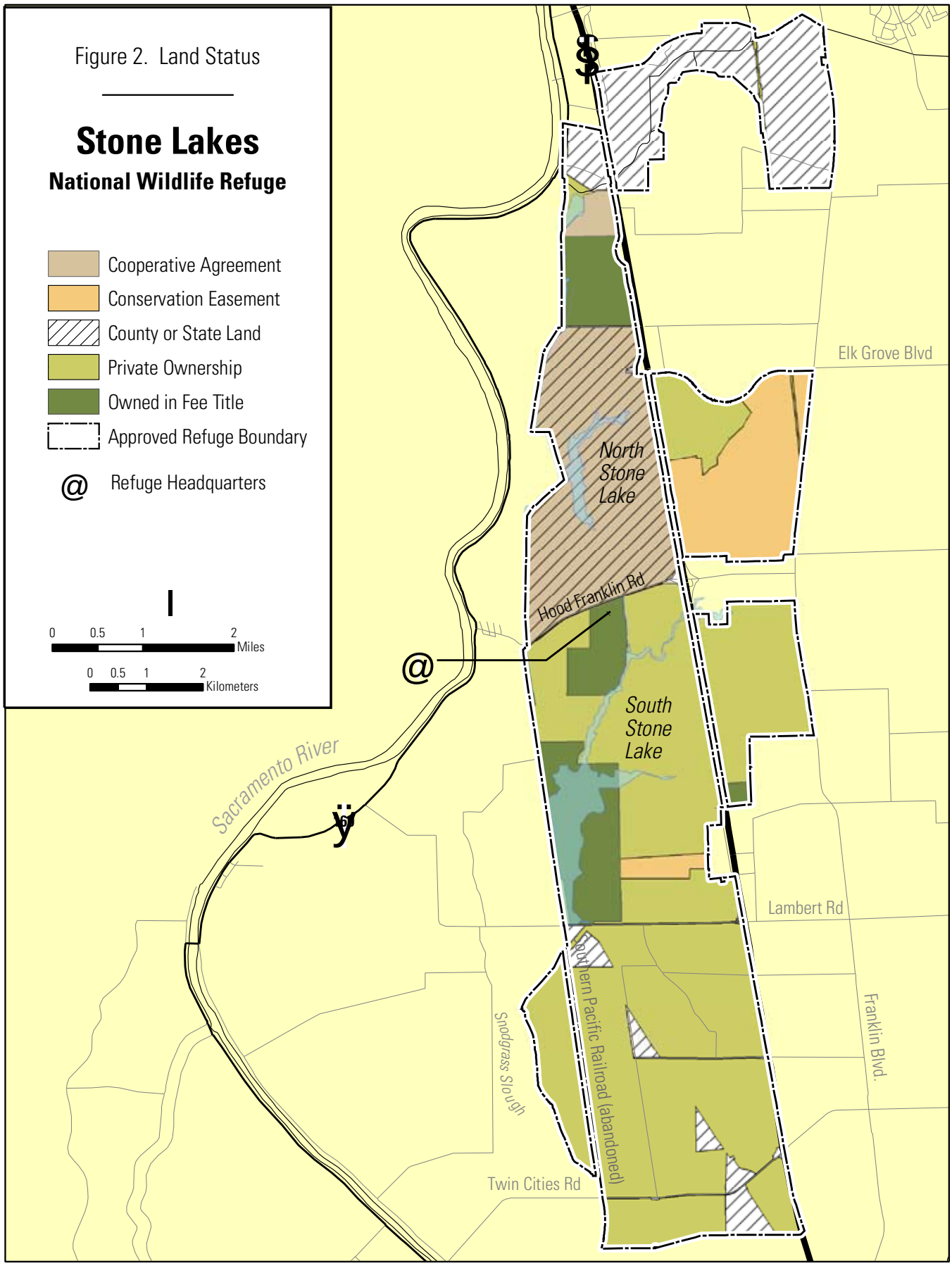


Figure 2. Land Status
Stone Lakes
National Wildlife Refuge
Cooperative Agreement
Conservation Easement
County or State Land
Private Ownership
Owned in Fee Title
Approved Refuge Boundary
Refuge Headquarters
0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
Elk Grove Blvd
North Stone Lake
Hood Franklin Rd
South Stone Lake
Sacramento River
Lambert Rd
Southern Pacific Railroad (abandoned)
Snodgrass Slough
Franklin Blvd.
Twin Cities Rd

Wildland Fire Management Situation

Historic Role of Fire

The typical period of high fire danger is from May through early November based on information from the California Department of Forestry (CDF). Most fires on the Refuge have lasted no more than one burning period.

Pre-settlement fires

Most of the Stone Lakes NWR was and is grassland. Lightning-caused fire in the Sacramento Valley is uncommon, although fires which began in the foothills may have historically spread to the Valley floor. Native American practices likely included burning of the area, although frequency is unclear. Native grasslands were probably well-adapted to fire, but information on these native plant communities is extremely limited due to the intense agriculture that has existed in the area since the 1800s.

Post-settlement Fire History

Since the establishment of the Refuge in 1994, there have been 2 wildland fires on the Refuge that were contained at less than 1 acre each. Other fires have occurred within the planned Refuge boundary, but documentation of these fires is poor. Most wildland fires that have occurred within the entire Refuge have been fire trespass incidents along the Refuge boundaries (i.e., adjacent to public use areas, roadways, and a railroad line). Damage from these fires may have negative effects on resident or nesting wildlife, threatened and endangered species, or habitat.

Prescribed fire history

Prescribed fire has been utilized since 1998 as part of Refuge habitat management. Fire is used to produce the desired habitat conditions that meet specific needs of wildlife or to reduce non-native plant species. Stone Lakes NWR had a total of three prescribed fires between 1998-2000. These fires averaged 10 acres.

Responsibilities

Stone Lakes NWR does not have an onsite fire management staff and only limited suppression equipment. The Refuge landbase consists of several isolated units spread over the Refuge project area. This necessitates reliance on the Elk Grove CSD. The closest Service fire crew is stationed at Sacramento NWRC, about 75 miles to the north. Responsibilities for fire management at Stone Lakes NWR are shared by the Refuge Manager, Refuge Biologist, Central Valley Zone Assistant Fire Management Officer stationed at Sacramento NWRC, and the Zone Fire Management Officer stationed at San Luis NWRC.

The Stone Lakes NWR Project Leader is the primary line officer responsible for all aspects of the Refuge fire management program and for ensuring that all fire management program elements are carried out in accordance with Service policies, regulations, and guidelines. The Central Valley Zone Assistant Fire Management Officer assists with preparing and submitting the fire management plan updates, prescribed burn plans, and the annual fire budget. The prescribed burn plans are approved by the Refuge Manager.

Red-carded staff will assist with the overall implementation of the fire management program. Assistance from local fire department and neighboring Refuges will be needed.

Project Leader (PL)

- Is responsible for implementation of all Fire Management activities within the Refuge and will ensure compliance with Department, Service and refuge policies.

- Selects the appropriate management responses to wildland fire in the WFSA process.
- Coordinates Refuge programs to ensure personnel and equipment are made available and utilized for fire management activities including fire suppression, prescribed burning and fire effects monitoring.
- Ensures that the fire management program has access to Refuge resources when needed.
- Ensures that Refuge Staff considers the fire management program during Refuge related planning and implementation.

Biologist
- Identifies prescribed burn units and biological objectives to the Central Valley Zone (AFMO) notifies FMO of prescribed fire project constraints, and ensures that Refuge resources are available to accomplish prescribed fire and fire suppression objectives.
- Acts as the primary Refuge Resource Management Specialist during fire management planning and operations.
- Ensures fire effects monitoring is being implemented, drafts wildfire Rehabilitation Plans for Project Leader, and is responsible for posting and enforcing fire restriction regulations.
- Coordinates through Project Leader to provide biological input for the fire program with the Zone AFMO.
- Assists in design and implementation of fire effects monitoring, with Zone AFMO.
- Participates, as requested, in prescribed burning and fire suppression.

Zone Fire Management Officer (FMO)
- Responsible for all fire related planning and implementation for the Complex, which includes Stone Lakes NWR, San Luis NWRC, Kern NWRC, Sacramento NWRC, and San Francisco Bay NWRC.

Zone Assistant Fire Management Officer (AFMO)
- Integrates biological Refuge objectives into all fire management planning and implementation.
- Solicits program input from the PL and Biologist.
- Supervises prescribed fire planning.
- Coordinates fire related training.
- Coordinates with cooperators to ensure adequate resources are available for fire operational needs.
- Is responsible for preparation of fire reports following the suppression of wildland fires and for operations undertaken while conducting prescribed fires.
- Prepares an annual report detailing fire occurrences and prescribed fire activities undertaken in each calendar year. This report will serve as a post-year's fire management activities review, as well as provide documentation for development of a comprehensive fire history record for the complex.
- Submits budget requests and monitors FIREBASE funds.
- Maintains records for all personnel involved in suppression and prescribed fire activities, detailing the individual's qualifications and certifications for such activities.

Fire Management/Suppression Personnel
- Consist of all Refuge personnel, whether permanent or seasonal, who meet the minimum standard set by the National Wildfire Coordinating Group (NWCG) for firefighters.
- Are fully equipped with proper personal protective equipment, have taken and passed the minimum classroom training, and meet physical fitness standards required.
- Undertake fire management duties as assigned by the qualified IC on each suppression action or by the Prescribed Fire Burn Boss on each prescribed fire project.
- Are responsible for their personal protective equipment and physical conditioning, qualifying annually with the work capacity test.

Incident Commander
Incident Commanders (of any level) use strategies and tactics as directed by the Project Leader and WFSA where applicable to implement selected objectives on a particular incident. A specific Limited Delegation of Authority (Appendix F) will be provided to each Incident Commander prior to assuming responsibility for an incident. Major duties of the Incident Commander are given in the National Wildfire Coordinating Group (NWCG) Fireline Handbook, including:

- Brief subordinates, direct their actions, and provide work tools.
- Ensure that safety standards identified in the Fire Orders, the Watch Out Situations, and agency policies are followed at all times.
- Personally scout and communicate with others to be knowledgeable of fire conditions, fire weather, tactical progress, safety concerns and hazards, condition of personnel, and needs for additional resources.
- Order resources to implement the management objectives for the fire.
- Inform appropriate dispatch of current situation and expected needs.
- Coordinate mobilization and demobilization with dispatch and the AFMO.
- Perform administrative duties, i.e., approving work hours, completing fire reports for command period, maintaining property accountability, providing or obtaining medical treatment, and evaluating performance of subordinates.
- Assure aviation safety is maintained to the highest standards.

Initial attack modules
Initial attack modules will consist of red-carded firefighters with appropriate red-carded supervision. A Type 5 (ICT5) or Engine Boss (ENGB) is the basic requirement of leadership when responding to a fire with an organized suppression module, i.e., engine. Modules will be prepared and equipped with hand and power tools as needed and will be dispatched with a day's supply of food and water, so they can continue work for 24 hours without additional support.

Employees participating in any wildland fire activities on Fish and Wildlife Service or cooperators' lands will meet fitness requirements established in PMS 310-1, except where Service-specific fitness requirements apply.

- Continue to develop a cadre of "red-carded" firefighters for wildland fire; trained and equipped to accomplish the fire management program.
- Maintain the Refuge fire cache and fire equipment in ready state.

Interagency Operations

There is currently a cooperative agreement between the Refuge and the Elk Grove Community Services District to provide initial attack for wildland fires within the Refuge (Appendix D). Other interagency contacts will be established at the federal, state, and local levels to provide the most efficient level of fire management operations. Other agreements and memoranda of understanding (MOU) will be established, as needed, to establish guidelines for assistance from local cooperators. The MOU allows the responding agency to assume command of the incident until a representative of the Refuge arrives to establish a unified command or assume responsibility for the incident, if qualified. The Refuge Dispatch Plan (Appendix G) contains guidelines for a reported fire and the proper dispatching to affect a quick and orderly initial attack by the closest local resource.

Protection of Sensitive Resources

To protect Refuge resources, mechanical line construction (dozers, discing) must be authorized by the Refuge Manager or their designate, unless human life and/or property are threatened. Sensitive areas will be mapped and distributed to suppression resources.

The Regional Archaeologist and/or his/her staff will work with fire staff, project leaders, and incident commanders to ensure that cultural resources are protected from fire and fire management activities. The "Request For Cultural Resource Compliance" form (RCRC, Appendix L) will be used to inform the Regional Archaeologist of impending activities, thereby meeting the regulations and directions governing the protection of cultural resources as outlined in Departmental Manual Part 519, National Historic Preservation Act (NHPA) of 1966, Code of Federal Regulations (36CFR800), the Archaeological Resources Protection Act of 1979, as amended, and the Archaeological and Historic Preservation Act of 1974. The NHPA Section 106 clearance will be followed for any fire management activity that may affect historic properties (cultural resources eligible to the National Register of Historic Places).

Impacts to archaeological resources by fire resources vary. The four basic sources of damage are (1) fire intensity, (2) duration of heat, (3) heat penetration into soil, and (4) suppression actions. Of the four, the most significant threat is from equipment during line construction for prescribed fires or wildfire holding actions (Anderson 1983).

The following actions will be taken to protect archaeological and cultural resources:

Wildland Fires

- Minimum impact fire suppression tactics will be used to the fullest extent possible.
- Resource Advisors will inform Fire Suppression personnel of any areas with cultural resources. The Resource advisor should contact the Regional Archaeologist and/or his/her staff for more detailed information.
- Foam will be limited in areas known to harbor surface artifacts.
- Mechanized equipment should not be used in areas of known cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.
- Rehabilitation plans will address cultural resources impacts and will be submitted to the Regional Archaeologist using the RCRC.

Prescribed Fires

- The Refuge Fire staff will submit a completed RCRC to the Regional Archaeologist and/or his/her staff as soon as the burn area is identified (i.e., as soon as feasible).
- Upon receipt of the RCRC, the Regional Archaeologist and/or his/her staff will be responsible for consulting with the FMO and evaluating the potential for adverse impacts to cultural resources.
- When necessary, the Regional Archaeologist and/or his/her staff will coordinate with the State Historic Preservation Officer (SHPO). The SHPO has 30 days to respond. The Refuge will consider all SHPO recommendations.
- Mechanized equipment should not be used in areas of know cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.

Wildland Fire Activities

Fire program management describes the operational procedures necessary to implement fire management at Stone Lakes NWR. Program management includes: fire prevention, preparedness, emergency preparedness, step-up staffing plan, fire detection, fire suppression, minimum impact suppression, minimum impact rehabilitation, and documentation.

All fires not classified as prescribed fires are wildland fires and will be appropriately suppressed. Records show that fire season is typically from May through early November, based on information provided by CDF.

Fire Management Strategies

All unplanned wildland fires will be suppressed in a prompt, safe, and cost-effective manner to produce fast, efficient action with minimum damage to resources while using appropriate management strategies.

- Suppress all wildland fires in a safe and cost effective manner;
- Conduct all fire management programs in a manner consistent with applicable laws, policies and regulations;
- Develop and maintain cooperative agreements with local fire agencies, since the Refuge will rely largely on local fire departments for suppression as well as prescribed fire back up;
- Develop monitoring to see if objectives are being met and that wildlife and special status species are not negatively affected.
- Develop and implement fire prevention/education programs.
- Utilize mechanical treatments to reduce hazardous fuels or disrupt fuel continuity.

Although the resource impacts of suppression alternatives must always be considered in selecting a fire management strategy, resource benefits will not be the primary consideration. Appropriate suppression action will be taken to ensure firefighter safety, public safety, and protection of resources.

Preparedness

Preparedness is the work accomplished prior to fire occurrence to ensure that the appropriate response, as directed by the Fire Management Plan, can be carried out. Preparedness activities include: budget planning, equipment acquisition, equipment maintenance, dispatch (i.e., initial attack, extended, and expanded), equipment inventory, personnel qualifications, training, and fire prevention.

Fire readiness planning is to be done on an annual basis. This will ensure that all personnel, engines, fire cache, Personal Protective Equipment (PPE), and training are identified and prepared for the fire season. Lists of engines, equipment, and inventory are located in Appendix H.

Historical Weather

The fire season generally begins with the curing of annual grasses in late May and extends to the first rains in mid October to early November. Easterly and northerly winds in September and October increase the potential for large fires in the local area. However, there is some potential for prescribed and wildland fires year-round. Neither Elk Grove CSD nor the Sacramento County Fire Protection District have any weather station data that could be used to characterize historical weather trends.

Fire Prevention
Stone Lakes NWR fire prevention program is designed to protect human life and property, and prevent damage to cultural resources or physical facilities. A program of internal and external education regarding potential fire danger will be implemented. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and neighbor awareness of fire hazards. Qualified Refuge staff will interpret for the public the beneficial effects of prescribed fires as opposed to unwanted human-caused fires. Emphasis will be placed on information, essential to understanding the potential severity of human-caused wildland fires, and how to prevent them. Zone fire staff will keep Refuge staff informed about changes in existing conditions throughout the fire season.

During periods of extreme or prolonged fire danger, emergency restrictions regarding Refuge operations or area closures may become necessary. Such restrictions, when imposed by the Project Leader, will usually be consistent with those implemented by Refuge cooperators. It will remain the duty of the Central Valley Zone AFMO to inform the Project Leader of extreme fire danger.

Staffing Levels
There are no fire-funded staff stationed at Stone Lakes NWR, therefore there will be no formalized step-up plan. Elk Grove CSD will be responsible for suppression operations and will determine their staffing levels based on their own indicators. Indicators which include weather, fire location and proximity to the highway. There are no automatic triggers for shutting down equipment or instituting closures, however, the PL may restrict equipment and visitation as deemed necessary and as authorized by the Fire Management Handbook.

Training
Departmental policy requires that all personnel engaged in suppression and prescribed fire duties meet the standards set by the National Wildfire Coordinating Group (NWCG). Stone Lakes NWR will conform strictly to the requirements of the wildland and prescribed fire management qualification and certification system (PMS 310-1) and Service guidelines.

Service policy sets training, qualification, and fitness standards for all fire positions. All fire personnel (full time fire or collateral duty) will be provided with the training (classroom and on-the-job) required to meet Service fire position qualification standards for the positions they are expected to perform. All firefighters will be required to participate in an annual refresher to remain qualified. Refreshers will focus on local needs; fire shelter deployment; Look outs, Communications, Escape Routes, Safety Zones (LCES); fire orders; and watch out situations. On-the job training is encouraged and will be conducted at the field level. Whenever appropriate, the use of fire qualification task books will be used to document the fire experience of trainees. The AFMO will coordinate fire training needs with those of other nearby Refuges, cooperating agencies, and the Regional Office (RO).

All fire-qualified employees are required to pass the mandatory fitness and training requirements prior to May 30 or within 2 weeks of entering duty. Employees not meeting fitness and training requirements may assist in support capacities, but will not be permitted on the fireline. Personnel will not perform fire jobs they are not qualified for.

Refuge engines may be used for prescribed burning and may assist Elk Grove CSD in suppression operations. All Refuge engines will be equipped with tools, firing devices, and water handling accessories. To ensure engine readiness, all annual maintenance should be completed by Sacramento NWRC fire staff in the off season (by May 30), and Refuge staff will maintain the equipment during fire season.
The Refuge supports the development of individual Incident Command System (ICS)

overhead personnel from among qualified and experienced Refuge staff for assignment to overhead teams at the local, regional, and national level.

Supplies and Equipment
A small fire cache for three people will be located at Refuge headquarters, and the engines are typically located at the maintenance shop. All firefighters will be issued the required personal protective equipment to include: Nomex pants and shirts, gloves, helmet and goggles, field pack with shelter, overnight pack, sleeping bag, headlamp, and personal first aid kit.

Detection
Fires are typically reported by members of the general public to the 9-1-1 system, and Sacramento County dispatchers initiate suppression response. If Refuge staff observe a wildland fire, they are to call 9-1-1. Sacramento County dispatch notifies Elk Grove CSD, who initiates suppression response. Elk Grove CSD will notify Refuge staff as specified in the MOU (Appendix D).

Communications
Elk Grove CSD uses 800 megahertz radios for primary communication. The Refuge will acquire one or more radios to be able to communicate directly with Elk Grove CSD personnel. The Refuge is currently working on frequency authorization. Telephones may be used as a secondary communication tool. A complete contact list with phone numbers for Refuge staff and cooperators is located in the dispatch plan (Appendix G).

Some of the local agencies have capability to communicate using the NIFC and CDF tactical Channels. The most frequently used for all operations on Refuges is NIFC tactical channel 2 (168.200). For those local agencies that do not have that capability, a Service radio will be provided and cell phone information exchanged to ensure communication during the incident. Cell phones will not be used as the primary communication tool on fires, unless no other options exist.

Pre-attack Plan
Pre-attack planning data will be updated annually by Refuge staff. Pre-attack plans will be placed in each engine, the Fire Management Office, and with the Dispatch Plan at the Refuge. Pre-attack plans should include:
- Response map: roads, gates, water sources, mutual aid zones / fire cooperator districts.
- Hazard/Risk map: power lines, main ditches and canals.
- Natural and cultural resources map: sensitive zones, non-sensitive zones, restricted vehicle access areas.
- Structure list and maps.
- Ownership maps.

Fire Management Units
Stone Lakes NWR will be managed as a single Fire Management Unit (FMU). Suppression strategies, management restrictions, fuels, fire environment, and values at risk are similar throughout the Refuge.

Due to staff limitations, relatively small land management parcels, valuable resources, and values at risk on neighboring lands, this plan does not recommend wildland fire managed for resource benefit as an option for Stone Lakes NWR. Wildland fires will be suppressed using the appropriate suppression response. Prescribed fires will be used to reduce hazardous fuels and to meet resource management objectives.

Fuel Types and Fire Behavior
The following behaviors are based on the average conditions found on the Refuge in a normal fire season or mid-July averages for the 14:00 weather. These averages include: maximum temp of 98 degrees F, 25% relative humidity, mid-flame wind speed of 8 mph, and 4% average 1hr (< 1/4 A diameter) dead fuel moisture. The slope is 0 to 2% and the rate of spread is for a head fire. The outputs are from the BEHAVE - Fire Behavior Prediction Models based on the conditions above and for the major fuel models found within the Refuge:

Fuel Model 1 - Upland Grass and Vernal Pools: Fire spread is governed by the fine and continuous herbaceous fuels that have cured or are nearly cured. Fires are surface fires that move rapidly through the cured grass and associated material. The fire behavior is directly related to the fuel moisture and windspeed. Fuel loading is 0.74 tons/acre and consists of 1/4" or smaller (1 hr) dead fuel component. Spot fires are generally not produced because fuels are consumed too quickly and thoroughly. Resistance to control is low to moderate, depending on windspeed. The behavior output includes:
- Rate of Spread - 275 chains/hr (3.5 mph)
- Flame Length - 7.7 feet

Fuel Model 3 - Seasonal Marsh: Fires in this model display high rates of spread under the influence of wind. Wind may drive fire into the uppers heights of the bulrush and across standing water. Stands are tall, averaging about 3-6 feet but considerable variation may occur. Approximately 1/3 or more of the stand is considered dead or cured and maintains the fire. Fuel loading is 3.0 tons/acre and consists of up to 1/4" 1 and 10 hr) dead fuel component. Fire behavior is directly related to the fuel moisture and windspeed. Short-range (up to 100') spotting usually occurs and causes high to extreme control problems. The behavior output includes:
- Rate of Spread - 259 chains/hr (3.0 mph
- Flame Length - 20.4 feet

Fuel Model 9 - Riparian Woodland: Fires are carried by dead, loosely compacted leaves and understory grasses. Wind tumbled leaves and torching trees may cause short-range spotting that may increase the rate of spread above the predicted value. Fuel loading is 3.5 tons/acre and consists of <3" of dead and live fuel. Fire behavior is directly related to the fuel moisture and fuel loading with windspeed in exposed areas. Resistance to control is moderate except during drought conditions when extreme fire conditions are present. The behavior output includes:
- Rate of Spread - 22 chains/hr (0.2 mph)
- Flame Length - 4.8 feet

Suppression Tactics

Wildland fires will be suppressed in a prompt, safe, and cost-effective manner to produce fast, efficient action with minimum damage to resources. Suppression involves a range of possible actions. All wildland fires will be suppressed.

Personnel and equipment must be efficiently organized to suppress fire effectively and safely. To this end, the Elk Grove Fire Protection District assumes the command function on major or multiple fire situations, setting priorities for the use of available resources and establishing a suppression organization. There will be only one Incident (IC) Commander responsible to the Refuge Manager. The Incident Commander will designate all overhead positions on fires requiring extended attack.

Suppression Conditions
The Cooperative agreement with Elk Grove ensures that a qualified IC is assigned for each fire occurring on the Refuge. The IC will be responsible for all aspects of the fire's management, within the predetermined guidelines of this Plan. The IC will select the appropriate suppression strategies and tactics. Minimum impact tactics will be used whenever possible. Dozers, plows, discs, or graders will be used inside Refuge boundaries only in cases where necessary to protect life and/or property, or where specifically authorized by the Refuge Manager or their designate.

Mutual aid resources responding from local fire departments to Refuge fires must meet federal fire qualifications as outlined in PMS 310-1 or National Fire Protection Association (NFPA) standards. The California State Fire Marshall's Office has issued standards for the State that meet or exceed PMS 310-1 standards.

The IC will notify the Refuge Manager whenever it appears that a fire will exceed initial attack efforts, may threaten private lands, or when fire complexity will exceed the capabilities of command or operations. The Refuge Manager will be responsible for coordinating with the IC all extended attack actions including:
- Completion and daily review of a WFSA (Wildland Fire Situation Analysis; Appendix I);
- Assignment or ordering of appropriate resources;
- Completion of Delegation of Authority if needed; and
- Development of standards and guidelines for use of heavy equipment, foam, retardant, aircraft, etc. using an interdisciplinary process.

Wildland Fire Situation Analysis
For fires that cannot be contained in one burning period, a WFSA must be prepared (Appendix I). In the case of a wildland fire, the IC, in conjunction with the Zone AFMO, will prepare the WFSA. Approval of the WFSA resides with the Refuge Project Leader.

The purpose of the WFSA is to allow consideration of alternatives by which a fire may be controlled. Damages from the fire, suppression costs, safety, and the probable character of suppression actions are all important considerations.

Public safety will require coordination between all Refuge staff and the IC. Notices may be posted to warn visitors of possible trail closures and traffic control may be necessary where smoke crosses roads. Where wildland fires do cross roads, the adjacent burned areas should be mopped up and dangerous snags felled. Every attempt will be made to utilize natural and constructed barriers, including changing fuel complexes, in the control of wildland fire. Rehabilitation efforts will concentrate on the damages done by suppression activities rather than on the burned area itself.

Aircraft Operations
Aircraft may be used in all phases of fire management operations. All aircraft must be Office of Aircraft Services (OAS) or U.S. Forest Service approved. An OAS Aviation Policy Department Manual will be provided by OAS.

Helicopters may be used for reconnaissance, bucket drops and transportation of personnel and equipment. Natural helispots and parking lots are readily available in most cases. Clearing for new helispots should be avoided where possible. Improved helispots will be rehabilitated following the fire.

As in all fire management activities, safety is a primary consideration. Qualified aviation personnel will be assigned to all flight operations.

Rehabilitation and Restoration

When suppression action is taken, rehabilitation is appropriate. The most effective rehabilitation measure is prevention of impacts through careful planning and the use of minimum impact suppression techniques. All wildland fire sites will be evaluated for rehabilitation needs as soon as possible. Re-seeding needs will be determined according to Service policy and regulations. Per Service policy, only damage to improvements caused by suppression efforts can be repaired with fire funds. Rehabilitation will be directed toward minimizing or eliminating the effects of the suppression effort and reducing the potential hazards caused by the fire. These actions may include:

1. Backfill control lines, scarify, and seed.
2. Install water bars and construct drain dips on control lines to prevent erosion.
3. Install check dams to reduce erosion potential in drainages.
4. Restore natural ground contours.
5. Remove all flagging, equipment and litter.
6. Completely restore camping areas and improved helispots.
7. Consider and plan more extensive rehabilitation or re-vegetation to restore sensitive impacted areas.

If re-vegetation or seeding is necessary, only native plant species will be used.

If emergency rehabilitation measures are needed or if rehabilitation is needed to reduce the effects of a wildland fire then the Refuge can request appropriate funding through the Burned Area Emergency Stabilization and Rehabilitation (ESR) fund.

Required Reporting

The fire staff will complete all situation reports as soon as practical. The IC will complete the DI-1202 Fire Report and Crew Time Reports for all personnel assigned to the fire, and return these documents to the Fire Program Manager for entry into the DOI Computer (SACS). The Fire Program Manager will ensure that all expenses and/or items lost on the fire are reported, that the timekeeper is advised of all fire time and premium pay to be charged to the fire and that expended supplies are replaced.

Fire Investigation

Fire management personnel will attempt to locate and protect the probable point of origin and record pertinent information required to determine fire cause. They will be alert for possible evidence, protect the scene and report findings to the fireline supervisor.

The Project Leader, Zone FMO/AFMO, or Incident Commander may order a fire investigator through normal dispatch channels.

Prescribed Fire Activities

Prescribed Burn Program Objectives

Stone Lakes National Wildlife Refuge has pursued a prescribed burning program as part of the overall management of the Refuge. Prescribed fire has been an integral part of the resource management on the Refuge since 1998. Planning and coordination for any prescribed fire activity is conducted on an annual basis. The use of prescribed fire to remove excess vegetation in wetlands and uplands reduces the accumulation of dead fuels. It also creates an improved mosaic of open water and emergent vegetation that provides for less intense fires in the future and better quality habitat for many waterbirds and other species. The prescribed fire program goals are hazard fuel reduction and resource/habitat management.

Hazard fuel reduction (i.e., mechanical removal or prescribed fire) will be pursued within or near Refuge development zones, sensitive natural resources areas, and Refuge boundary areas to reduce the risks of wildland fire. To the greatest extent possible, hazard fuel burns should compliment resource management objectives. Resource management prescribed fire is used to restore/create/maintain a diversity of plant communities in order to restore and perpetuate native wildlife species. The frequency of achieving many of the goals requires repeated prescribed burns every 5-10 years in marsh units and every 1-5 years in upland units. Goals of prescribed burning include:

- maintain fuel loadings within the natural ranges (determined by fuel type).
- protect resources / habitat from wildland fire trespass.
- establish defensible space around improvements and structures.
- aid in control of noxious weeds.
- control dense hardstem bulrush and cattail growth in wetlands.
- enhance native upland species production.
- maintain/rejuvenate quality “green browse” for ducks, geese, and cranes in upland areas.
- maintain/rejuvenate quality nesting cover for waterfowl.

Complexity is dependent upon fuels/vegetation, objectives, burn boundaries, and size. Burns on the Refuge vary from low-medium in fuel models 1 and 3, which represents approximately 80-90% of the total acres treated, to low- high in the model 9 fuels. Complexities are determined by using the FIREBASE analysis described in the Service Fire Management Handbook.

The Refuge reserves the option to utilize an interagency team approach for complex burns carried out on the boundaries and close to developed areas or burns of large acreage. The most highly qualified and experienced personnel in the regional interagency community would be requested to serve on this team.

Fire Management Strategies

The following strategies will be employed to meet the fire management objectives:

- Conduct all fire management programs in a manner consistent with applicable laws, policies and regulations.
- Maintain Memoranda of Understanding with local fire agencies and protection districts to support prescribed fire activities.
- Utilize prescribed fire as a management treatment for achieving hazard fuel reduction and resource management objectives.
- Initiate cost effective fire monitoring to assist managers ascertain if objectives are being met. Monitoring information will also be used to refine burn prescriptions to better achieve objectives.
- Integrate fire ecology, management, and prevention themes into existing interpretive and education programs.

Prescribed Fire Planning

The climate of the Sacramento-San Joaquin River Delta and the Sacramento Valley and their diverse plant communities combined with habitat management objectives, allow prescribed burns to be conducted at any time of the year. However, most burning will occur from June through November.

Annual Activities

The AFMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary, personnel utilized, and fire effects.

The Refuge Biologist and Project Leader, in conjunction with fire staff, are responsible for identifying annual prescribed fire needs and developing resource goals and treatment objectives for Refuge units/areas. The AFMO determines if prescribed fire can be utilized to meet the treatment objectives and identifies a burn boss to complete the Prescribed Fire Plan. Burn plans will meet all training, personnel, equipment, and other requirements as specified in the Service Fire Management Handbook. Prescribed fires will be planned to minimize the risk of escape and/or to mitigate necessary risks and provide an adequate contingency plan for suppressing the fire should an escape occur. The plan will then go through the review process with input from the Refuge Biologist and FMO/AFMO before final approval from the Project Leader.

Agricultural Burn Permits will be obtained from the Sacramento Metropolitan Air Quality Management District (issued by the Sacramento County Agricultural Commissioner). Permit parameters and fees may vary and be subject to change. An estimate of total acres to be treated should be provided early in the planning process to allow the air district to complete and coordinate for the proposed emissions.

Prescribed Fire Burn Plan

Individual prescribed fire burn plans will be the primary document used to record prescribed fire information. Burn plans document air quality requirements, personnel, costs, fire behavior, weather, fire summary, and burn critique information (Appendix J). Prescribed burns will also be documented on
DI-1202 forms and entered into the Department of the Interior Shared Applications Computer System (SACS).

The Prescribed Fire Burn Boss will conduct a field reconnaissance of the proposed burn location with the FMO, AFMO, Prescribed Fire Specialist (PFS), Refuge Biologist, and/or Refuge Manager to discuss objectives, special concerns, and gather all necessary information to prepare the burn plan. After completing the reconnaissance, a qualified Prescribed Fire Burn Boss will prepare the prescribed fire burn plan.

All prescribed fires will have prescribed fire burn plans. The prescribed burn plan is a site specific action plan describing the purpose, objectives, prescription, and operational procedures needed to prepare and safely conduct the burn. The treatment area, objectives, constraints, and alternatives will be clearly outlined. No burn will be ignited unless all prescriptions of the plan are met. Fires not within those parameters will be suppressed.

Strategies and Personnel

The Sacramento NWRC fire staff will oversee and assist the Refuge field staff with the unit preparations including equipment maintenance, fuel break mowing, and blacklining. Refuge staff will be responsible for assisting with public relations and education regarding the use of fire as a management practice.

The PFS will assign a burn boss of the appropriate level to implement the burn. The burn boss will follow all guidelines and procedures that are contained in the Prescribed Fire Burn Plan.

The Refuge will meet or exceed standard and qualification requirements as outlined in the Service Fire Management Handbook and Interagency prescribed fire qualification (NWCG publication 310-1). The Refuge Manager shall delegate to the AFMO the responsibility for ensuring that Refuge personnel maintain the qualifications necessary to implement the growing fire program.

Weather and fuel moisture conditions must be monitored closely in planned burn units to determine when the prescription criteria are met. A belt weather kit may also be utilized to augment monitoring.

When all prescription criteria are within the acceptable range, the Burn Boss will select an ignition time based on current and predicted weather forecasts. A thorough briefing will be given by the Burn Boss and specific assignments and placement of personnel will be discussed. An updated spot weather forecast will be obtained on the day of ignition and all prescription elements will be rechecked to determine if all elements are still within the approved ranges. If all prescription and plan elements are met using the Go-No-Go check list and concurrence with the Project Leader or their designate, a test fire will be ignited to determine on-site fire behavior conditions as affected by current weather. If conditions are not satisfactory, the test fire will be suppressed and the burn will be rescheduled. If conditions are satisfactory the burn will continue as planned.

Prior to ignition the burn boss will verify that contingency resources are available. Minimum contingency resources for the Refuge are: a qualified Incident Commander Type III (within 30 minutes), and suppression resources to be determined based on each burn plan. If the prescribed burn escapes the predetermined burn area, all further ignition will be halted except as needed for suppression efforts. Suppression efforts will be initiated, as discussed in the pre-burn briefing. The Zone AFMO or FMO will be notified immediately of any control actions on a prescribed burn. If the escaped prescribed fire escapes initial suppression efforts, the burn will be declared a wildland fire and suppressed using guidelines established in this plan. If the escaped fire continues into the next burning period, a WFSA will be completed and additional personnel and resources ordered as determined by the Incident Commander. If the fire continues to burn out of control, additional resources will be called from the local cooperating agencies via the servicing dispatch. A management overhead team may be requested to assume command of the fire.

Monitoring and Evaluation

Monitoring of prescribed fires is intended to provide information for quantifying and predicting fire behavior and its ecological effects on Refuge resources while generating an historical record. Monitoring will measure the parameters common to all fires: fuels, topography, weather and fire behavior. In addition, ecological changes such as plant and wildlife species composition and structural changes will be monitored. This information will then be utilized to fine-tune the prescribed burn program.

During prescribed burns, monitoring can serve as a precursor to invoking suppression action to help determine if the fire is in prescription, assess its overall potential, and determine the effects of the prescribed burn.

Monitoring and evaluation are part of the prescribed fire process. Monitoring is completed in three steps: pre-burn, burn day, and post-burn. Burn day evaluations document

temperature, relative humidity, wind speed, rate of spread, flame length, smoke dispersal, and objectives.

Required Reports
All prescribed burn forms will be completed as outlined by the Prescribed Burn Boss. A monitor will be assigned to collect all pre-identified information and complete all necessary forms prior to, during, and after the burn. All records will be archived in the Refuge's fire records for future use and reference.

The Prescribed Burn Boss will prepare a final report on the prescribed burn for the Project Leader. Information will include a narrative of the burn operation, a determination of whether objectives were met, weather and fire behavior data, map of the burn area, photographs of the burn, number of work hours, and final cost of the burn.

Prescribed Burn Critique
Prescribed fires will be critiqued by the burn boss and documented in the burn plan. The Zone AFMO and Project Leader will conduct a formal critique if:
- significant injury/accident.
- an escape prescribed fire occurs.
- significant safety concerns are raised.
- smoke management problems occur.

Air Quality / Smoke Management Guidelines

Visibility and clean air are primary natural resource values. The protection of these resources must be given full consideration in fire management planning and operations. In addition, smoke management can have serious health and safety effects which must be considered during the planning and approval process.

Smoke management is a concern in the southern Sacramento River Valley. The Refuge is situated in a non-attainment area. When air quality is poor, a "no-burn" day is declared by the Sacramento Metropolitan Air Quality Management District (SMAQMD) in Sacramento. All Refuge prescribed burns should be conducted between 10:00 a.m. and 5:00 p.m. to help reduce air pollution. Early morning and late afternoon fires tend to produce more smoke that persists longer (due to more stable atmospheric condition). If smoke on public roads is anticipated, the California Highway Patrol should be notified. Prior to any burns, a public notice should be placed in local newspapers to avoid unnecessary public concern.

All prescribed burns must comply with the State of California Air Quality Regulations for Burning (CCR Title 17, Subchapter 2 "Smoke Management Guidelines for Agricultural and Prescribed Burning"), and local implementation plans. All burns are required to have a permit ("credits") from SMAQMD.

The management of smoke will be incorporated into the planning of prescribed fires and to the extent possible, in the suppression of wildland fires. A sample Burn permit is located in Appendix K. Sensitive areas will be identified and precautions will be taken to safeguard visitors and Refuge neighbors. When burning occurs adjacent to roads and highways, close monitoring will be conducted of wind conditions to prevent traffic hazards. There will be no hesitation to postpone a burn if wind conditions become questionable.

Fire Research

Assessing the effects of fire upon Refuge plant and animal communities will involve ongoing monitoring and research. Through applied research and careful application of fire, data collection will provide a better understanding of the natural ecological effects of fire and the information needed to refine prescriptions to meet resource objectives. Normal fire-year funding cannot be used to fund research projects.

Any research will comply with accepted scientific guidelines. This data, along with information gathered through research studies, will be used to improve the effectiveness of the fire management program.

Conducting the following fire research would be beneficial at Stone Lakes NWR:

- comprehensive inventory and assessment of Refuge hazard fuels and the identification and prioritization of hazard fuel units;
- assessment of hazard fuel management options, and their effects upon Refuge resource objectives;
- assessment of long and short term fire effects on upland and wetland habitats of the Refuge with recommendations for using prescribed fire in conjunction with other management tools to meet resource objectives; and
- assessment of fire effect monitoring needs and preparation of fire effect monitoring plan..

Public Safety

Firefighter and public safety will always take precedence over property and resource protection during any fire management activity. The greatest threat to public safety from Refuge wildland fires or escaped prescribed fires is entrapment by extremely fast moving fire fronts or fingers. Of particular concern are hunters or visitors who may be present in the area of the fire and neighbors who initiate their own suppression actions without proper training, equipment, or communication. Refuge staff will attempt to ensure that the fire scene is clear of people except for Service firefighters and any resources requested from cooperators.

Another concern is smoke from a Refuge wildland or prescribed fire, particularly smoke that drifts into a roadway causing dangerously reduced visibility. The fire dispatcher may notify the local law enforcement agency (i.e., Sacramento County Sheriff's Department) whenever the IC believes that drifting smoke may compromise public safety. The California Highway Patrol may also be consulted to assess the situation and take action as needed.

A final concern is fires which may escape the Refuge and expand onto inhabited nearby private property. The IC is responsible for contacting the appropriate official (Sacramento County Sheriff's Department) to warn and evacuate the public from potentially dangerous wildland fires.

Public Information and Education

Providing effective public outreach is an important part of fire suppression, fire prevention, prescribed fire, and the Service mission. During fire operations, the IC and/or burn boss is responsible for providing fire information to the press and the public. The IC may delegate this task as needed.

Informing the public is a vital element of the prescribed fire program. Areas that have been burned may present an opportunity for the public to actually see the effects of fire and offer an excellent opportunity for Refuge staff to interpret the goals of the fire program to the public. These programs should demonstrate the Refuge's capability to safely conduct prescribed fire operations and increase the public's tolerance of the short-term aesthetic impacts.

Approximately 90-95 percent of the Refuge's wildland fires have been human caused (i.e., traffic along county and state roads, equipment, power poles) and could have been prevented. Human-caused fires have the potential to cause significant damage since they can occur at a time of year when few initial attack resources are available and fuels are well cured.

In general, the local public and many visitors to the Refuge are well aware of fire prevention. However, the Refuge should employ the following, as needed:

- signing,
- closures when necessary,
- public contacts through press releases and verbal contacts,
- enforcement of regulations and prosecution of violators,
- employee training and awareness,
- implementation of state regulations and restrictions,
- contacts with Refuge cooperators and neighbors, and
- maintenance of a fuel break and/or blackline around headquarters each spring.

Fire Critiques and Annual Plan Review

Fire Critiques

Wildland fires with be critiqued by the IC. The FMO will conduct formal fire critiques in the event of:

- significant injury/accident.
- significant property or resource damage.
- significant safety concerns are raised.
- an extended attack is necessary.

Annual Fire Summary Report

The Zone AFMO will be responsible for completing an annual fire summary report that will contain the number of fires by type, acres burned by fuel type, cost summary (prescribed burns and wildland fires), personnel utilized, and fire effects.

Annual Fire Management Plan Review

The Fire Management Plan will be reviewed annually. Necessary updates or changes will be accomplished prior to the upcoming fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan.

Consultation and Coordination

Numerous agencies, organizations and/or individuals were consulted in the course of developing the fire management program for Stone Lakes NWR. All fire management program activities will continue to be implemented in cooperation and coordination with federal, state, county, and local agencies. Other agencies and organizations will be consulted as needed. General program consultation and coordination will be sought from the Regional Fire Management Coordinator, Regional Prescribed Fire Specialist, and the National Interagency Fire Center (NIFC).

During the planning process for establishment of the Refuge in the early 1990s, the Service received over 6,000 public comments in the form of letters, petitions and received input from the public in the course of 24 public meetings. In the course of this public involvement, there were numerous opportunities to comment on the full range of potential Refuge habitat management approaches, including use of fire.

In the course of finalizing the Cooperative Agreement with the Elk Grove Community Services District, Refuge staff attended two public district meetings and solicited input on the Refuge fire management program. As part of the pre-planning process for prescribed burns conducted in 1999 and 2000, the Refuge provided public notices to several local newspapers. No comments on these notices were received and no opposition to prescribed burning was conveyed to the Refuge. Rather, support for the use of prescribed fire has been communicated to Refuge staff by adjacent private landowners on several occasions.

Service and Refuge fire planning staff have also hosted a number of meetings with staff of the Sacramento Metropolitan Air Quality Management District, the California Air Resources Board, and the Sacramento County Agricultural Commission. At these meeting, these entities expressed their support for the goals of the Refuge fire program and agreed to cooperate during its implementation. Coordination meetings with these agencies will be held by Refuge staff on an annual basis.

Since some fire management activities occur on lands owned by Sacramento County Department of Regional Parks, Recreation and Open Space and California Department of Parks and Recreation which are managed as part of Stone Lakes NWR through cooperative agreement, the Service will continue ongoing coordination and consultation with those agencies, as needed.

Roddy Baumann, Prescribed Fire Specialist, Pacific Region, USFWS, Portland, OR.

Michael Brady, Wildlife Biologist, Stone Lakes NWR, Elk Grove, CA

Michael Durfee, Prescribed Fire Specialist, Walkill NWR, Sussex, NJ

Kenneth Fuller, Fish and Wildlife Biologist, Sacramento Fish and Wildlife Office, Sacramento, CA

Richard Hadley, Assistant Refuge Supervisor, California/Nevada Operations, Sacramento, CA

Amanda McAdams, Fire Planner, Pacific Region, USFWS, Portland, OR.

Vince Nyvall, Sacramento County Agricultural Commissioner, Sacramento, CA

David Paullin, Refuge Supervisor, California-Nevada Operations Office, Sacramento, CA

Roger Wong, Zone Fire Management Officer, San Luis NWRC, Los Banos, CA

Appendices

Appendix C.1: References Cited

Sacramento County and U.S. Fish and Wildlife Service. February 1999. Cooperative Agreement for Grassland Management on the North Stone Lake Wildlife Refuge and Notice of Exemption. 8 pp.

Elk Grove Fire Protection District. 1998. Cooperative Agreement with U.S. Fish and Wildlife Service. 3 pp.

EA Engineering, Science, and Technology. 1990. Draft Land Use and Management Plan for the Proposed North Stone Lake Wildlife Refuge. Prepared for: Sacramento County Department of Parks and Recreation. 27 pp.

Hart, J. A. and U.S. Fish and Wildlife Service. In Draft. North Stone Lake Restoration and Management Master Plan. HART Inc. Prepared for Sacramento County, Department of Regional Parks, Recreation and Open Space.

Tremaine, K. 1994. Preliminary observations on lacustrine adaptation in the Central Valley, California. Paper presented at the 28th Annual Meeting, Society for California Archeology, Ventura, California.

U.S. Fish and Wildlife Service. 1992. Final Environmental Impact Statement with appendices for Stone Lakes National Wildlife Refuge Project, Sacramento County, California. With Technical assistance provided by Jones and Stokes, Associates, Inc. (JSA 91-047), Sacramento, California.

Tremaine and Associate. In Preparation. Archaeological Survey Report for the North Stone Lake Unit of Stone Lakes National Wildlife Refuge, Sacramento County, California.

Appendix C.2: Definitions

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices or services of the Department.

Class of Fire (as to size of wildland fires):
Class A—3 acre or less.
Class B—more than 3 but less than 10 acres.
Class C—10 acres to 100 acres.
Class D—100 to 300 acres.
Class E—300 to 1,000 acres.
Class F—1,000 to 5,000 acres.
Class G—5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC). A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.

Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.

Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.

Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.

Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

Natural fire. A fire of natural origin, caused by lightning or volcanic activity.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.
NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to realize maximize net benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.

Prevention. Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation. (1) Actions to limit the adverse effects of suppression on soils, watershed, or other values, or (2) actions to mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.

Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildfire. An unwanted wildland fire.

Wildland Fire. Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

Wildland/urban interface fire. A wildland fire that threatens or involves structures.

Appendix C.3: Compliance Documents

United States Fish and Wildlife Service
Environmental Action Statement for Categorical Exclusion

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the following proposed action is categorically excluded from NEPA documentation requirements consistent with 40 CFR 1508.4 and 516 DM 2.3A.

Proposed Action and Alternatives

The U.S. Fish and Wildlife Service (Service) proposes to adopt a Fire Management Plan for Stone Lakes National Wildlife Refuge (NWR) that will utilize fire as a habitat management tool for the maintenance and enhancement of grasslands and wetlands and reduction of hazardous fuels on the refuge. The Service currently manages 4,000 acres within the approved refuge boundary, consisting of both Service-owned properties and lands belonging to other agencies including, California Department of Transportation, Sacramento County Department of Regional Parks, Recreation and Open Space, and California Department of Parks and Recreation. The refuge supports a variety of habitats including grasslands, seasonal and permanent wetlands, and riparian woodlands. Alternate vegetation management approaches which the refuge is pursuing include livestock grazing, mowing, discing, and planting of native grasses and woody vegetation. All methods may be incorporated, to varying degrees, into the grassland and wetland management programs of the refuge, when appropriate and feasible to implement. For example, a successful domestic livestock grazing program has been in place on the 2,600-acre North Stone Lake unit and Gallagher property within the refuge for three years and will continue to be utilized. However, the refuge has determined that fire should continue to be utilized for restoration of native grass communities and hazardous fuel reduction due to it's cost effectiveness and since not all refuge properties are suitable for the alternative vegetation techniques.

Categorical Exclusion(s)

The specific categorical exclusions from NEPA allowing for this action pursuant to 516 DM 2.3A (2) are:

B.(4) The use of prescribed burning for habitat improvement purposes, when conducted in accordance with local and State ordinances and laws.

B.(5) Fire management activities, including prevention and restoration measures, when conducted in accordance with departmental and Service procedures.

Permits/Approvals

In accordance with Service policy, a Prescribed Burn Plan will be prepared and approved by the Project Leader prior to conducting a prescribed burn.

An Agricultural Burn Permit will be obtained from the Sacramento County Agricultural Commission on behalf of the Sacramento Metropolitan Air Quality Management District. Stone Lakes NWR has also entered into a cooperative agreement with the Elk Grove Fire Protection District (District). In accordance with this agreement, the refuge is required to provide copies of Prescribed Burn Plans to the District in advance of any prescribed burning. The Service must also acquire a District radio prior to prescribed burn.

Service Endangered Species Division staff from the Sacramento Fish and Wildlife Office were informally consulted on the refuge grassland habitat management program including the use of fire as a management tool. As result of this consultation, the refuge Project Leader determined this management program will have "no affect" on listed, proposed, and/or candidate species or designated critical habitat.

Due to the presence of a number of cultural resource sites within the refuge boundary, ongoing coordination and consultation to ensure protection of these sites will continue, as needed, between refuge staff and the State Historic Preservation Office, California Native American Heritage Commission, local tribal representatives, and private archaeological consultants. All refuge lands have been surveyed and known historic properties delineated. Archaeological specialists and local Native American representatives are annually consulted in the planning of refuge habitat management activities to ensure that all responsibilities under Section 106 of the National Historic Preservation Act are satisfied.

Public Involvement/Interagency Coordination

During the planning process for establishment of Stone Lakes NWR (U.S. Fish and Wildlife Service 1992), the Service received over 6000 public comments in the form of letters, petitions and received input from the public in the course of 24 public meetings. In the course of this public involvement, there were numerous opportunities to comment on the full range of potential refuge habitat management approaches, including use of fire.

In the course of finalizing a cooperative agreement with the Elk Grove Fire Protection District, refuge staff attended two public district meetings and solicited input on the refuge fire management program. As part of the pre-planning process for prescribed burns conducted in 1999 and 2000, the refuge provided public notices to several local newspapers. No comments on these notices were received and no opposition to prescribed burning was conveyed to the refuge. Rather, support for the use of prescribed fire has been communicated to refuge staff by adjacent private landowners on several occasions.

Service and refuge fire planning staff have also hosted a number of meetings with staff of the Sacramento Metropolitan Air Quality Management District, the California Air Resources Board, and the Sacramento County Agricultural Commission. At these meeting, these entities expressed their support for the goals of the refuge fire program and agreed to cooperate during its implementation. Coordination meetings with these agencies will be held by refuge staff on an annual basis.

Since some fire management activities occur on lands owned by Sacramento County Department of Regional Parks, Recreation and Open Space and California Department of Parks and Recreation which are managed as part of Stone Lakes NWR through cooperative management agreement, the Service will continue ongoing coordination and consultation with those agencies, as needed.

Supporting Documents

Sacramento County and U.S. Fish and Wildlife Service. February 1999. Cooperative Agreement for Grassland Management on the North Stone Lake Wildlife Refuge and Notice of Exemption. 8 pp.

Elk Grove Fire Protection District. 1998. Cooperative Agreement with U.S. Fish and Wildlife Service. 3 pp.

EA Engineering, Science, and Technology. 1990. Draft Land Use and Management Plan for the Proposed North Stone Lake Wildlife Refuge. Prepared for: Sacramento County Department of Parks and Recreation. 27 pp.

Hart, J. A. and U.S. Fish and Wildlife Service. In Draft. North Stone Lake Restoration and Management Master Plan. HART Inc. Prepared for Sacramento County, Department of Regional Parks, Recreation and Open Space.

Tremaine, K. 1994. Preliminary Observations on lacustrine adaption in the Central Valley, California. Paper presented at the 28th Annual Meeting, Society for California Archeology, Ventura, California.

U.S. Fish and Wildlife Service. 1992. Final Environmental Impact Statement with appendices for Stone Lakes National Wildlife Refuge Project, Sacramento County, California. With Technical assistance provided by Jones and Stokes, Associates, Inc. (JSA 91-047), Sacramento, California.

Tremaine and Associate. In Preparation. Archaeological Survey Report for the North Stone Lake Unit of Stone Lakes National Wildlife Refuge, Sacramento County, California.

_____ _____

Project Leader Date
Stone Lakes National Wildlife Refuge

Appendix C.4: Cooperative Agreements

Cooperative Agreement for Grassland Management on North Stone Lake Wildlife Refuge

THIS AGREEMENT is made and entered into by and between the United States Fish and Wildlife Service, an executive agency of the United States Department of The Interior (hereinafter referred to as "Service"), and the County of Sacramento (hereinafter referred to as "County").

R E C I T A L S:

WHEREAS, the Service and the County share a common interest in protecting, enhancing, and managing habitat for the benefit of migratory birds and other wildlife and native plan communities; and

WHEREAS, this agreement allows for the limited interchange of services, personnel, equipment, facilities, and funds; and provides for the long term management and administration of the lands which as of the date of this agreement constitute the North Stone Lake Wildlife Refuge in South Sacramento County; and

WHEREAS, this Cooperative Agreement is made and entered into under the following authorities of the Parties, among others:

A. Service:
Section 1 of the Fish and Wildlife Coordination Act (48 Stat/401 as amended; (6 U.S.C. 661 et seq.), Section 7 of the Fish and Wildlife Act of 1956, 16 U.S.C. 742f (a)(4), and the Migratory Bird Conservation Act (45 Stat. 1222).

B. County:
Government Code, Section 23004. Board of Supervisors Resolution No. _____ dated _____; and

WHEREAS, the County, as landowner of 1,567 acres of the North Stone Lake Wildlife Refuge, desires to enable the long term protection, care, regulation, administration, enhancement, and management of these lands by making available the herein described land base; and

WHEREAS, the Service as designated land manager, desires to secure through established wildlife refuge management practices the long term protection, care, regulation, administration, enhancement, and management of these lands; and

WHEREAS, the purpose and objective of this Cooperative Agreement is to establish a framework for the management and administration of the property subject to this Agreement consistent with the goals and objectives of the "Grasslands" chapter of the Draft North Stone Lake Restoration and Management Master Plan (hereinafter referred to as "Management Plan") and as a component of and consistent with the native plant restoration goals of Stone Lakes National Wildlife Refuge.

NOW, THEREFORE, in consideration of the mutual promises and covenants hereinafter set forth the parties agree as follows:

Section 1. APPLICATION. This Cooperative Agreement applies to the administration and management of the following lands, which are collectively referred to herein as "property subject to this Agreement" (See Map, Figure A);

All portions of the County's existing holdings in the vicinity of North Stone Lake, known as the North Stone Lake Wildlife Refuge (Assessors Parcel Numbers: 119-230-20,48,49; 132-010-54-58,64,65,68,69; 132-120-24-26; 132-131-27,28), hereinafter referred to as "the Refuge", in Sacramento County as of the date of this Agreement.

Section 2. PURPOSE. Service agrees that it will manage the grasslands on the Refuge in a manner consistent with the goals and objectives of the "Grasslands" chapter of the Management Plan and the native plant restoration goals described in the Final Environmental Impact Statement for Stone Lakes National Wildlife Refuge (May 1992).

Section 3. LIMITATIONS. In the event that the Management Plan is ultimately approved by the County, the Service agrees to abide by the "Grasslands" chapter of such plan.

Section 4. COOPERATIVE AGREEMENT ADMINISTRATORS. The parties agree to appoint the following project officers, or their designees, to coordinate the implementation of this Cooperative Agreement:

The County of Sacramento:
Director
Department of Regional Parks, Recreation and Open Space
3711 Branch Center Road
Sacramento, California 95827
Phone: (916) 366-2932; 366-2950 (fax)

The U.S. Fish and Wildlife Service:
Project Leader
Stone Lakes National Wildlife Refuge
2233 Watt Avenue, Suite 230
Sacramento, California 95825
Phone: (916) 979-2085; 979-2058 (fax)

Section 5. SERVICE OBLIGATIONS. The Service, as designated on-site land manager, shall:

A. develop a grassland management strategy for the Refuge, select a qualified grazing permittee, and in consultation with the County, oversee implementation of a cooperative land management agreement with the grazing permittee. The cooperative land management agreement will identify: the season of use, stocking rate, estimated animal unit months (AUM), the rate charged per AUM, and a program for the control of noxious weeds as defined by the County Agricultural Commissioner;

B. provide necessary staff, commensurate with available funding, to pursue the goals of Stone Lakes National Wildlife Refuge; related to grassland management and habitat protection and enhancement;

C. provide expertise in planning and consulting on habitat enhancement activities including securing of funds to implement improved management of the Refuge;

D. coordinate any law enforcement activities on the Refuge with County law enforcement authorities;

E. prepare and present for review by the Sacramento County Recreation and Park and Fish and Game Commission, an annual report for the previous year and an annual work plan for the current year summarizing Service management of the Refuge;

F. not permit hunting nor the possession or discharge of firearms on the Refuge pursuant to County Ordinances;

G. protect any cultural resources on the Refuge from routine maintenance and other activities pursuant to Section 106 of the National Historic Preservation Act and the California Public Resources Code Section 5097.5 and 5097.9 et seq; and

H. manage the Refuge as part of the National Wildlife Refuge System, as directed in Title 50, United States Code, as well as other laws, regulations and policies for the administration of the National Wildlife Refuge System.

Section 6. COUNTY OBLIGATIONS. The County, as landowner, shall:

A. provide the necessary land base as described by the aforementioned Refuge for the purposes of accomplishing the goals described in this Cooperative Agreement and in the "Grasslands" chapter of the Management Plan; and

B. allow the Service with the agreement of the County, to exercise flexibility in requiring the permittee to perform a variety of maintenance and management tasks on the property subject to this Agreement in lieu of providing grazing fees to the County.

Section 7. SPECIAL PROVISIONS. The Service and the County further agree:

A. to provide neighboring landowners and reclamation districts with advance notification of any proposed physical modification of the property subject to this Agreement; notification will be the responsibility of the party proposing the modification and any modification must comply with the Sacramento County Water Resources Division Flood Management Plan and not result in any net loss in flood plain storage;

B. that in the event the County proposes to establish a habitat mitigation bank or mitigation site on the Refuge, consistent with the Management Plan, the Service agrees, consistent with Service mitigation policy, to cooperate in the creation of said mitigation site in conformance with a Habitat Restoration Program as adopted by the Sacramento County Department of Regional Parks, Recreation and Open Space. Any funds generated from the sale of mitigation credits will go to the Sacramento County Department of Regional Parks, Recreation and Open Space Trust Fund and not back to management of the Refuge;

C. to meet at least semi-annually. The Stone Lakes National Wildlife Refuge Project Leader shall be responsible for scheduling meetings in this regard;

D. that nothing herein shall be considered as obliging the Service or the County to expend funds or otherwise obligate the Service or County for the future payment of money in excess of appropriations authorized by law and administratively allocated for the provisions of this Agreement;

E. to recognize each other's interests as parties to this Agreement and the development of the Refuge in public media releases, public signs, and promotional materials where such acknowledgment is appropriate; and

F. to administer the grassland and refuge management programs on the property so that traditional and historic agricultural practices on adjacent properties can continue. In the event of a conflict between this program and adjacent agriculture, an adequate buffer zone will be established on the Refuge in consultation with the County Agricultural Commissioner.

G. to continue to recognize and allow historic drainage flows into the Stone Lakes Slough from neighboring reclamation districts.

Section 8. FUNDING. Revenues resulting from use of the property subject to this Agreement, such as those generated by grazing, will go back for use on the Refuge for maintenance, security, capital improvements for the grassland management program, management, enhancement, and other operations. Any revenues that may result that are not applied back to the Refuge will be deposited in the Sacramento County Department of Regional Parks, Recreation and Open Space Trust Fund.

Section 9. TERMINATION. Either party may terminate this Agreement by providing to the other written notice of such termination one year prior to the date such termination is to take effect. The County may immediately suspend this agreement in the event of a health or safety emergency or other related cause as determined by the Director of the Sacramento County Department of Regional Parks, Recreation and Open Space.

Section 10. MODIFICATIONS. Modifications to the Agreement may be proposed by either party but no modification or amendment to this Agreement shall be effective unless in writing and executed by both parties.

Section 11. NOTICES. Any notice required or authorized to be given pursuant to this Agreement shall be deemed delivered twenty-four (24) hours after being deposited, postage prepaid, in the United States Post and addressed in the manner set forth in Section 4 hereof.

Section 12. EXECUTION. This Cooperative Agreement is executed in three (3) copies, each of which is to be considered an original.

Section 13. ELECTED OFFICIALS NOT TO BENEFIT. No member of or delegate to the Congress or resident commissioner shall be entitled to any share or part of this Management Agreement or to any benefit that may arise from it.

Section 14. EFFECTIVE DATE. This Agreement shall become effective upon being executed by the Parties and remain in effect for a period of five (5) years from the date of initiation of a cooperative land management agreement with the grazing permittee, but not to exceed six (6) years, unless terminated prior to that time by either of the parties, or until such time as the County ultimately approves the Management Plan and the terms of this Agreement are revisited.

EXECUTED THIS _____ DAY OF _____, 1998, in Sacramento, County, California.

"Service"
U.S. FISH AND WILDLIFE SERVICE

_____ _____
Name Title

_____
Signature

Contract Sufficiency Review (U.S. Fish and Wildlife Service):

_____ Date: _____
Signature

_____
Title

"County"
COUNTY OF SACRAMENTO - BOARD OF SUPERVISORS

_____ _____
Name Title

_____
Signature

ATTEST:

_____
Clerk of the Board of Supervisors

DEPARTMENT OF REGIONAL PARKS, RECREATION AND OPEN SPACE

_____ _____
Name Title

_____
Signature

Cooperative Agreement Between the U.S. Fish and Wildlife Service and the Elk Grove Fire Protection District

I. INTRODUCTION

The U.S. Fish and Wildlife Service (hereinafter referred to as the Service), an agency of the Federal Government, is primarily responsible for the welfare and protection of lands, structures and wildlife within the boundaries of National Wildlife Refuge (hereinafter referred to as the Refuge). Because wildfires sometime threaten to damage those resources, and local fire districts have historically provided fire protection assistance to the Refuges, the Service desires to enter an agreement with the Elk Grove Fire Protection District (hereinafter referred to as the District) which will formalize responsibilities of both parties and provide for remuneration to the District for fire suppression services rendered.

II. AUTHORITY

The Service enters into agreement under the authority of the "Protection Act of September 20, 1922", (42 Stat.857; 16 USC 594), the "Reciprocal Fire Protection Act of May 27, 1955"60 Stat.66, 67; 42 USC 1856, 1856a and b" and 31 USC 6305 (Cooperative Agreements).

III. PURPOSE

The purpose of this agreement is to provide fire protection services to those portions of National Wildlife Refuge within the boundaries of the Fire Protection District and to remunerate the District for costs incurred in providing fire suppression services to those lands.

IV. TERMS OF AGREEMENT

This agreement shall become effective upon being executed by both parties and shall remain in effect through December 31, 2005. This agreement terminates and supersedes any previous agreements between the District and the Service.

V. SPECIFIC OBLIGATIONS OF THE PARTIES

A. The Service shall:

1. Delegate authority to the District as necessary to put the Fire Chief or his delegate in Unified command of the fire fighting effort.
2. Provide manpower and/or equipment, as available, to assist the District in fighting fires on or adjacent to Service lands when so requested by the District.
3. Provide funds (as indicated in Section VII, herein) for fire suppression services.
4. Make arrangements with the Elk Grove Fire Department to borrow a portable 800 MHz radio, until such time that the Service changes over to these frequencies.
5. All prescribe burns will require there own burn plan and be conducted in accordance to NWCG rules and guidelines and will be sent to Elk Grove Fire Chief no later than 14 days before the actual burn date.

B. The District shall:

1. Provide, as available, manpower and equipment necessary to suppress wildland and structural fires on Service lands within the District's jurisdiction.
2. Respond as quickly as possible when asked to suppress any such fire on Service lands.

VI. PROJECT OFFICERS

A. The Service's project officer shall be:

Refuge Manager - Stone Lakes National Wildlife Refuge
2233 Watt Ave. Suite 230
Sacramento, CA 95825
916-979-2086

VII. FUNDING

A. The Service agrees to pay the District for actual fire suppression costs incurred by the District while suppressing fires on Refuge lands. Reimbursement to be claimed by the District (as determined by the District and approved by the Service) shall include:

1. Salaries and wages for District personnel used to suppress a fire. Reimbursement for the salary or wage of any employee shall be computed on the direct daily or hourly wage of that employee, including both actual overtime payments and related employee benefit cost
2. The actual cost to the District for use of personnel from other agencies, and for paid "pickup" labor used to suppress a fire.
3. The actual cost to the District for food services, transportation, and sleeping accommodations for personnel engaged in suppressing a fire.
4. The actual equipment operation costs expended by the District to suppress a fire. These costs shall be calculated using an hourly or mileage based rate for each class of equipment or vehicle.
5. The total cost to the District for equipment rented to suppress a fire.
6. Replacement or repair costs to the District for equipment and tools damaged, destroyed or lost as a result of a fire. However, any such claim shall be reduced by any salvage value and be based on the depreciated value of such equipment and tools prior to the fire, as determined by the District. Furthermore, the District shall eliminate from said claims any costs directly attributable to the negligence of District personnel operating the equipment or tool.
7. Costs will include direct expenditures, as well as indirect or administrative costs.
8. Fire Cost Reimbursement Tables for manpower and equipment are attached as Appendix A, and the District will update these costs annually.

B. Reimbursement to the District for fires which burn onto the Refuge from adjacent property shall be based on the percentage of the total acres burned that were actually within the Refuge.

C. Reimbursement to the District for fire suppression on lands in accordance with this agreement may not exceed $50,000 per response or $150,000 per fiscal year without further approval of the Refuge Manager .

D. Reimbursement will be made to the District within 60 days of receiving the District's invoice for suppression costs. Each payment will be made to the District at the address listed above.

E. All invoices prepared by the District should be submitted to the Refuge Manager at the address listed above.

VIII. SPECIAL PROVISIONS

A. This agreement shall not affect the rights of any party to recover suppression costs and/or damages sustained as a result of the negligent or willful act of any person causing a fire.

B. No party shall be liable to any other for loss, damage, personal injury or death occurring in consequence of the performance of this agreement, except as provided herein.

C. Both parties may work jointly on fire trespass investigations. Fire law enforcement reports may be prepared independently.

D. Copies of fire reports shall be mutually provided to the other agency as soon as possible.

IX. GENERAL PROVISIONS

The U.S. Office of Management and Budget Circular numbers: 87, 102 and 128; shall be applicable to this agreement and are incorporated herein as Attachments 1,2 and 3.

X. AMENDMENTS

Amendment to this agreement may be proposed by either party and shall become effective upon being reduced to a written document executed by both parties.

XI. TERMINATION

This agreement may be terminated in whole or in part when all parties agree that the continuation of the agreement would not produce satisfactory results. The parties shall agree upon the termination conditions including the effective date and, in the case of partial terminations, the portion to be terminated. The parties shall not incur new obligations after the effective date of termination, and shall cancel as many outstanding obligations as possible. The Service shall allow full credit to the other parties for the Federal share of non-cancelable obligations properly incurred by the other parties prior to termination.

U.S. Fish and Wildlife Service - Stone Lakes National Wildlife Refuge

_____ _____
Signature Date

_____
Title

Elk Grove Fire Protection District

_____ _____
Signature Date

_____
Title

Sufficiency Review:

U.S. Fish and Wildlife Service

_____ _____
Signature Date

_____
Title

Appendix C.5: Species List

Stone Lakes NWR Reptiles

Common Name	Scientific Name	Habitat	Sp	S	F	W
Class AMPHIBIA (amphibians) Order ANURA						
Family BUFONIDAE (true toads)						
western toad	*Bufo boreas*	msrg	r	r	r	r
Family HYLIDAE (tree frogs and relatives)						
pacific treefrog	*Pseudacris regilla*	rm	c	c	c	r
Family RANIDAE (true frogs)						
bullfrog	*Rana catesbeiana*	omr	c	c	c	r
Class REPTILIA (reptiles) Order SQUAMATA (lizards and snakes)						
Family ANGUIDAE (alligator lizards and relatives)						
southern alligator lizard	*Elgaria multicarinata*	rg	r	r	r	r
Family COLUBRIDAE (Colubrids)						
western yellowbelly racer	*Coluber constrictor mormon*	rg	u	c	u	r
common kingsnake	*Lampropeltis getula*	sg	u	c	u	r
gopher snake	*Pituophis catenifer*	sg	u	c	u	r
elegant garter snake	*Thamnophis elegans*	sm	u	c	u	r
giant garter snake	*Thamnophis gigas*	msrg	r	r	r	r
common garter snake	*Thamnophis sirtalis*	sm	u	c	u	r
Family PHRYNOSOMATIDAE (North American spiny lizards)						
western fence lizard	*Sceloporus occidentalis*	sg	c	c	c	c
Order TESTUDINES (turtles)						
Family EMYDIDAE (box and water turtles)						
western pond turtle	*Clemmys marmorata* (syn. *Emys marmorata*)	om	u	u	u	r
red-eared slider	*Trachemys scripta*	om	u	u	u	u

Stone Lakes NWR Mammals

Common Name	Scientific Name	Habitat	Sp	S	F	W
Order ARTIODACTYLA (even-toed hoofed animals)						
Family CERVIDAE (deer, moose, reindeer, elk)						
black-tailed deer	*Odocoileus hemionus*	rsg	r	r	r	r
Order CARNIVORA (meat-eaters)						
Family CANIDAE (coyotes, dogs, foxes, jackals and wolves)						
coyote	*Canis latrans*	wide	c	c	c	c
gray fox	*Urocyon cinereoargenteus*	gr	o	o	o	o
Family FELIDAE (cats)						
feral house cat	*Felis catus*	rgu	c	c	c	c
Family MEPHITIDAE (skunks and stink badgers)						
striped skunk	*Mephitis mephitis*	wide	u	u	u	u
Family MUSTELIDAE (badgers, otters, weasels and relatives)						
river otter	*Lontra canadensis*	or	c	c	c	c
mink	*Mustela vison*	om	o	o	o	o
Family PROCYONIDAE (coatis, raccoons, lesser pandas)						
raccoon	*Procyon lotor*	mr	c	c	c	c
	Order CHIROPTERA (bats)					
Family MOLOSSIDAE (free-tailed bats)						
guano bat	*Tadarida brasiliensis*	r	r	r	r	r
Order DIDELPHIMORPHIA (American marsupials)						
Family DIDELPHIDAE (opossums)						
virginia opossum	*Didelphis virgiana*	r	c	c	c	c
Order INSECTIVORA (insect-eaters)						
Family Soricidae (shrews)						
ornate shrew	*Sorex ornatus*	msg	r	r	r	r
Order LAGOMORPHA (pikas, hares and rabbits)						
Family LEPORIDAE (hares and rabbits)						
black-tailed jackrabbit	*Lepus californicus*	sg	c	c	c	c
desert cottontail	*Sylvilagus audubonii*	g	c	c	c	c
Order RODENTIA (gnawing mammals)						
Family CASTORIDAE (beavers)						
beaver	*Castor canadensis*	mr	a	a	a	a
Family CRICETIDAE (New World rats and mice, voles, hamsters and relatives)						
California vole	*Microtus californicus*	gr	c	c	c	c
muskrat	*Ondatra zibethicus*	om	c	c	c	c
deer mouse	*Peromyscus maniculatus*	rg	u	u	u	u
western harvest mouse	*Reithrodontomys megalotis*	msg	u	u	u	u

Common Name	Scientific Name	Habitat	Sp	S	F	W
Family GEOMYIDAE (gophers)						
Botta's Pocket Gopher	*Thomomys bottae*	g	u	u	u	u
Family MURIDAE (Old World mice, rats)						
house mouse	*Mus musculus*	sgru	u	u	u	u
Norway rat	*Rattus norvegicus*	sgru	u	u	u	u
black rat	*Rattus rattus*	sgru	u	u	u	u
Family SCIURIDAE (chipmunks, squirrels, marmots)						
western gray squirrel	*Sciurus griseus*	sg	u	u	u	u
Fox Squirrel	*Sciurus niger*	rg	u	u	u	u
California ground squirrel	*Spermophilus beecheyi*	rg	u	u	u	u

Stone Lakes NWR Birds

Common Name	Scientific Name	Habitat	Sp	S	F	W
Order ANSERIFORMES (waterfowl)						
Family ANATIDAE (ducks, geese and swans)						
wood duck*	*Aix sponsa*	osr	c	c	c	c
greater white-fronted goose	*Anser albifrons*	oga	o	-	u	c
northern pintail	*Anas acuta*	s	u	r	c	c
american wigeon	*Anas americana*	s	c	-	c	a
northern shoveler	*Anas clypeata*	s	a	r	u	a
green-winged teal	*Anas crecca*	s	c	-	c	c
cinnamon teal*	*Anas cyanoptera*	msg	c	o	o	c
blue-winged teal	*Anas discors*	s	r	-	r	r
eurasian wigeon	*Anas penelope*	s	-	-	-	r
mallard*	*Anas platyrhynchos*	msg	a	a	a	a
gadwall*	*Anas strepera*	msg	c	r	r	c
lesser scaup	*Aythya affinis*	os	u	-	-	u
redhead	*Aythya americana*	os	r	-	-	r
ring-necked duck	*Aythya collaris*	os	o	-	-	c
greater scaup	*Aythya marila*	os	-	-	-	#
canvasback	*Aythya valisineria*	os	r	-	-	c
bufflehead	*Bucephala albeola*	os	o	-	-	c
common goldeneye	*Bucephala clangula*	os	-	-	-	u
barrow's goldeneye	*Bucephala islandica*	os	-	-	-	#
canada goose*	*Branta canadensis*	osg	o	o	o	o
snow goose	*Chen caerulescens*	osga	-	-	-	r
ross' goose	*Chen rossii*	osga	-	-	-	r
tundra swan	*Cygnus buccinator*	osa	-	-	-	o
hooded merganser	*Lophodytes cucullatus*	os	r	-	-	o
common merganser	*Mergus merganser*	os	r	-	-	r
ruddy duck*	*Oxyura jamaicensis*	os	o	r	r	o
Order APODIFORMES (swifts and hummingbirds)						
Family APODIDAE (swifts)						
white-throated swift	*Aeronautes saxatalis*	a	r	r	r	r
Vaux's swift	*Chaetura vauxi*	a	r	-	r	-
Family TROCHILIDAE (hummingbirds)						
black-chinned hummingbird*	*Archilochus alexandri*	r	r	r	u	-
Anna's hummingbird*	*Calypte anna*	r	c	c	c	u
Rufous/Allen's hummingbird	*Selasphorus rufus*	r	-	-	r	-
Order CHARADRIIFORMES (shorebirds)						
Family CHARADRIIDAE (plovers and lapwings)						
semipalmated plover	*Charadrius semipalmatus*	s	r	-	r	-
killdeer*	*Charadrius vociferus*	wide	a	a	a	a

Common Name	Scientific Name	Habitat	Sp	S	F	W
black-bellied plover	*Pluvialis squatarola*	s	o	-	u	c
Family LARIDAE (gulls and terns)						
black tern	*Chlidonias niger*	osa	#	-	-	-
herring gull	*Larus argentatus*	osa	o	-	-	c
California gull	*Larus californicus*	osa	o	r	c	c
Mew Gull	*Larus canus*	osa	#	-	r	r
ring-billed gull	*Larus delawarensis*	osa	o	-	c	c
Thayer's gull	*Larus glaucoides*	osa	-	-	#	-
Bonaparte's gull	*Larus philadelphia*	osa	-	r	r	#
Caspian tern*	*Sterna caspia*	osa	o	r	o	-
Forster's tern	*Sterna forsteri*	osa	c	r	r	o
Family RECURVIROSTRIDAE (avocets and stilts)						
black-necked stilt*	*Himantopus mexicanus*	s	c	o	c	c
american avocet*	*Recurvirostra americana*	s	o	u	o	o
Family SCOLOPACIDAE (sandpipers and phalaropes)						
spotted sandpiper	*Actitis macularius*	s	o	r	o	o
ruddy turnstone	*Arenaria interpres*	s	#	-	-	-
sanderling	*Calidris alba*	s	#	-	-	-
dunlin	*Calidris alpina*	s	c	-	a	a
baird's sandpiper	*Calidris bairdii*	s	-	-	#	-
western sandpiper	*Calidris mauri*	s	c	-	c	o
pectoral sandpiper	*Calidris melanotos*	s	-	-	#	-
least sandpiper	*Calidris minutilla*	s	c	o	c	a
semipalmated sandpiper	*Calidris pusilla*	s	-	-	r	-
willet	*Catoptrophorus semipalmatus*	s	#	-	-	-
common snipe	*Gallinago delicata*	s	u	r	o	c
short-billed dowitcher	*Limnodromus griseus*	s	-	#	-	-
long-billed dowitcher	*Limnodromus scolopaceus*	s	c	-	c	c
whimbrel	*Numenius phaeopus*	sga	o	-	r	-
long-billed curlew	*Numenius americanus*	sga	o	r	o	o
red-necked phalarope	*Phalaropus lobatus*	s	r	-	r	-
wilson's phalarope*	*Phalaropus tricolor*	s	o	r	r	-
ruff	*Philomachus pugnax*	s	#	-	-	-
lesser yellowlegs	*Tringa flavipes*	s	o	-	o	o
greater yellowlegs	*Tringa melanoleuca*	s	c	r	c	c
solitary sandpiper	*Tringa solitaria*	s	#	-	#	-
Order CICONIIFORMES (storks, herons and relatives)						
Family ARDEIDAE (bitterns, herons and egrets)						
great blue heron*	*Ardea herodias*	wide	a	a	a	a
great egret*	*Ardea alba*	wide	a	a	a	a

Common Name	Scientific Name	Habitat	Sp	S	F	W
American bittern*	*Botaurus lentiginosus*	m	o	o	o	u
cattle egret	*Bubulcus ibis*	g	-	-	r	r
green heron*	*Butorides virescens*	mr	o	o	o	o
snowy egret*	*Egretta thula*	ms	c	u	c	c
least bittern	*Ixobrychus exilis*	m	r	r	r	-
black-crowned night-heron*	*Nycticorax nycticorax*	mr	o	o	o	o
Family CATHARTIDAE (vultures)						
turkey vulture*	*Cathartes aura*	a	a	a	a	a
Family THRESKIORNITHIDAE (ibises)						
white-faced ibis	*Eudocimus albus*	sg	o	o	o	-
Order COLUMBIFORMES (pigeons)						
Family COLUMBIDAE (doves and pigeons)						
rock dove*	*Columba livia*	u	c	c	c	c
mourning dove*	*Zenaida macroura*	wide	c	c	c	c
Order CORACIIFORMES (kingfishers and relatives)						
Family ALCEDINIDAE (kingfishers)						
belted kingfisher*	*Ceryle alcyon*	ra	c	c	c	c
Order FALCONIFORMES (diurnal birds of prey)						
Family ACCIPITRIDAE (osprey, kites, eagles and hawks)						
osprey	*Pandion haliaetus*	ra	r	r	r	-
cooper's hawk*	*Accipiter cooperii*	ra	u	u	c	c
sharp-shinned hawk	*Accipiter striatus*	ra	o	o	o	o
golden eagle	*Aquila chrysaetos*	sga	o	o	o	o
red-tailed hawk*	*Buteo jamaicensis*	wide	a	a	a	a
red-shouldered hawk*	*Buteo lineatus*	ra	a	a	a	a
rough-legged hawk	*Buteo lagopus*	mga	-	-	-	r
ferruginous hawk	*Buteo regalis*	sa	-	-	-	r
swainson's hawk*	*Buteo swainsoni*	rsga	o	c	u	-
northern harrier*	*Circus cyaneus*	msga	a	c	a	a
white-tailed kite*	*Elanus leucurus*	wide	c	c	c	c
bald eagle	*Haliaeetus leucocephalus*	a	-	-	-	#
Family FALCONIDAE (falcons)						
merlin	*Falco columbarius*	rga	r	-	-	o
prairie falcon	*Falco mexicanus*	msga	r	-	-	r
peregrine falcon!	*Falco peregrinus*	msga	r	-	r	r
american kestrel*	*Falco sparverius*	wide	a	a	a	a
Order GALLIFORMES (megapodes, curassows, pheasants, quails and relatives)						
Family PHASIANIDAE						
ring-necked pheasant*	*Phasianus colchicus*	rg	a	a	a	a
Family ODONTOPHORIDAE						
california quail*	*Callipepla californica*	rg	c	c	c	c

Common Name	Scientific Name	Habitat	Sp	S	F	W
Order GRUIFORMES (coots, cranes and rails)						
Family GRUIDAE (cranes)						
sandhill crane	*Grus canadensis*	sg	r	-	c	c
Family RALLIDAE						
American coot*	*Fulica americana*	ms	c	o	o	a
common moorhen*	*Gallinula chloropus*	m	o	o	o	o
sora*	*Porzana carolina*	m	o	o	o	o
Virginia rail*	*Rallus limicola*	m	o	o	o	o
Order PASSERIFORMES (perching birds)						
Family AEGITHALIDAE (bushtits)						
bushtit*	*Psaltriparus minimus*	r	a	a	a	a
Family ALAUDIDAE (larks)						
horned lark	*Eremophila alpestris*	g	o	-	c	c
Family BOMBYCILLIDAE (waxwings)						
cedar waxwing	*Bombycilla cedrorum*	r	u	-	u	u
Family CARDINALIDAE (grosbeaks and buntings)						
lazuli bunting*	*Passerina amoena*	r	u	u	-	-
blue grosbeak*	*Passerina caerulea*	r	u	u	-	-
black-headed grosbeak*	*Pheucticus melanocephalus*	r	c	c	-	-
Family CERTHIIDAE (creepers)						
brown creeper	*Certhia americana*	r	-	-	#	#
Family CORVIDAE (jays, magpies and crows)						
western scrub-jay*	*Aphelocoma californica*	rs	a	a	a	a
American crow*	*Corvus brachyrhynchos*	rsg	c	c	c	c
yellow-billed magpie*	*Pica nuttalli*	rsg	o	o	o	o
Family EMBERIZIDAE (towhees and sparrows)						
spotted towhee*	*Pipilo maculatus*	r	a	a	a	a
dark-eyed junco	*Junco hyemalis*	r	u	-	u	c
swamp sparrow	*Melospiza georgiana*	g	-	-	#	-
Lincoln's sparrow	*Melospiza lincolnii*	gs	u	-	-	o
song sparrow*	*Melospiza melodia*	mr	c	c	c	c
savannah sparrow	*Passerculus sandwichensis*	gs	a	-	a	a
fox sparrow	*Passerella iliaca*	r	o	-	r	o
California towhee*	*Pipilo crissalis*	r	u	u	u	u
vesper sparrow	*Pooecetes gramineus*	g	#	-	-	-
chipping sparrow	*Spizella passerina*	g	#	#	-	-
white-throated sparrow	*Zonotrichia albicollis*	gs	r	-	-	r
golden-crowned sparrow	*Zonotrichia atricapilla*	gs	r	-	c	a
white-crowned sparrow	*Zonotrichia leucophrys*	gs	r	-	c	a

Common Name	Scientific Name	Habitat	Sp	S	F	W
Family FRINGILLIDAE (finches)						
lesser goldfinch*	*Carduelis psaltria*	g	-	-	r	r
American goldfinch*	*Carduelis tristis*	g	c	c	c	c
house finch*	*Carpodacus mexicanus*	wide	a	a	a	a
pine siskin	*Carduelis pinus*	r	-	-	r	-
purple finch	*Carpodacus purpureus*	r	-	-	-	#
Family HIRUNDINIDAE (swallows)						
barn swallow*	*Hirundo rustica*	msra	c	c	c	-
cliff swallow*	*Petrochelidon pyrrhonota*	msra	a	a	o	-
northern rough-winged swallow*	*Stelgidopteryx serripennis*	msra	u	o	r	-
tree swallow*	*Tachycineta bicolor*	msra	a	a	o	r
violet-green swallow	*Tachycineta thalassina*	msra	-	-	r	-
Family ICTERIDAE (icterids)						
red-winged blackbird*	*Agelaius phoeniceus*	mg	a	a	a	a
tricolored blackbird	*Agelaius tricolor*	mg	o	o	r	r
Brewer's blackbird*	*Euphagus cyanocephalus*	us	a	a	a	a
bullock's oriole*	*Icterus bullockii*	r	u	u	-	-
hooded oriole	*Icterus cucullatus*	r	r	-	-	-
brown-headed cowbird*	*Molothrus ater*	wide	c	c	c	o
great-tailed grackle*	*Quiscalus mexicanus*	sg	r	r	r	r
western meadowlark*	*Sturnella neglecta*	g	a	a	a	a
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	m	r	r	-	-
Family LANIIDAE (shrikes)						
northern shrike	*Lanius excubitor*	gr	-	-	-	#
loggerhead shrike*	*Lanius ludovicianus*	gr	u	u	u	u
Family MIMIDAE (mockingbirds and thrashers)						
northern mockingbird*	*Mimus polyglottos*	rg	o	o	o	o
Family MOTACILLIDAE (wagtails and pipits)						
American pipit	*Anthus rubescens*	sg	c	-	u	c
Family PARIDAE (titmice)						
oak titmouse*	*Baeolophus inornatus*	r	u	u	u	u
Family PARULIDAE (warblers)						
yellow-rumped warbler	*Dendroica coronata*	r	c	-	c	a
black-throated gray warbler	*Dendroica nigrescens*	r	o	-	u	r
yellow warbler	*Dendroica petechia*	r	c	r	c	-
townsend's warbler	*Dendroica townsendi*	r	o	-	o	-
common yellowthroat*	*Geothlypis trichas*	mr	c	c	c	u
yellow-breated chat	*Icteria virens*	r	#	-	-	-
Macgillivray's warbler	*Oporornis tolmiei*	r	o	-	u	-

Common Name	Scientific Name	Habitat	Sp	S	F	W
northern waterthrush	*Seiurus noveboracensis*	m	#	-	-	-
orange-crowned warbler	*Vermivora celata*	r	c	r	c	r
Nashville warbler	*Vermivora ruficapilla*	r	r	-	r	-
Canada warbler	*Wilsonia canadensis*	r	-	#	-	-
Wilson's warbler	*Wilsonia pusilla*	r	c	-	c	-
Family PASSERIDAE (Old World sparrows)						
house sparrow*	*Passer domesticus*	u	c	c	c	c
Family REGULIDAE (kinglets)						
ruby-crowned kinglet	*Regulus calendula*	r	c	-	c	a
golden-crowned kinglet	*Regulus satrapa*	r	r	-	u	u
Family SITTIDAE (nuthatches)						
white-breasted nuthatch*	*Sitta carolinensis*	r	u	u	u	u
Family STURNIDAE (starlings)						
european starling*	*Sturnus vulgaris*	rs	a	a	a	a
Family SYLVIIDAE (gnatchatchers)						
blue-gray gnatcatcher	*Polioptila caerulea*	r	#	-	r	-
Family THRAUPIDAE (tanagers)						
western tanager	*Piranga ludoviciana*	r	u	r	u	-
Family TIMALIIDAE (babbler)						
wrentit*	*Chamaea fasciata*	r	c	c	c	c
Family TROGLODYTIDAE (wrens)						
marsh wren*	*Cistothorus palustris*	m	a	a	a	a
rock wren	*Salpinctes obsoletus*	g	#	#	#	#
house wren*	*Troglodytes aedon*	r	c	c	c	u
bewick's wren*	*Thryomanes bewickii*	mr	u	u	u	u
winter wren	*Troglodytes troglodytes*	r	-	-	-	r
Family TURDIDAE (thrushes)						
hermit thrush	*Catharus guttatus*	r	o	-	o	o
Swainson's thrush	*Catharus ustulatus*	r	o	-	o	-
varied thrush	*Ixoreus naevius*	r	-	-	r	r
mountain bluebird	*Sialia currucoides*	r	-	-	-	#
western bluebird	*Sialia mexicana*	rg	#	-	-	#
American robin*	*Turdus migratorius*	rg	c	u	c	c
Family TYRANNIDAE (flycatchers)						
olive-sided flycatcher	*Contopus cooperi*	r	r	-	o	-
western wood-pewee*	*Contopus sordidulus*	r	r	-	o	-
pacific-slope flycatcher	*Empidonax difficilis*	r	r	r	r	-
hammond's flycatcher	*Empidonax hammondii*	r	#	-	r	-
dusky flycatcher	*Empidonax oberholseri*	r	#	#	-	-
willow flycatcher	*Empidonax traillii*	r	r	-	o	-
ash-throated flycatcher*	*Myiarchus cinerascens*	rg	u	c	r	-

Common Name	Scientific Name	Habitat	Sp	S	F	W
black phoebe*	*Sayornis nigricans*	mr	a	a	a	a
say's phoebe	*Sayornis saya*	sg	-	-	u	u
tropical kingbird	*Tyrannus melancholicus*	rg	-	-	-	#
western kingbird*	*Tyrannus verticalis*	rg	u	c	-	-
Family VIREONIDAE (vireos)						
Cassin's vireo	*Vireo cassinii*	r	r	-	r	-
warbling vireo	*Vireo gilvus*	r	u	-	u	-
Hutton's vireo	*Vireo huttoni*	r	r	r	r	r
Order PELECANIFORMES (pelicans, tropicbirds, cormorants and relatives)						
Family PELECANIDAE (pelicans)						
American white pelican	*Pelecanus erythrorhynchos*	os	c	u	o	o
Family PHALACROCORACIDAE (cormorants)						
double-crested cormorant	*Phalacrocorax auritus*	o	c	c	o	c
Order PICIFORMES (woodpeckers and relatives)						
Family PICIDAE (woodpeckers)						
northern flicker*	*Colaptes auratus*	r	c	o	c	c
acorn woodpecker	*Melanerpes formicivorus*	r	-	-	-	#
Nuttall's woodpecker*	*Picoides nuttallii*	r	c	c	c	c
downy woodpecker*	*Picoides pubescens*	r	c	c	c	c
red-breasted sapsucker	*Sphyrapicus nuchalis*	r	-	-	r	r
Order PODICIPEDIFORMES (grebes)						
Family PODICIPEDIDAE (grebes)						
clark's grebe	*Aechmophorus clarkii*	o	r	r	o	o
western grebe	*Aechmophorus occidentalis*	o	r	r	o	o
horned grebe	*Podiceps auritus*	os	r	-	r	r
eared grebe	*Podiceps nigricollis*	oms	r	r	r	r
pied-billed grebe*	*Podilymbus podiceps*	oms	c	u	a	a
Order STRIGIFORMES (owls)						
Family TYTONIDAE (typical owls)						
long-eared owl	*Asio otus*	srg	-	-	-	#
short-eared owl	*Asio flammeus*	msg	-	-	-	r
burrowing owl*	*Athene cunicularia*	f	r	r	r	r
great horned owl*	*Bubo virginianus*	r	c	c	c	c
western screech-owl	*Megascops kennicottii*	r	r	r	r	r
barn owl*	*Tyto alba*	wide	c	c	c	c

Habitats: o - Open water, lakes, creeks, ponds; m - Marshes, tule and cattail stands; s - seasonal wetlands, mudflats, flooded fields; r - Riparian forests; g - Grasslands; a - Aerial, usually observed in flight; wide - Widespread, found in a variety of habitats; u - urban

Seasons: Sp - Spring, March through May; S - Summer, June through August; F - Fall, September through November; W - Winter, December through February

Abundance: a - Abundant, expected to be observed 80 to 100 percent of the time in appropriate habitat; c - Common: 60 to 80 percent; u - Uncommon: 30 to 60 percent; o - Occasionally: 10 to 30 percent; r - Rare: 0 to 10 percent; * - Birds known to nest locally; ! -Threatened/Endangered Species; # - Observed less than 10 times in the past 10 years

Stone Lakes NWR Plants

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
ACERACEAE (maple family)					
Acer negundo var. *californicum*	box elder	native	perennial	tree	dicot
ALISMATACEAE (water plantain family)					
Alisma lanceolatum	water plantain	introduced	perennial	forb/herb	monocot
Echinodorus berteroi	burhead	native	perennial	forb/herb	monocot
Sagittaria latifolia	arrowhead	native	perennial	forb/herb	monocot
ANACARDIACEAE (sumac family)					
Toxicodendron diversilobum	poison oak	native	perennial	shrub/vine	monocot
APIACEAE (carrot family)					
Daucus carota	wild carrot	introduced	biennial	forb/herb	dicot
Foeniculum vulgare	fennel	introduced	biennial, perennial	forb/herb	dicot
Scandix pecten-veneris	Venus' needle	introduced	annual	forb/herb	dicot
APOCYNACEAE (dogbane family)					
Apocynum cannabinum	indian hemp	native	perennial	forb/herb	dicot
ASCLEPIADACEAE (milkweed family)					
Asclepias fascicularis	narrow leaf milkweed	native	perennial	forb/herb	dicot
Asclepias incarnata	milkweed	native	perennial	forb/herb	dicot
ASTERACEAE (aster family)					
Achyrachaena mollis	blow-wives	native	perennial	forb/herb	dicot
Acroptilon repens	russian knapweed	introduced	perennial	forb/herb	dicot
Ambrosia psilostachya	western ragweed	native	perennial	forb/herb	dicot
Anthemis cotula	chamomile	introduced	annual	forb/herb	dicot
Artemisia douglasiana	mugwort	native	perennial	forb/herb	dicot
Aster subulatus var. *ligulatus*	southern annual saltmarsh aster	native	annual, biennial	forb/herb	dicot
Baccharis pilularis	coyote bush	native	perennial	subshrub, shrub	dicot
Bidens frondosa	nodding beggarticks	native	annual	forb/herb	dicot
Carduus pycnocephalus	italian thistle	introduced	annual	forb/herb	dicot
Centaurea solstitialis	yellow star thistle	introduced	annual	forb/herb	dicot
Matricaria discoidea (syn. *Chamomilla suaveolens*)	pineapple weed	introduced	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Cichorium intybus	chicory	introduced	biennial, perennial	forb/herb	dicot
Cirsium vulgare	bull thistle	introduced	biennial	forb/herb	dicot
Conyza canadensis	horseweed	native	annual, biennial	forb/herb	dicot
Coreopsis wrightii	tickseed	native	annual	forb/herb	dicot
Euthamia occidentalis	grass-leaved goldenrod	native	perennial	forb/herb	dicot
Gnaphalium luteo-album	cudweed, weedy	introduced	annual	forb/herb	dicot
Gnaphalium palustre	cudweed, everlasting	native	annual	forb/herb	dicot
Gnaphalium stramineum	cudweed, everlasting	native	annual, biennial	forb/herb	dicot
Grindelia camporum	gum plant	native	perennial	subshrub, forb/herb	dicot
Helianthus annuus	sunflower	native	annual	forb/herb	dicot
Hemizonia fitchii	fitch's tarweed	native	annual	forb/herb	dicot
Centromadia pungens (syn. *Hemizonia pungens*)	spikeweed	native	annual	forb/herb	dicot
Hesperevax caulescens	dwarf dwarf-cudweed	native	annual	forb/herb	dicot
Heterotheca grandiflora	telegraph plant	native	annual, biennial, perennial	forb/herb	dicot
Holocarpha virgata	holocarpha	native	annual	forb/herb	dicot
Hypochaeris glabra	smooth cats ear	introduced	annual	forb/herb	dicot
Hypochaeris radicata	rough cat's-ear	introduced	perennial	forb/herb	dicot
Lactuca serriola	prickly lettuce	introduced	annual, biennial	forb/herb	dicot
Lasthenia californica	California goldfields	native	annual, perennial	forb/herb	dicot
Lasthenia fremontii	Fremont's goldfields	native	annual	forb/herb	dicot
Lasthenia glaberrima	smooth goldfields	native	annual	forb/herb	dicot
Layia chrysanthemoides	tidy tips	native	annual	forb/herb	dicot
Madia elegans ssp. *vernalis*	common madia	native	annual	forb/herb	dicot
Picris echioides	bristly ox-tongue	introduced	annual	forb/herb	dicot
Psilocarphus brevissimus	wooly heads	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Psilocarphus oregonus	Oregon wooly-heads	native	annual	forb/herb	dicot
Senecio vulgaris	common groundsel	introduced	annual, biennial	forb/herb	dicot
Silybum marianum	milk thistle	introduced	annual, biennial	forb/herb	dicot
Sonchus asper ssp. *asper*	prickly sow thistle	introduced	annual	forb/herb	dicot
Sonchus oleraceus	annual sowthistle	introduced	annual	forb/herb	dicot
Xanthium spinosum	spiny cocklebur	introduced	annual	forb/herb	dicot
Xanthium strumarium	cocklebur	native	annual	forb/herb	dicot
BORAGINACEAE (borage family)					
Amsinckia menziesii var. *intermedia*	fiddleneck	native	annual	forb/herb	dicot
Heliotropium curassavicum	heliotrope	native	annual, perennial	subshrub, forb/herb	dicot
Plagiobothrys greenei	popcorn flower	native	annual	forb/herb	dicot
Plagiobothrys leptocladus	alkali popcorn flower	native	annual	forb/herb	dicot
Plagiobothrys stipitatus var. *micranthus*	stalked popcornflower	native	annual	forb/herb	dicot
Plagiobothrys stipitatus var. *stipitatus*	stalked popcornflower	native	annual	forb/herb	dicot
Plagiobothrys trachycarpus	roughfruit popcornflower	native	annual	forb/herb	dicot
BRASSICACEAE (mustard family)					
Brassica nigra	black mustard	introduced	annual	forb/herb	dicot
Brassica rapa	field mustard	introduced	annual, biennial	forb/herb	dicot
Capsella bursa-pastoris	shepherd's purse	introduced	annual	forb/herb	dicot
Cardamine oligosperma	little western bittercress	native	annual, biennnial, perennial	forb/herb	dicot
Cardaria chalepensis	lens-podded hoary-cress	introduced	perennial	shrub	dicot
Lepidium latifolium	perennial peppergrass	introduced	perennial	forb/herb	dicot
Lepidium latipes var. *heckardii*	Heckard's peppergrass	native	annual	forb/herb	dicot
Lepidium nitidum var. *nitidum*	shining pepperweed	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Raphanus raphanistrum	jointed charlock	introduced	annual, biennial	forb/herb	dicot
Raphanus sativus	wild radish	introduced	annual, biennial	forb/herb	dicot
Rorippa curvisiliqua	yellow cress	native	annual, biennial	forb/herb	dicot
CALLITRICHACEAE (water-starwort family)					
Callitriche trochlearis	water starwort	native	annual	forb/herb	dicot
CAMPANULACEAE (bellflower family)					
Downingia bicornuta var. *bicornuta*	downingia	native	annual	forb/herb	dicot
Downingia ornatissima var. ornatissima	folded calicoflower	native	annual	forb/herb	dicot
Legenere limosa	legenere	native	annual	forb/herb	dicot
CAPRIFOLIACEAE (honeysuckle family)					
Sambucus nigra (syn. *Sambucus mexicana*)	elderberry	native	perennial	shrub, tree	dicot
Symphoricarpos albus var. *laevigatus*	snowberry	native	perennial	subshrub, shrub	dicot
CARYOPHYLLACEAE (pink family)					
Cerastium glomeratum	sticky chickweed	introduced	annual	forb/herb	dicot
Silene gallica	catchfly	introduced	annual, biennial	forb/herb	dicot
Spergula arvensis ssp. *arvensis*	starwort	introduced	annual	forb/herb	dicot
Spergularia bocconii	sand-spurry	introduced	annual	forb/herb	dicot
Stellaria media	common chickweed	introduced	annual	forb/herb	dicot
CHENOPODIACEAE (goosefoot family)					
Chenopodium album	lamb's quarters	native, introduced	annual	forb/herb	dicot
Chenopodium ambrosioides	Mexican tea	introduced	annual, perennial	forb/herb, subshrub	dicot
Chenopodium multifidum	chenopodium	introduced	annual	forb/herb	dicot
Salsola tragus	russian tumbleweed	introduced	annual	forb/herb	dicot
CONVOVULACEAE (morning-glory family)					
Convolvulus arvensis	bindweed	introduced	perennial	vine, forb/herb	dicot
CRASSULACEAE (stonecrop family)					
Crassula aquatica	water pygmyweed	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
CUCURBITACEAE (cucumber family)					
Marah fabaceus	manroot	native	perennial	vine, forb/herb	dicot
CUSCUTACEAE (dodder family)					
Cuscuta pentagona	dodder	native	annual, perennial	vine, forb/herb	dicot
CYPERACEAE (sedge family)					
Carex praegracilis	carex	native	perennial	graminoid	monocot
Cyperus eragrostis	sedge	native	perennial	graminoid	monocot
Cyperus erythrorhizos	redroot flatsedge	native	annual, perennial	graminoid	monocot
Cyperus esculentus	yellow nut sedge	native, introduced	perennial	graminoid	monocot
Eleocharis macrostachya	spike rush	native	perennial	graminoid	monocot
Schoenoplectus acutus (syn. *Scirpus acutus var. occidentalis*)	hardstem bulrush	native	perennial	graminoid	monocot
Schoenoplectus mucronatus (syn. *Scirpus mucronatus*)	bog bulrush	introduced	perennial	graminoid	monocot
Scirpus robustus	alkali bull rush	native	perennial	graminoid	monocot
Schoenoplectus glaucus (syn. *Scirpus tuberosus*)	scirpus	introduced	perennial	graminoid	monocot
EUPHORBIACEAE (spurge family)					
Chamaesyce maculata	spotted sandmat	native	annual	forb/herb	dicot
Eremocarpus setigerus	turkey mullin, doveweed	native	annual	forb/herb	dicot
FABACEAE (pea family)					
Glycyrrhiza lepidota	wild licorice	native	perennial	forb/herb	dicot
Lotus corniculatus	trefoil	introduced	perennial	forb/herb	dicot
Lotus unifoliolatus var. unifoliolatus (syn. *Lotus purshianus* var. *purshianus*)	lotus	native	annual	forb/herb	dicot
Lupinus albifrons var. *albifrons*	lupine	native	perennial	subshrub, shrub	dicot
Lupinus bicolor	annual lupine	native	annual	forb/herb	dicot
Medicago polymorpha	California burclover	introduced	annual, perennial	forb/herb	dicot
Medicago sativa	alfalfa	introduced	annual, perennial	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Melilotus alba	white sweetclover	introduced	annual, biennnial, perennial	forb/herb	dicot
Melilotus indica	yellow sweetclover	introduced	annual	forb/herb	dicot
Trifolium depauperatum var. *depauperatum*	balloon clover	native	annual	forb/herb	dicot
Trifolium dubium	hopclover, shamrock	introduced	annual	forb/herb	dicot
Trifolium fucatum	bull clover	native	annual	forb/herb	dicot
Trifolium hirtum	rose clover	introduced	annual	forb/herb	dicot
Trifolium microdon	thimble clover	native	annual	forb/herb	dicot
Trifolium variegatum	whitetip clover	native	annual	forb/herb	dicot
Trifolium willdenovii	tomcat clover	native	annual	forb/herb	dicot
Vicia sativa ssp. *nigra*	common vetch	introduced	annual	vine, forb/herb	dicot
Vicia villosa	hairy vetch	introduced	annual, biennnial, perennial	vine, forb/herb	dicot
FAGACEAE (beech family)					
Quercus douglasii	blue oak	native	perennial	tree	dicot
Quercus lobata	valley oak	native	perennial	tree	dicot
Quercus wislizenii	live oak	native	perennial	tree	dicot
Centaurium muehlenbergii	centaury	native	annual, biennial	forb/herb	dicot
Erodium botrys	broad leaf cranes bill	introduced	annual, biennial	forb/herb	dicot
Erodium cicutarium	red stemmed filaree	introduced	annual, biennial	forb/herb	dicot
Erodium moschatum	white-stemmed filaree	introduced	annual, biennial	forb/herb	dicot
GERANIACEAE (geranium family)					
Geranium carolinianum	Carolina geranium	native	annual, biennial	forb/herb	dicot
Geranium dissectum	geranium	introduced	annual, biennial	forb/herb	dicot
HYDROPHYLLACEAE (waterleaf family)					
Nemophila menziesii	baby blue-eyes	native	annual	forb/herb	dicot
Nemophila pedunculata	nemophila	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
IRIDACEAE (iris family)					
Sisyrinchium bellum	blue-eyed grass	native	perennial	forb/herb	monocot
JUGLANDACEAE (walnut family)					
Juglans californica var. *hindsii*	black walnut	native	perennial	tree	dicot
JUNCACEAE (rush family)					
Juncus arcticus ssp. *littoralis* (syn. *Juncus balticus*)	baltic rush	native	perennial	graminoid	monocot
Juncus bufonius	toad rush	native	annual	graminoid	monocot
Juncus patens	rush	native	perennial	forb/herb	monocot
Juncus phaeocephalus	rush	native	perennial	graminoid	monocot
Juncus xiphioides	irisleaf rush	native	perennial	graminoid	monocot
LAMIACEAE (mint family)					
Lamium amplexicaule	henbit	introduced	annual, biennial	forb/herb	dicot
Lycopus americanus	bugleweed	native	perennial	forb/herb	dicot
Marrubium vulgare	white horehound	introduced	perennial	subshrub, forb/herb	dicot
Mentha pulegium	pennyroyal	introduced	perennial	forb/herb	dicot
Pogogyne douglasii	Douglas' mesamint	native	annual	forb/herb	dicot
Pogogyne ziziphoroides	Sacramento mesamint	native	annual	forb/herb	dicot
Stachys ajugoides	hedge nettle	native	perennial	forb/herb	dicot
Trichostema lanceolatum	vinegar weed	native	annual	forb/herb	dicot
LAURACEAE (laurel family)					
Umbellularia californica	California bay tree	native	perennial	tree, shrub	dicot
LILIACEAE (lily family)					
Asparagus officinalis ssp. *officinalis*	asparagus	introduced	perennial	forb/herb	monocot
Brodiaea elegans ssp. elegans	harvest brodiaea	native	perennial	forb/herb	monocot
Chlorogalum pomeridianum	soap root	native	perennial	forb/herb	monocot
Dichelostemma capitatum ssp. *capitatum*	blue dicks	native	perennial	forb/herb	monocot
Triteleia hyacinthina	white brodiaea	native	perennial	forb/herb	monocot
Triteleia laxa	Ithuriel's spear	native	perennial	forb/herb	monocot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
LYTHRACEAE (loosestrife family)					
Ammannia coccinea	ammannia	native	annual	forb/herb, subshrub	dicot
Lythrum hyssopifolia	hyssop loosestrife	introduced	annual, biennial	forb/herb	dicot
Lythrum tribracteatum	threebract loosestrife	introduced	perennial	forb/herb	dicot
MALVACEAE (mallow family)					
Abutilon theophrasti	velvetleaf	introduced	annual	forb/herb	dicot
Malva neglecta	cheeses	introduced	annual, biennnial, perennial	forb/herb	dicot
Malvella leprosa	alkali mallow	native	perennial	forb/herb	dicot
OLEACEAE (olive family)					
Fraxinus latifolia	Oregon ash	native	perennial	tree	dicot
ONAGRACEAE (evening primrose family)					
Epilobium brachycarpum	willowweed	native	annual	forb/herb	dicot
Epilobium canum	zauschneria	native	perennial	subshrub, forb/herb	dicot
Epilobium ciliatum	willow weed	native	perennial	forb/herb	dicot
Epilobium pygmaeum	epilobium	native	annual	forb/herb	dicot
Ludwigia peploides ssp. *peploides*	water primrose	native	perennial	forb/herb	dicot
PAPAVERACEAE (poppy family)					
Eschscholzia californica	California poppy	native	annual, perennial	forb/herb	dicot
PLANTAGINACEAE (plantain family)					
Plantago coronopus	buckhorn plantain	introduced	annual, biennial	forb/herb	dicot
Plantago elongata	little plantain	native	annual	forb/herb	dicot
Plantago lanceolata	English plantain	introduced	annual, biennnial, perennial	forb/herb	dicot
PLATANACEAE (plane-tree family)					
Platanus racemosa	California sycamore	native	perennial	tree	dicot
POACEAE (grass family)					
Alopecurus saccatus	foxtail	native	annual	graminoid	monocot
Avena fatua	wild oats	introduced	annual	graminoid	monocot
Briza minor	quaking grass	introduced	annual	graminoid	monocot
Bromus carinatus	California brome	native	annual, perennial	graminoid	monocot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Bromus diandrus	ripgut brome	introduced	annual, perennial	graminoid	monocot
Bromus hordeaceus	soft chess	introduced	annual	graminoid	monocot
Bromus madritensis ssp. *rubens*	foxtail chess	introduced	annual	graminoid	monocot
Crypsis schoenoides	swamp grass	introduced	annual	graminoid	monocot
Crypsis vaginiflora	swamp timothy	introduced	annual	graminoid	monocot
Cynodon dactylon	bermuda grass	introduced	perennial	graminoid	monocot
Deschampsia cespitosa	tufted hairgrass	native	perennial	graminoid	monocot
Distichlis spicata	salt grass	native	perennial	graminoid	monocot
Echinochloa crus-galli	water grass	introduced	annual	graminoid	monocot
Elymus glaucus	blue wild rye	native	perennial	graminoid	monocot
Elymus trachycaulus	wheat grass	native	perennial	graminoid	monocot
Eragrostis mexicana	Mexican lovegrass	native	annual	graminoid	monocot
Schedonorus phoenix (syn. *Festuca arundinacea*)	tall fescue	introduced	perennial	graminoid	monocot
Festuca brevipila (syn. *Festuca trachyphylla*)	hard fescue	introduced	perennial	graminoid	monocot
Hordeum brachyantherum	meadow barley	native	perennial	graminoid	monocot
Hordeum jubatum	foxtail barley	native	perennial	graminoid	monocot
Hordeum marinum ssp. *gussonianum*	mediterranean barley	introduced	annual	graminoid	monocot
Hordeum murinum ssp. *leporinum*	foxtail barley	introduced	annual	graminoid	monocot
Koeleria macrantha	junegrass	native	perennial	graminoid	monocot
Leymus triticoides	creeping wild rye	native	perennial	graminoid	monocot
Leptochloa uninervia	Mexican sprangletop	native	annual, perennial	graminoid	monocot
Lolium perenne ssp. *multiflorum* (syn. *Lolium multiflorum*)	annual rye grass	introduced	annual, perennial	graminoid	monocot
Melica californica	California melic	native	perennial	graminoid	monocot
Muhlenbergia rigens	deer grass	native	perennial	graminoid	monocot
Nassella cernua	nodding needlegrass	native	perennial	graminoid	monocot
Nassella pulchra	purple needle grass	native	perennial	graminoid	monocot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Paspalum dilatatum	dallis grass	introduced	perennial	graminoid	monocot
Phalaris californica	California canarygrass	native	perennial	graminoid	monocot
Phalaris minor	canary grass	introduced	annual	graminoid	monocot
Phalaris paradoxa	hood canarygrass	introduced	annual	graminoid	monocot
Phleum pratense	cultivated timothy	introduced	perennial	graminoid	monocot
Poa annua	annual bluegrass	introduced	annual	graminoid	monocot
Poa bulbosa	bulbous bluegrass	introduced	perennial	graminoid	monocot
Polypogon monspeliensis	rabbit foot grass	introduced	annual	graminoid	monocot
Setaria pumila	bristly foxtail	introduced	annual	graminoid	monocot
Sorghum halepense	johnsongrass	introduced	perennial	graminoid	monocot
Taeniatherum caput-medusae	medusahead	introduced	annual	graminoid	monocot
Vulpia myuros	rat tail fescue	introduced	annual	graminoid	monocot
POLYGONACEAE (buckwheat family)					
Polygonum amphibium var. *emersum*	water smartweed	native	perennial	forb/herb	dicot
Polygonum arenastrum	common knotweed	introduced	annual, perennial	forb/herb	dicot
Polygonum lapathifolium	willow smartweed	native	annual	forb/herb	dicot
Polygonum persicaria	thumbprint smartweed	probably introduced	annual, perennial	forb/herb	dicot
Polygonum punctatum	annual smartweed	native	annual, perennial	forb/herb	dicot
Rumex conglomeratus	clustered dock	introduced	perennial	forb/herb	dicot
Rumex crispus	curly dock	introduced	perennial	forb/herb	dicot
Rumex maritimus	golden dock	native	annual, biennial	forb/herb	dicot
Rumex pulcher	fiddle dock	introduced	perennial	forb/herb	dicot
POLEMONIACEAE (phlox family)					
Linanthus montanus	mustang clover	native	annual	forb/herb	dicot
Navarretia leucocephala	whitehead navarretia	native	annual	forb/herb	dicot
PONTEDERIACEAE (water-hyacinth family)					
Eichhornia crassipes	water hyacinth	introduced	perennial	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
PORTULACEAE (purslane family)					
Calandrinia ciliata	red maids	native	annual	forb/herb	dicot
Claytonia parviflora	miners lettuce	native	annual	forb/herb	dicot
Claytonia perfoliata ssp. *mexicana*	miners' lettuce	native	annual	forb/herb	dicot
Montia fontana	water chickweed	native	annual	forb/herb	dicot
PRIMULACEAE (primrose family)					
Anagallis arvensis	scarlet pimpernel	introduced	annual, biennial	forb/herb	dicot
RANUNCULACEAE (buttercup family)					
Clematis ligusticifolia	virgin's bower	native	perennial	vine	dicot
Ranunculus bonariensis var. *trisepalus*	buttercup	native	annual	forb/herb	dicot
Ranunculus muricatus	spiny-fruited buttercup	introduced	annual, biennnial, perennial	forb/herb	dicot
Rosa californica	california rose	native	perennial	subshrub	dicot
Rubus armeniacus (syn. *Rubus discolor)*	himalayan blackberry	introduced	perennial	subshrub	dicot
Rubus ursinus	California blackberry	native	perennial	subshrub	dicot
RUBIACEAE (madder family)					
Cephalanthus occidentalis var. *californicus*	California button willow	native	perennial	tree, shrub	dicot
Galium tricornutum	rough corn bedstraw	introduced	annual	forb/herb	dicot
SALICACEAE (willow family)					
Populus fremontii	Fremont's cottonwood	native	perennial	tree	dicot
Salix exigua	sandbar willow	native	perennial	tree, shrub	dicot
Salix gooddingii	Goodding's willow	native	perennial	tree	dicot
Salix laevigata	red willow	native	perennial	shrub	dicot
Salix lasiolepis	arroyo willow	native	perennial	tree, shrub	dicot
Salix lucida ssp. *lasiandra*	yellow willow	native	perennial	tree, shrub	dicot
SCROPHULARIACEAE (figwort family)					
Castilleja attenuata	valley tassels	native	annual	forb/herb	dicot
Castilleja campestris ssp. *campestris*	owl's clover	native	annual	forb/herb	dicot
Castilleja campestris ssp. *succulenta*	succulent owl's clover	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Castilleja exserta	purple owl's clover	native	annual	forb/herb	dicot
Kickxia spuria	sharppoint fluellin	introduced	annual	forb/herb	dicot
Diplacus aurantiacus ssp. aurantiacus (syn. *Mimulus aurantiacus*)	orange bush monkeyflower	native	perennial	subshrub, shrub	dicot
Mimulus glaucescens (syn. *Mimulus guttatus*)	shieldbract monkeyflower	native	annual	forb/herb	dicot
Mimulus latidens	broadtooth monkeyflower	native	annual	forb/herb	dicot
Mimulus tricolor	tricolor monkeyflower	native	annual	forb/herb	dicot
Triphysaria eriantha ssp. *eriantha*	Johnny jump-up	native	annual	forb/herb	dicot
Triphysaria pusilla	dwarf owl's-clover	native	annual	forb/herb	dicot
Veronica peregrina ssp. *xalapensis*	purslane speedwell	native	annual	forb/herb	dicot
Veronica persica	persian speedwell	introduced	annual	forb/herb	dicot
SOLANACEAE (potato family)					
Nicotiana quadrivalvis	coyote tobacco	native	annual	forb/herb	dicot
Physalis lanceolata	ground cherry	native	perennial	forb/herb	dicot
TYPHACEAE (cat-tail family)					
Typha angustifolia	cattail	introduced	perennial	forb/herb	monocot
Typha latifolia	narrow leaf cattail	native	perennial	forb/herb	monocot
URTICACEAE (nettle family)					
Urtica dioica	stinging nettles	native and introduced	perennial	forb/herb	dicot
Urtica urens	dwarf nettle	introduced	annual	forb/herb	dicot
Phyla nodiflora	phyla	native	perennial	forb/herb	dicot
VERBENACEAE (Verbena family)					
Verbena bonariensis	verbena	introduced	annual, biennnial, perennial	subshrub, forb/herb	dicot
VISCACEAE (Christmas mistletoe family)					
Phoradendron macrophyllum ssp. *macrophyllum* (syn. *Phoradendron tomentosum* ssp. *macrophyllum*)	mistletoe	native	perennial	subshrub, shrub	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
VITACEAE (grape family)					
Vitis californica	wild grape	native	perennial	vine	dicot
ZYGOPHYLLACEAE (Creosote-bush family)					
Tribulus terrestris	puncturevine	introduced	annual	forb/herb	dicot

All plant scientific names confirmed by: USDA, NRCS. 2006. The PLANTS Database (http://plants.usda.gov, August 2006). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Appendix C.6: Delegation of Authority

REFUGE NAME

Delegation of Authority
for

_____ Incident

_____ is assigned as Incident Commander. You have full authority and responsibility for managing the fire suppression activities within the framework of laws, Agency policy, and direction provided in the Wildland Fire Situation Analysis and the Agency Administrator Briefing.

Your primary responsibility is to organize and direct your assigned resources for efficient and effective suppression of the fire. You are accountable to the Agency Administrator the representatives designated below.

Specific direction for this incident covering management and environmental concerns are:

1. Protection of life and private property is your highest priority task.
2. Give special consideration to firefighter safety, especially with respect to aviation operations, working around dozers, snags, and entrapments. Avoid sensitive environmental areas such as the Little White Salmon River and hatchery fish production ponds and intakes. When in doubt, sacrifice acres not people in your strategic and tactical decisions.
3. You are authorized to utilize helicopters, chainsaws, portable pumps, fireline explosives, and retardant at REFUGE NAME. You are not authorized to use equipment within the ANY AREAS. Do not use hatchery raceways as a helicopter bucket dip site. Do not use retardant adjacent to fish production ponds.
4. Manage human resources assigned to the fire in a manner that promotes mutual respect and is consistent with the enclosed U.S. Fish & Wildlife Service "Harassment-Free Workplace" policy.
5. Be cost effective; Final costs should be no more than 120% of the preferred WFSA alternative.
6. Manage equipment and supplies to ensure losses are within Acceptable Fire Loss/Use Rates.

You should takeover management of the incident on or before _____, _____.

_____ _____
NAME, Project Leader, REFUGE NAME Date

LINE BUILDING

1. Do not fall snags on the outside of the line unless they are an obvious safety hazard.
2. On the inside of the line, fall only those snags that would reach the fire line should they burn and fall over, or if they are an obvious safety hazard.
3. Don't cut live trees over 12" d.b.h. unless deemed absolutely necessary by the Complex Manager. Limbing of these trees, as necessary, should be the first choice.
4. Cut brush or small trees flush with the ground if the area is visible from roads.
5. Lop and scatter cut limbs so the depth will not exceed 15 inches.
6. There will be no dozer line construction unless qualified person is present to protect archaeological sites.

MOP-UP

1. Extinguish fire in living trees or snags within 200 feet of the fires perimeter with water or dirt. Fell those trees as a last resort.
2. If felling occurs in the vicinity of service roads/trails, cut the stumps flush with the ground.
3. Buck fallen trees across service roads/trails only to the extent necessary to facilitate road/trail passage.

AIR OPERATIONS

1. Consider fixed wing delivery of water vs. standard colored retardant.
2. When possible, use long line slings instead of cutting helispots.
3. Do not dip helicopter buckets into hatchery raceways.

Appendix C.7: Dispatch Plan

Stone Lakes National Wildlife Refuge

1. When a report of smoke or fire is received the following information should be taken from the caller:
Location of smoke or fire:
Location of person reporting:
Name and telephone number of person reporting:
Size of fire:
Character of fire (running, creeping, direction, etc.):
Type of fuel:
Color of smoke:
Anyone fighting fire?:
Did they see anyone in vicinity or vehicles leaving area?:
Time since caller first noticed fire to time call placed:

2. Notify Refuge:
Stone Lakes National Wildlife Refuge
Office (916) 775-4421(8:00 am to 4:30pm)

IF NO ANSWER ABOVE OR NOTIFY:
- Elk Grove Fire Protection District: 911 or (916) 685-1426
- Deputy Refuge Manager: Beatrix Treiterer:
  Wk: (916) 775-4421, Hm: (916) 966-7676
- Refuge Manager: Thomas Harvey
  Wk: (916) 775-4421, Hm: (916) 988-9707

3. Dispatch Refuge Staff Fire Personnel and Refuge Engine (if Fire Crew not available):
Fire is on refuge property
Fire is threatening refuge property
If requested by Local Fire District for assistance.

4. Other contacts:
Zone Fire Manager - Roger Wong
Wk: (209) 826-3508, Hm: (209)827-4390, Cell: (209) 777-4504
Zone AFMO - Perry Grissom
Wk: (530) 510-6326 Hm: (530) 934-5869
Refuge Supervisor - Dave Paullin: (916) 414-6464
Regional Fire Management Coordinator: (503) 231-6174 or (503) 231-6175 (Pam Ensley or Andy Anderson)

Appendix C.8: Equipment Inventory

- Chevy Brush Truck with 150 gallon slip on unit
- Caterpillar D7 Dozer
- 98 International Dump Truck with towing package
- Jacob's flatbed equipment trailer
- John Deere 7410 Tractor with disk and mower

Appendix C.9: Wildland Fire Situation Analysis (WFSA)

(Available from Sacramento Valley Fire Management Officer upon request)

Appendix C.10: Sample Burn Plan

Prescribed Fire Plan
Stone Lakes National Wildlife Refuge
Tract _____

Approved By: _____ Date: _____
Project Leader

Prepared By: _____ Date _____
Prescribed Fire Burn Boss

Reviewed By: _____ Date: _____
Refuge Fire Management Officer

Reviewed By: _____ Date: _____
Assistant Refuge Manager

Reviewed By: _____ Date _____
Refuge Biologist

The approved Prescribed Fire Plan constitutes the authority to burn, pending approval of Section 7 Consultations, Environmental Assessments, or other required documents. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Prescribed burning conditions established in the plan are firm limits. Actions taken in compliance with the approved Prescribed Fire Plan will be fully supported, but personnel will be held accountable for actions taken which are not in compliance with the approved plan.

Refuge: Stone Lakes NWR

Name of Area:

Acres To Be Burned:

Legal Description:
State: California **County:** Sacramento
Latitude: Longitude:
Township: Range: Sections:
Quad Map: USGS - **Series:** 7.5" Scale: 1:24000

Is a Section 7 Consultation being forwarded to Fish and Wildlife Enhancement for review? **YES/NO**

Prescribed Fire Burn Boss/Specialist participated in the development of this plan? **YES/NO**

I. General Description of Burn Unit

Physical Features and Vegetation Cover Types: (Species, height, density, etc.):

Elevation: ‘ Slope: % **Aspect:**

Unit Description:

Vegetation:

Primary Resource Goals of Unit:.

Objectives of Fire and Acceptable Range of Results:
General Objectives:
1) Provide for Firefighter and Public Safety.
2) E.g., Reduce non-native plant cover
3) Minimize smoke impacts

Resource Objectives and Ranges:
1) e.g., Reduce or consume 1 hr fuels(jointgrass); 60 - 100%

II. Pre-Burn Monitoring

Vegetation Type	Acres	%	FBPS Fuel Model	
				Model
				Model
Total			100	

Habitat Conditions:

Type of Transects:

III. Planning and Actions

Complexity Analysis Results: Medium (see attached complexity sheet)

Prescribed Fire Organization:

Site preparation:
Who:
Time:
What is to be done:

Weather information required:
Instrument Location and Elevation(s): On site (wx kit)

Data Collected and Sampling Period: Temp, RH, Wind Speed and direction(mid flame). On site will be 1 day prior to burn.

Forecasts: Weather forecasts(general) will be monitored 2 - 3 days prior to burning. A spot weather forecast will be requested for the day of the burn via internet e-mail request. Forecast will be obtained from the local Fire Weather Unit: Sacramento Fire Weather Office, National Weather Service.

Safety considerations:

General:

Special Constraints and Considerations (Should be discussed with Burn Boss):

Special Safety Precautions Needing Attention: (Aerial ignition, aircraft, ignition from boat, etc.):

Public safety:

Safety Zones and Escape Routes: All areas will be identified in the pre-fire briefing....

Medical Facility: Minor injuries will be handled at the scene. Major injuries -

Adjacent Lands:

Adjacent Fuels:
To the north. To the east. To the south. To the west.

Facilities:

Protection of sensitive features:

Endangered, Threatened, or Listed Species:
PROTECTION ACTIONS:

Sensitive or Species of Concern:
PROTECTION ACTIONS:

Archeological, Historical, or Cultural Areas:
PROTECTION ACTIONS:

COMMUNICATION:

Communication and Coordination on the Burn (Who will have radios, frequencies to be used, who will coordinate various activities.):

Media Contacts (Radio stations, newspaper, etc., list with telephone numbers):

IV. Ignition, Burning and Control

Ignition Technique:

Prescription monitoring: Fire behavior, weather, smoke, and effects will be monitored during the burn. Duration will be a minimum of every 1 hour or sooner if needed or conditions start to change.

Stone Lakes NWR - Tract_____
Scheduling: Approx. Date(s):
Duration:
Acceptable Range:

FBPS Fuel Model
Temperature (degrees F)

Relative Humidity (%)

MF Wind Speed (sustained)

Wind Direction

Cloud Cover (%)
Anticipated

ENVIRONMENTAL CONDITIONS
1 hr. Fuel Moisture
10 hr. FM
Live Fuel Moisture

FIRE BEHAVIOR
Rate of Spread (mph):

Head fire
Backing fire

Flame Length (feet)

Head fire
Backing fire

Cumulative effects of weather and drought on fire behavior:
Summer drought is normal for this region, and vegetation dries through the summer, peaking in August. Drought conditions are ... than normal so far this year. For stations in the general area, the Palmer drought index is currently ... and the Keetch-Byram drought index is ...

V. Smoke Management

Permits:

Burn will be conducted on a declared Aburn day@ or as planned under a favorable 48 and 24 hour smoke forecast from the California Air Resources Board(ARB). A call will be placed at 8:30 a.m. the day of the burn to the Air Quality District for Burn Day status and to register the acres for the day.

Total Particulate Emissions Estimate(Tons):

FOFEM Generated -
PM 10:
PM 2.5:

Distance and Direction from Smoke Sensitive Area(s):
Interstate 5 -

Visibility Hazard(s) (Roads, airports, etc.):

Actions to Reduce Visibility Hazard(s):

Residual Smoke Problems:

VI. Funding and Personnel

Activity Code: 11710-9263-

VII. Burn-Day Activities

Contacts on Burn Day:

Crew & Equipment Assignments:

Crew Briefing Points: Area / unit overview, burn objectives, safety including escape and safety zones, weather, fire behavior, crew assignments, firing pattern and timing, holding concerns, communication, and contingency actions and responsibilities.

Firing Procedures:

Personnel Escape Plan:

Go-No-Go Checklist: (see Attached)

Holding Actions:

Critical Control Problems:

Water Refill Points:

Contingency Plan:

General plan for escapes into these areas:
To north:
Spot fire--. Escape--.

To east:

To south:

To west:

In the event of an escape or conditions become unfavorable(smoke, weather, fire behavior, and/or objectives not being achieved)the Burn Boss will declare the fire out of prescription or escaped (which ever is the situation) and will assume IC of the fire(until relieved by a higher rated IC). All new burning will stop unless needed to contain the RX or escaped fire. The holding crew will begin attacking the escape and the ignition crew will hold and work the RX fire until the RX fire is contained or is deemed as no threat.

If the fire exceeds the capability of the crews on hand a call will be placed for assistance from local resources through ... (phone). The contingency plan will be outlined in the briefing with procedures for activation of the contingency plan. Dispatch will be the ordering point for the incident. If the escape fire exceeds more than 12 hours, a Wildland Fire Situation Analysis(WFSA) will be completed for the incident.

Minimum required on-site contingency resources and response times:

Minimum required off-site contingency resources and response times:

Mop Up and Patrol:

Rehabilitation Needs:

VIII. Critique of Burn

Were burn objectives within acceptable range of results? (Refer to Section I):

What would be done differently to obtain results or get better results?

Was there any deviation from plan? If so, why?

Problems and general comments:

IX. Post-Burn Monitoring

Date: Refuge Burn Number:

Length of Time after Burn:

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Other:

X. Follow-Up Evaluation

Date: Refuge Burn Number:
Length of Time after Burn:

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Example Complexity Analysis
from FIREBASE

Score	Score Criteria
Potential for Escape	
5	Potential for multiple spot fires outside the burn unit totaling more than 1 acre, requiring greater than average holding capability along certain sections of burn perimeter. Additional holding resources may be needed to control if escape occurs. Fuel outside burn unit is continuous, with limited fuel breaks. Engines and heavy equipment are primary suppression tools.
Values to be Protected	
3	Burn is in area occasionally visited by people, and may be adjacent to a primary field unit road. The burn unit contains structures, cultural resources, sensitive biological communities, or T&E habitat that must be protected from fire.
Fuels/Fire Behavior	
3	Fuels within the primary model vary somewhat in loadings and arrangement, but are still well represented by one of the standard fire behavior fuel models. There may be small areas of secondary fuel types present, mostly away from the burn unit perimeter. The terrain contains low relief, and slope and aspect cause minor variations in fire behavior. The fire behavior variations present no difficulties in carrying out the burn, and the predominant fire behavior still can be predicted easily under most prescription conditions.
Fire Duration	
1	Entire burn unit will be burned in one burning period. Some minor residual burning may continue inside the unit, but reuqires no continued resource commitment. Primarily 1-hour fuels.
Air Quality	
3	If prescription parameters are not met one or more minor developments or visitor use areas may experience noticeably impaired visibility and increased particulate concentrations, but not in excess of secondary Federal standards. The impairment is expected to last no more than 3 days. No critical targets are present. There are no impacts to non-attainment areas.
Ignition Methods	
3	Burn is ignited using simple ground methods or Terra Torch device (or equivalent). Ignition requires three to four personnel who may work in small teams igniting separate areas simultaneously. Ignition patterns may be complex enough to require detailed planning, but there is only minor chance of confusion. Ignition team is not expected to become involved in hazardous situations.
Management Team Size	
7	Burn team consists of 10-12 personnel, including Burn Boss, Ignition and Holding Specialist, Aircraft Manager (aerial ignitions), and a Fire Weather Observer.
Treatment Objectives	
1	Objectives are limited to fuel reduction or maintenance burning and are easily achieved (e.g., removing cured grasses from grasslands or field maintenance). Prescriptions are broad and encompass safe burning conditions.

Element

Potential for escape

Values at risk

Fuels/fire behavior

Fire duration

Smoke/air quality

Ignition methods

Management team size

Treatment objectives

TOTAL

Total weighted score: 158, Medium Complexity, RXB2

APPENDIX C.11: Air Quality Burn Permit

Appendix C.12: Request For Cultural Resource Compliance

Request For Cultural Resource Compliance
U.S. Fish and Wildlife Service, Region 1

Project Name:					Program: (Partners, Refuges, JITW, WSECP, etc.)	
State: CA, ID, HI, NV, OR, WA		EcoRegion: CBE, IPE,KCE, NCE			FWS Unit: Org Code:	
Project Location:	County	Township	Range	Section	FWS Contact: Name, Tel#, Address	
USGS Quad:					Date of Request:	
Total project acres/ linear ft/m:		APE Acres / linear ft/m (if different)			Proposed Project Start Date:	
MAPS Attached		Check below				
Copy of portion of USGS Quad with project area marked clearly (required)				Project (sketch) map showing Area of Potential Effect with locations of specific ground altering activities (required)		
Photocopy of aerial photo showing location (if available)				Any other project plans, photographs, or drawings that may help CRT in making determination (if available)		
Directions to Project: (if not obvious)						

Description of Undertaking:	Describe proposed project and means to facilitate (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25' of 3' high check dam)?
Area of Potential Effects (APE):	Describe where disturbance of the ground will occur. What are the dimensions of the area to be disturbed? How deep will you excavate? How far apart are fenceposts? What method are you using to plant vegetation? Where will fill be obtained? Where will soil be dumped? What tools or equipment will be used? Are you replacing or repairing a structure? Will you be moving dirt in a relatively undisturbed area? Will the project reach below or beyond the limits of prior land disturbance? Differentiate between areas slated for earth movement vs. areas to be inundated only. Is the area to be inundated different from the area inundated today, in the recent past, or under natural conditions? Provide acres and/or linear ft/m for all elements of the project.
Environmental and Cultural Setting:	Briefly describe the environmental setting of the APE. A) What was the natural habitat prior to modifications, reclamation, agriculture, settlement? B) What is land-use history? When was it first settled, modified? How deep has it been cultivated, grazed, etc.? C) What is land use and habitat today? What natural agents (e.g., sedimentation, vegetation, inundation) or cultural agents (e.g., cultivation) might affect the ability to discover cultural resources? D) Do you (or does anybody else) know of cultural resources in or near the project area?

Appendix D. Wildlife Species Found on Stone Lakes National Wildlife Refuge

Stone Lakes NWR Reptiles

Common Name	Scientific Name	Habitat	Sp	S	F	W
Class AMPHIBIA (amphibians) Order ANURA						
Family BUFONIDAE (true toads)						
western toad	*Bufo boreas*	msrg	r	r	r	r
Family HYLIDAE (tree frogs and relatives)						
pacific treefrog	*Pseudacris regilla*	rm	c	c	c	r
Family RANIDAE (true frogs)						
bullfrog	*Rana catesbeiana*	omr	c	c	c	r
Class REPTILIA (reptiles) Order SQUAMATA (lizards and snakes)						
Family ANGUIDAE (alligator lizards and relatives)						
southern alligator lizard	*Elgaria multicarinata*	rg	r	r	r	r
Family COLUBRIDAE (Colubrids)						
western yellowbelly racer	*Coluber constrictor mormon*	rg	u	c	u	r
common kingsnake	*Lampropeltis getula*	sg	u	c	u	r
gopher snake	*Pituophis catenifer*	sg	u	c	u	r
elegant garter snake	*Thamnophis elegans*	sm	u	c	u	r
giant garter snake	*Thamnophis gigas*	msrg	r	r	r	r
common garter snake	*Thamnophis sirtalis*	sm	u	c	u	r
Family PHRYNOSOMATIDAE (North American spiny lizards)						
western fence lizard	*Sceloporus occidentalis*	sg	c	c	c	c
Order TESTUDINES (turtles)						
Family EMYDIDAE (box and water turtles)						
western pond turtle	*Clemmys marmorata* (syn. *Emys marmorata*)	om	u	u	u	r
red-eared slider	*Trachemys scripta*	om	u	u	u	u

Stone Lakes NWR Mammals

Common Name	Scientific Name	Habitat	Sp	S	F	W
Order ARTIODACTYLA (even-toed hoofed animals)						
Family CERVIDAE (deer, moose, reindeer, elk)						
black-tailed deer	*Odocoileus hemionus*	rsg	r	r	r	r
Order CARNIVORA (meat-eaters)						
Family CANIDAE (coyotes, dogs, foxes, jackals and wolves)						
coyote	*Canis latrans*	wide	c	c	c	c
gray fox	*Urocyon cinereoargenteus*	gr	o	o	o	o
Family FELIDAE (cats)						
feral house cat	*Felis catus*	rgu	c	c	c	c
Family MEPHITIDAE (skunks and stink badgers)						
striped skunk	*Mephitis mephitis*	wide	u	u	u	u
Family MUSTELIDAE (badgers, otters, weasels and relatives)						
river otter	*Lontra canadensis*	or	c	c	c	c
mink	*Mustela vison*	om	o	o	o	o
Family PROCYONIDAE (coatis, raccoons, lesser pandas)						
raccoon	*Procyon lotor*	mr	c	c	c	c
Order CHIROPTERA (bats)						
Family MOLOSSIDAE (free-tailed bats)						
guano bat	*Tadarida brasiliensis*	r	r	r	r	r
Order DIDELPHIMORPHIA (American marsupials)						
Family DIDELPHIDAE (opossums)						
virginia opossum	*Didelphis virgiana*	r	c	c	c	c
Order INSECTIVORA (insect-eaters)						
Family Soricidae (shrews)						
ornate shrew	*Sorex ornatus*	msg	r	r	r	r
Order LAGOMORPHA (pikas, hares and rabbits)						
Family LEPORIDAE (hares and rabbits)						
black-tailed jackrabbit	*Lepus californicus*	sg	c	c	c	c
desert cottontail	*Sylvilagus audubonii*	g	c	c	c	c
Order RODENTIA (gnawing mammals)						
Family CASTORIDAE (beavers)						
beaver	*Castor canadensis*	mr	a	a	a	a
Family CRICETIDAE (New World rats and mice, voles, hamsters and relatives)						
California vole	*Microtus californicus*	gr	c	c	c	c
muskrat	*Ondatra zibethicus*	om	c	c	c	c
deer mouse	*Peromyscus maniculatus*	rg	u	u	u	u
western harvest mouse	*Reithrodontomys megalotis*	msg	u	u	u	u

Common Name	Scientific Name	Habitat	Sp	S	F	W
Family GEOMYIDAE (gophers)						
Botta's Pocket Gopher	*Thomomys bottae*	g	u	u	u	u
Family MURIDAE (Old World mice, rats)						
house mouse	*Mus musculus*	sgru	u	u	u	u
Norway rat	*Rattus norvegicus*	sgru	u	u	u	u
black rat	*Rattus rattus*	sgru	u	u	u	u
Family SCIURIDAE (chipmunks, squirrels, marmots)						
western gray squirrel	*Sciurus griseus*	sg	u	u	u	u
Fox Squirrel	*Sciurus niger*	rg	u	u	u	u
California ground squirrel	*Spermophilus beecheyi*	rg	u	u	u	u

Stone Lakes NWR Birds

Common Name	Scientific Name	Habitat	Sp	S	F	W
Order ANSERIFORMES (waterfowl)						
Family ANATIDAE (ducks, geese and swans)						
wood duck*	*Aix sponsa*	osr	c	c	c	c
greater white-fronted goose	*Anser albifrons*	oga	o	-	u	c
northern pintail	*Anas acuta*	s	u	r	c	c
american wigeon	*Anas americana*	s	c	-	c	a
northern shoveler	*Anas clypeata*	s	a	r	u	a
green-winged teal	*Anas crecca*	s	c	-	c	c
cinnamon teal*	*Anas cyanoptera*	msg	c	o	o	c
blue-winged teal	*Anas discors*	s	r	-	r	r
eurasian wigeon	*Anas penelope*	s	-	-	-	r
mallard*	*Anas platyrhynchos*	msg	a	a	a	a
gadwall*	*Anas strepera*	msg	c	r	r	c
lesser scaup	*Aythya affinis*	os	u	-	-	u
redhead	*Aythya americana*	os	r	-	-	r
ring-necked duck	*Aythya collaris*	os	o	-	-	c
greater scaup	*Aythya marila*	os	-	-	-	#
canvasback	*Aythya valisineria*	os	r	-	-	c
bufflehead	*Bucephala albeola*	os	o	-	-	c
common goldeneye	*Bucephala clangula*	os	-	-	-	u
barrow's goldeneye	*Bucephala islandica*	os	-	-	-	#
canada goose*	*Branta canadensis*	osg	o	o	o	o
snow goose	*Chen caerulescens*	osga	-	-	-	r
ross' goose	*Chen rossii*	osga	-	-	-	r
tundra swan	*Cygnus buccinator*	osa	-	-	-	o
hooded merganser	*Lophodytes cucullatus*	os	r	-	-	o
common merganser	*Mergus merganser*	os	r	-	-	r
ruddy duck*	*Oxyura jamaicensis*	os	o	r	r	o
Order APODIFORMES (swifts and hummingbirds)						
Family APODIDAE (swifts)						
white-throated swift	*Aeronautes saxatalis*	a	r	r	r	r
Vaux's swift	*Chaetura vauxi*	a	r	-	r	-
Family TROCHILIDAE (hummingbirds)						
black-chinned hummingbird*	*Archilochus alexandri*	r	r	r	u	-
Anna's hummingbird*	*Calypte anna*	r	c	c	c	u
Rufous/Allen's hummingbird	*Selasphorus rufus*	r	-	-	r	-
Order CHARADRIIFORMES (shorebirds)						
Family CHARADRIIDAE (plovers and lapwings)						
semipalmated plover	*Charadrius semipalmatus*	s	r	-	r	-
killdeer*	*Charadrius vociferus*	wide	a	a	a	a

Common Name	Scientific Name	Habitat	Sp	S	F	W
black-bellied plover	*Pluvialis squatarola*	s	o	-	u	c
Family LARIDAE (gulls and terns)						
black tern	*Chlidonias niger*	osa	#	-	-	-
herring gull	*Larus argentatus*	osa	o	-	-	c
California gull	*Larus californicus*	osa	o	r	c	c
Mew Gull	*Larus canus*	osa	#	-	r	r
ring-billed gull	*Larus delawarensis*	osa	o	-	c	c
Thayer's gull	*Larus glaucoides*	osa	-	-	#	-
Bonaparte's gull	*Larus philadelphia*	osa	-	r	r	#
Caspian tern*	*Sterna caspia*	osa	o	r	o	-
Forster's tern	*Sterna forsteri*	osa	c	r	r	o
Family RECURVIROSTRIDAE (avocets and stilts)						
black-necked stilt*	*Himantopus mexicanus*	s	c	o	c	c
american avocet*	*Recurvirostra americana*	s	o	u	o	o
Family SCOLOPACIDAE (sandpipers and phalaropes)						
spotted sandpiper	*Actitis macularius*	s	o	r	o	o
ruddy turnstone	*Arenaria interpres*	s	#	-	-	-
sanderling	*Calidris alba*	s	#	-	-	-
dunlin	*Calidris alpina*	s	c	-	a	a
baird's sandpiper	*Calidris bairdii*	s	-	-	#	-
western sandpiper	*Calidris mauri*	s	c	-	c	o
pectoral sandpiper	*Calidris melanotos*	s	-	-	#	-
least sandpiper	*Calidris minutilla*	s	c	o	c	a
semipalmated sandpiper	*Calidris pusilla*	s	-	-	r	-
willet	*Catoptrophorus semipalmatus*	s	#	-	-	-
common snipe	*Gallinago delicata*	s	u	r	o	c
short-billed dowitcher	*Limnodromus griseus*	s	-	#	-	-
long-billed dowitcher	*Limnodromus scolopaceus*	s	c	-	c	c
whimbrel	*Numenius phaeopus*	sga	o	-	r	-
long-billed curlew	*Numenius americanus*	sga	o	r	o	o
red-necked phalarope	*Phalaropus lobatus*	s	r	-	r	-
wilson's phalarope*	*Phalaropus tricolor*	s	o	r	r	-
ruff	*Philomachus pugnax*	s	#	-	-	-
lesser yellowlegs	*Tringa flavipes*	s	o	-	o	o
greater yellowlegs	*Tringa melanoleuca*	s	c	r	c	c
solitary sandpiper	*Tringa solitaria*	s	#	-	#	-
Order CICONIIFORMES (storks, herons and relatives)						
Family ARDEIDAE (bitterns, herons and egrets)						
great blue heron*	*Ardea herodias*	wide	a	a	a	a
great egret*	*Ardea alba*	wide	a	a	a	a

Common Name	Scientific Name	Habitat	Sp	S	F	W
American bittern*	*Botaurus lentiginosus*	m	o	o	o	u
cattle egret	*Bubulcus ibis*	g	-	-	r	r
green heron*	*Butorides virescens*	mr	o	o	o	o
snowy egret*	*Egretta thula*	ms	c	u	c	c
least bittern	*Ixobrychus exilis*	m	r	r	r	-
black-crowned night-heron*	*Nycticorax nycticorax*	mr	o	o	o	o
Family CATHARTIDAE (vultures)						
turkey vulture*	*Cathartes aura*	a	a	a	a	a
Family THRESKIORNITHIDAE (ibises)						
white-faced ibis	*Eudocimus albus*	sg	o	o	o	-
Order COLUMBIFORMES (pigeons)						
Family COLUMBIDAE (doves and pigeons)						
rock dove*	*Columba livia*	u	c	c	c	c
mourning dove*	*Zenaida macroura*	wide	c	c	c	c
Order CORACIIFORMES (kingfishers and relatives)						
Family ALCEDINIDAE (kingfishers)						
belted kingfisher*	*Ceryle alcyon*	ra	c	c	c	c
Order FALCONIFORMES (diurnal birds of prey)						
Family ACCIPITRIDAE (osprey, kites, eagles and hawks)						
osprey	*Pandion haliaetus*	ra	r	r	r	-
cooper's hawk*	*Accipiter cooperii*	ra	u	u	c	c
sharp-shinned hawk	*Accipiter striatus*	ra	o	o	o	o
golden eagle	*Aquila chrysaetos*	sga	o	o	o	o
red-tailed hawk*	*Buteo jamaicensis*	wide	a	a	a	a
red-shouldered hawk*	*Buteo lineatus*	ra	a	a	a	a
rough-legged hawk	*Buteo lagopus*	mga	-	-	-	r
ferruginous hawk	*Buteo regalis*	sa	-	-	-	r
swainson's hawk*	*Buteo swainsoni*	rsga	o	c	u	-
northern harrier*	*Circus cyaneus*	msga	a	c	a	a
white-tailed kite*	*Elanus leucurus*	wide	c	c	c	c
bald eagle	*Haliaeetus leucocephalus*	a	-	-	-	#
Family FALCONIDAE (falcons)						
merlin	*Falco columbarius*	rga	r	-	-	o
prairie falcon	*Falco mexicanus*	msga	r	-	-	r
peregrine falcon!	*Falco peregrinus*	msga	r	-	r	r
american kestrel*	*Falco sparverius*	wide	a	a	a	a
Order GALLIFORMES (megapodes, curassows, pheasants, quails and relatives)						
Family PHASIANIDAE						
ring-necked pheasant*	*Phasianus colchicus*	rg	a	a	a	a
Family ODONTOPHORIDAE						

Common Name	Scientific Name	Habitat	Sp	S	F	W
california quail*	*Callipepla californica*	rg	c	c	c	c
Order GRUIFORMES (coots, cranes and rails)						
Family GRUIDAE (cranes)						
sandhill crane	*Grus canadensis*	sg	r	-	c	c
Family RALLIDAE						
American coot*	*Fulica americana*	ms	c	o	o	a
common moorhen*	*Gallinula chloropus*	m	o	o	o	o
sora*	*Porzana carolina*	m	o	o	o	o
Virginia rail*	*Rallus limicola*	m	o	o	o	o
Order PASSERIFORMES (perching birds)						
Family AEGITHALIDAE (bushtits)						
bushtit*	*Psaltriparus minimus*	r	a	a	a	a
Family ALAUDIDAE (larks)						
horned lark	*Eremophila alpestris*	g	o	-	c	c
Family BOMBYCILLIDAE (waxwings)						
cedar waxwing	*Bombycilla cedrorum*	r	u	-	u	u
Family CARDINALIDAE (grosbeaks and buntings)						
lazuli bunting*	*Passerina amoena*	r	u	u	-	-
blue grosbeak*	*Passerina caerulea*	r	u	u	-	-
black-headed grosbeak*	*Pheucticus melanocephalus*	r	c	c	-	-
Family CERTHIIDAE (creepers)						
brown creeper	*Certhia americana*	r	-	-	#	#
Family CORVIDAE (jays, magpies and crows)						
western scrub-jay*	*Aphelocoma californica*	rs	a	a	a	a
American crow*	*Corvus brachyrhynchos*	rsg	c	c	c	c
yellow-billed magpie*	*Pica nuttalli*	rsg	o	o	o	o
Family EMBERIZIDAE (towhees and sparrows)						
spotted towhee*	*Pipilo maculatus*	r	a	a	a	a
dark-eyed junco	*Junco hyemalis*	r	u	-	u	c
swamp sparrow	*Melospiza georgiana*	g	-	-	#	-
Lincoln's sparrow	*Melospiza lincolnii*	gs	u	-	-	o
song sparrow*	*Melospiza melodia*	mr	c	c	c	c
savannah sparrow	*Passerculus sandwichensis*	gs	a	-	a	a
fox sparrow	*Passerella iliaca*	r	o	-	r	o
California towhee*	*Pipilo crissalis*	r	u	u	u	u
vesper sparrow	*Pooecetes gramineus*	g	#	-	-	-
chipping sparrow	*Spizella passerina*	g	#	#	-	-
white-throated sparrow	*Zonotrichia albicollis*	gs	r	-	-	r
golden-crowned sparrow	*Zonotrichia atricapilla*	gs	r	-	c	a
white-crowned sparrow	*Zonotrichia leucophrys*	gs	r	-	c	a

Common Name	Scientific Name	Habitat	Sp	S	F	W
Family FRINGILLIDAE (finches)						
lesser goldfinch*	*Carduelis psaltria*	g	-	-	r	r
American goldfinch*	*Carduelis tristis*	g	c	c	c	c
house finch*	*Carpodacus mexicanus*	wide	a	a	a	a
pine siskin	*Carduelis pinus*	r	-	-	r	-
purple finch	*Carpodacus purpureus*	r	-	-	-	#
Family HIRUNDINIDAE (swallows)						
barn swallow*	*Hirundo rustica*	msra	c	c	c	-
cliff swallow*	*Petrochelidon pyrrhonota*	msra	a	a	o	-
northern rough-winged swallow*	*Stelgidopteryx serripennis*	msra	u	o	r	-
tree swallow*	*Tachycineta bicolor*	msra	a	a	o	r
violet-green swallow	*Tachycineta thalassina*	msra	-	-	r	-
Family ICTERIDAE (icterids)						
red-winged blackbird*	*Agelaius phoeniceus*	mg	a	a	a	a
tricolored blackbird	*Agelaius tricolor*	mg	o	o	r	r
Brewer's blackbird*	*Euphagus cyanocephalus*	us	a	a	a	a
bullock's oriole*	*Icterus bullockii*	r	u	u	-	-
hooded oriole	*Icterus cucullatus*	r	r	-	-	-
brown-headed cowbird*	*Molothrus ater*	wide	c	c	c	o
great-tailed grackle*	*Quiscalus mexicanus*	sg	r	r	r	r
western meadowlark*	*Sturnella neglecta*	g	a	a	a	a
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	m	r	r	-	-
Family LANIIDAE (shrikes)						
northern shrike	*Lanius excubitor*	gr	-	-	-	#
loggerhead shrike*	*Lanius ludovicianus*	gr	u	u	u	u
Family MIMIDAE (mockingbirds and thrashers)						
northern mockingbird*	*Mimus polyglottos*	rg	o	o	o	o
Family MOTACILLIDAE (wagtails and pipits)						
American pipit	*Anthus rubescens*	sg	c	-	u	c
Family PARIDAE (titmice)						
oak titmouse*	*Baeolophus inornatus*	r	u	u	u	u
Family PARULIDAE (warblers)						
yellow-rumped warbler	*Dendroica coronata*	r	c	-	c	a
black-throated gray warbler	*Dendroica nigrescens*	r	o	-	u	r
yellow warbler	*Dendroica petechia*	r	c	r	c	-
townsend's warbler	*Dendroica townsendi*	r	o	-	o	-
common yellowthroat*	*Geothlypis trichas*	mr	c	c	c	u
yellow-breated chat	*Icteria virens*	r	#	-	-	-
Macgillivray's warbler	*Oporornis tolmiei*	r	o	-	u	-

Common Name	Scientific Name	Habitat	Sp	S	F	W
northern waterthrush	*Seiurus noveboracensis*	m	#	-	-	-
orange-crowned warbler	*Vermivora celata*	r	c	r	c	r
Nashville warbler	*Vermivora ruficapilla*	r	r	-	r	-
Canada warbler	*Wilsonia canadensis*	r	-	#	-	-
Wilson's warbler	*Wilsonia pusilla*	r	c	-	c	-
Family PASSERIDAE (Old World sparrows)						
house sparrow*	*Passer domesticus*	u	c	c	c	c
Family REGULIDAE (kinglets)						
ruby-crowned kinglet	*Regulus calendula*	r	c	-	c	a
golden-crowned kinglet	*Regulus satrapa*	r	r	-	u	u
Family SITTIDAE (nuthatches)						
white-breasted nuthatch*	*Sitta carolinensis*	r	u	u	u	u
Family STURNIDAE (starlings)						
european starling*	*Sturnus vulgaris*	rs	a	a	a	a
Family SYLVIIDAE (gnatchatchers)						
blue-gray gnatcatcher	*Polioptila caerulea*	r	#	-	r	-
Family THRAUPIDAE (tanagers)						
western tanager	*Piranga ludoviciana*	r	u	r	u	-
Family TIMALIIDAE (babbler)						
wrentit*	*Chamaea fasciata*	r	c	c	c	c
Family TROGLODYTIDAE (wrens)						
marsh wren*	*Cistothorus palustris*	m	a	a	a	a
rock wren	*Salpinctes obsoletus*	g	#	#	#	#
house wren*	*Troglodytes aedon*	r	c	c	c	u
bewick's wren*	*Thryomanes bewickii*	mr	u	u	u	u
winter wren	*Troglodytes troglodytes*	r	-	-	-	r
Family TURDIDAE (thrushes)						
hermit thrush	*Catharus guttatus*	r	o	-	o	o
Swainson's thrush	*Catharus ustulatus*	r	o	-	o	-
varied thrush	*Ixoreus naevius*	r	-	-	r	r
mountain bluebird	*Sialia currucoides*	r	-	-	-	#
western bluebird	*Sialia mexicana*	rg	#	-	-	#
American robin*	*Turdus migratorius*	rg	c	u	c	c
Family TYRANNIDAE (flycatchers)						
olive-sided flycatcher	*Contopus cooperi*	r	r	-	o	-
western wood-pewee*	*Contopus sordidulus*	r	r	-	o	-
pacific-slope flycatcher	*Empidonax difficilis*	r	r	r	r	-
hammond's flycatcher	*Empidonax hammondii*	r	#	-	r	-
dusky flycatcher	*Empidonax oberholseri*	r	#	#	-	-
willow flycatcher	*Empidonax traillii*	r	r	-	o	-
ash-throated flycatcher*	*Myiarchus cinerascens*	rg	u	c	r	-

Common Name	Scientific Name	Habitat	Sp	S	F	W
black phoebe*	*Sayornis nigricans*	mr	a	a	a	a
say's phoebe	*Sayornis saya*	sg	-	-	u	u
tropical kingbird	*Tyrannus melancholicus*	rg	-	-	-	#
western kingbird*	*Tyrannus verticalis*	rg	u	c	-	-
Family VIREONIDAE (vireos)						
Cassin's vireo	*Vireo cassinii*	r	r	-	r	-
warbling vireo	*Vireo gilvus*	r	u	-	u	-
Hutton's vireo	*Vireo huttoni*	r	r	r	r	r
Order PELECANIFORMES (pelicans, tropicbirds, cormorants and relatives)						
Family PELECANIDAE (pelicans)						
American white pelican	*Pelecanus erythrorhynchos*	os	c	u	o	o
Family PHALACROCORACIDAE (cormorants)						
double-crested cormorant	*Phalacrocorax auritus*	o	c	c	o	c
Order PICIFORMES (woodpeckers and relatives)						
Family PICIDAE (woodpeckers)						
northern flicker*	*Colaptes auratus*	r	c	o	c	c
acorn woodpecker	*Melanerpes formicivorus*	r	-	-	-	#
Nuttall's woodpecker*	*Picoides nuttallii*	r	c	c	c	c
downy woodpecker*	*Picoides pubescens*	r	c	c	c	c
red-breasted sapsucker	*Sphyrapicus nuchalis*	r	-	-	r	r
Order PODICIPEDIFORMES (grebes)						
Family PODICIPEDIDAE (grebes)						
clark's grebe	*Aechmophorus clarkii*	o	r	r	o	o
western grebe	*Aechmophorus occidentalis*	o	r	r	o	o
horned grebe	*Podiceps auritus*	os	r	-	r	r
eared grebe	*Podiceps nigricollis*	oms	r	r	r	r
pied-billed grebe*	*Podilymbus podiceps*	oms	c	u	a	a
Order STRIGIFORMES (owls)						
Family TYTONIDAE (typical owls)						
long-eared owl	*Asio otus*	srg	-	-	-	#
short-eared owl	*Asio flammeus*	msg	-	-	-	r
burrowing owl*	*Athene cunicularia*	f	r	r	r	r
great horned owl*	*Bubo virginianus*	r	c	c	c	c
western screech-owl	*Megascops kennicottii*	r	r	r	r	r
barn owl*	*Tyto alba*	wide	c	c	c	c

Habitats: o - Open water, lakes, creeks, ponds; m - Marshes, tule and cattail stands; s - seasonal wetlands, mudflats, flooded fields; r - Riparian forests; g - Grasslands; a - Aerial, usually observed in flight; wide - Widespread, found in a variety of habitats; u - urban

Seasons: Sp - Spring, March through May; S - Summer, June through August; F - Fall, September through November; W - Winter, December through February

Abundance: a - Abundant, expected to be observed 80 to 100 percent of the time in appropriate habitat; c - Common: 60 to 80 percent; u - Uncommon: 30 to 60 percent; o - Occasionally: 10 to 30 percent; r - Rare: 0 to 10 percent; * - Birds known to nest locally; ! -Threatened/Endangered Species; # - Observed less than 10 times in the past 10 years

Appendix E. Fish Species Found on Stone Lakes NWR

Common name (scientific name)	North Stone Lake	South Stone Lake	SP Cut	Meadowlark Lake	Black-Crown Lake	Nicolaus Pond	Laguna Creek	Morrison Creek	Fishhead Lake	Lost Lake
Order ATHERINIFORMES (rainbow fishes and silversides)										
Family ATHERINIDAE (silversides)										
Inland Silverside (Menidia beryllina)	x			x	x	x	x	x	x	
Order CLUPEIFORMES (anchovies and herrings)										
Family CLUPEIDAE (herrings, menhadens, pilchards, sardines, shads and sprats)										
American shad (Alosa sapidissima)	x									
Threadfin shad (Dorosoma petenense)	x	x	x	x	x		x		x	x
Order CYPRINIFORMES (suckers and minnows)										
Family CYPRINIDAE (carps and minnows)										
California roach (Hesperoleucus symmetricus)					x			x		
Carp (Cyprinus carpio)	x	x	x	x	x	x	x	x	x	
Goldfish (Carassius auratus)	x	x			x	x			x	
Golden shiner (Notemigonus crysoleucas)	x	x	x							
Hardhead minnow (Mylopharodon conocephalus)				x	x		x	x		x
Sacramento blackfish (Orthodon microlepidotus)	x			x	x		x	x	x	
Sacramento pikeminnow (Ptychocheilus grandis)	x	x								
*Sacramento splittail (Pogonichthys macrolepidotus)										
Order CYPRINODONTIFORMES (killifishes)										
Family POECILIIDAE (livebearers and topminnows)										
Mosquitofish (*Gambusia* spp.)	x			x	x	x	x	x	x	
Order PERCIFORMES (perch-likes)										
Family MORONIDAE (temperate basses)										
Striped Bass (Morone saxatilis)			x							

Family CENTRARCHIDAE (sunfish and sunfishes)										
Black Crappie (Pomoxis nigromaculatus)	x	x	x	x	x		x	x	x	x
Bluegill (Lepomis macrochirus)	x	x	x	x	x		x		x	x
Crappie (Pomoxis spp.)				x	x		x		x	
Green sunfish (Lepomis cyanellus)	x									
Hybrid sunfish (Lepomis spp.)	x									
Largemouth bass (Micropterus salmoides)	x	x		x	x				x	
Redear sunfish (Lepomis microlophus)	x	x	x							
Warmouth (Lepomis gulosus)	x			x	x		x		x	
White Crappie (Pomoxis annularis)	x	x		x	x		x	x	x	x
Family PECIDAE (perches and true perches)										
Bigscale logperch (Percina macrolepida)	x			x	x		x	x	x	
Order SCORPAENIFORMES (scorpion fishes and sculpins)										
Family COTTIDAE (scaleless sculpins and sculpins)										
Prickly sculpin (Cottus asper)	x									
Sculpin (Cottus spp.)					x				x	
Order SILURIFORMES (catfishes)										
Family ICTALURIDAE (bullhead catfishes and North American freshwater catfishes)										
Black bullhead (Ictalurus melas)	x	x	x	x	x			x	x	
Brown bullhead (Ictalurus nebulosus)	x	x		x			x		x	
Bullhead (Ictalurus ssp.)				x	x	x	x		x	
Channel catfish (Ictalurus punctatus)	x	x		x	x					
Yellow bullhead (Ameiurus natalis)				x	x				x	
White catfish (Ictalurus catus)	x	x	x	x	x					

* presumed to be intermitently present after flooding events allow entry to the Refuge.

Appendix F. Wilderness Review

A wilderness review is the process used by the Service to determine whether or not to recommend lands or waters in the National Wildlife Refuge System to Congress for designation as wilderness. The Service is required to conduct a wilderness review for each refuge as part of the CCP process. Lands or waters that meet the minimum criteria for wilderness are identified in a CCP and further evaluated to determine whether they merit recommendation for inclusion in the Wilderness System.
According to the Wilderness Act of 1964 (16 USC 1131-1136; 78 Stat. 890), "An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Stone Lakes National Wildlife Refuge contains a total 2,000 discontinuous acres. It is adjacent to a residential subdivision and a major interstate highway. The largest contiguous portion of land in fee ownership is about 840 acres, which is smaller than the area required for designation as wilderness. Moreover, the Refuge contains much evidence of past and current human use, including roads, actively managed wetlands, and remnants of past and current ranching and farming activities. For these reasons, Stone Lakes National Wildlife Refuge does not meet the criteria for wilderness designation.

Appendix G. Budget Requests: RONS & MMS

This page is intentionally left blank, for the 2006 Draft Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan (CCP). This appendix will be provided in the Final CCP.

Appendix H. Endangered Species Act, Section 7 Consultation

This page is intentionally left blank, for the 2006 Draft Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan (CCP). This appendix will be provided in the Final CCP.

Appendix I. Response to Public Comments

This page is intentionally left blank, for the 2006 Draft Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan (CCP). This appendix will be provided in the Final CCP.

Appendix J. Plants Species Found on Stone Lakes National Wildlife Refuge

Stone Lakes NWR Plants

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
ACERACEAE (maple family)					
Acer negundo var. *californicum*	box elder	native	perennial	tree	dicot
ALISMATACEAE (water plantain family)					
Alisma lanceolatum	water plantain	introduced	perennial	forb/herb	monocot
Echinodorus berteroi	burhead	native	perennial	forb/herb	monocot
Sagittaria latifolia	arrowhead	native	perennial	forb/herb	monocot
ANACARDIACEAE (sumac family)					
Toxicodendron diversilobum	poison oak	native	perennial	shrub/vine	monocot
APIACEAE (carrot family)					
Daucus carota	wild carrot	introduced	biennial	forb/herb	dicot
Foeniculum vulgare	fennel	introduced	biennial, perennial	forb/herb	dicot
Scandix pecten-veneris	Venus' needle	introduced	annual	forb/herb	dicot
APOCYNACEAE (dogbane family)					
Apocynum cannabinum	indian hemp	native	perennial	forb/herb	dicot
ASCLEPIADACEAE (milkweed family)					
Asclepias fascicularis	narrow leaf milkweed	native	perennial	forb/herb	dicot
Asclepias incarnata	milkweed	native	perennial	forb/herb	dicot
ASTERACEAE (aster family)					
Achyrachaena mollis	blow-wives	native	perennial	forb/herb	dicot
Acroptilon repens	russian knapweed	introduced	perennial	forb/herb	dicot
Ambrosia psilostachya	western ragweed	native	perennial	forb/herb	dicot
Anthemis cotula	chamomile	introduced	annual	forb/herb	dicot
Artemisia douglasiana	mugwort	native	perennial	forb/herb	dicot
Aster subulatus var. *ligulatus*	southern annual saltmarsh aster	native	annual, biennial	forb/herb	dicot
Baccharis pilularis	coyote bush	native	perennial	subshrub, shrub	dicot
Bidens frondosa	nodding beggarticks	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Carduus pycnocephalus	italian thistle	introduced	annual	forb/herb	dicot
Centaurea solstitialis	yellow star thistle	introduced	annual	forb/herb	dicot
Matricaria discoidea (syn. *Chamomilla suaveolens*)	pineapple weed	introduced	annual	forb/herb	dicot
Cichorium intybus	chicory	introduced	biennial, perennial	forb/herb	dicot
Cirsium vulgare	bull thistle	introduced	biennial	forb/herb	dicot
Conyza canadensis	horseweed	native	annual, biennial	forb/herb	dicot
Coreopsis wrightii	tickseed	native	annual	forb/herb	dicot
Euthamia occidentalis	grass-leaved goldenrod	native	perennial	forb/herb	dicot
Gnaphalium luteo-album	cudweed, weedy	introduced	annual	forb/herb	dicot
Gnaphalium palustre	cudweed, everlasting	native	annual	forb/herb	dicot
Gnaphalium stramineum	cudweed, everlasting	native	annual, biennial	forb/herb	dicot
Grindelia camporum	gum plant	native	perennial	subshrub, forb/herb	dicot
Helianthus annuus	sunflower	native	annual	forb/herb	dicot
Hemizonia fitchii	fitch's tarweed	native	annual	forb/herb	dicot
Centromadia pungens (syn. *Hemizonia pungens*)	spikeweed	native	annual	forb/herb	dicot
Hesperevax caulescens	dwarf dwarf-cudweed	native	annual	forb/herb	dicot
Heterotheca grandiflora	telegraph plant	native	annual, biennial, perennial	forb/herb	dicot
Holocarpha virgata	holocarpha	native	annual	forb/herb	dicot
Hypochaeris glabra	smooth cats ear	introduced	annual	forb/herb	dicot
Hypochaeris radicata	rough cat's-ear	introduced	perennial	forb/herb	dicot
Lactuca serriola	prickly lettuce	introduced	annual, biennial	forb/herb	dicot
Lasthenia californica	California goldfields	native	annual, perennial	forb/herb	dicot
Lasthenia fremontii	Fremont's goldfields	native	annual	forb/herb	dicot
Lasthenia glaberrima	smooth goldfields	native	annual	forb/herb	dicot
Layia chrysanthemoides	tidy tips	native	annual	forb/herb	dicot
Madia elegans ssp. *vernalis*	common madia	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Picris echioides	bristly ox-tongue	introduced	annual	forb/herb	dicot
Psilocarphus brevissimus	wooly heads	native	annual	forb/herb	dicot
Psilocarphus oregonus	Oregon wooly-heads	native	annual	forb/herb	dicot
Senecio vulgaris	common groundsel	introduced	annual, biennial	forb/herb	dicot
Silybum marianum	milk thistle	introduced	annual, biennial	forb/herb	dicot
Sonchus asper ssp. *asper*	prickly sow thistle	introduced	annual	forb/herb	dicot
Sonchus oleraceus	annual sowthistle	introduced	annual	forb/herb	dicot
Xanthium spinosum	spiny cocklebur	introduced	annual	forb/herb	dicot
Xanthium strumarium	cocklebur	native	annual	forb/herb	dicot
BORAGINACEAE (borage family)					
Amsinckia menziesii var. *intermedia*	fiddleneck	native	annual	forb/herb	dicot
Heliotropium curassavicum	heliotrope	native	annual, perennial	subshrub, forb/herb	dicot
Plagiobothrys greenei	popcorn flower	native	annual	forb/herb	dicot
Plagiobothrys leptocladus	alkali popcorn flower	native	annual	forb/herb	dicot
Plagiobothrys stipitatus var. *micranthus*	stalked popcornflower	native	annual	forb/herb	dicot
Plagiobothrys stipitatus var. *stipitatus*	stalked popcornflower	native	annual	forb/herb	dicot
Plagiobothrys trachycarpus	roughfruit popcornflower	native	annual	forb/herb	dicot
BRASSICACEAE (mustard family)					
Brassica nigra	black mustard	introduced	annual	forb/herb	dicot
Brassica rapa	field mustard	introduced	annual, biennial	forb/herb	dicot
Capsella bursa-pastoris	shepherd's purse	introduced	annual	forb/herb	dicot
Cardamine oligosperma	little western bittercress	native	annual, biennnial, perennial	forb/herb	dicot
Cardaria chalepensis	lens-podded hoary-cress	introduced	perennial	shrub	dicot
Lepidium latifolium	perennial peppergrass	introduced	perennial	forb/herb	dicot
Lepidium latipes var. *heckardii*	Heckard's peppergrass	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Lepidium nitidum var. *nitidum*	shining pepperweed	native	annual	forb/herb	dicot
Raphanus raphanistrum	jointed charlock	introduced	annual, biennial	forb/herb	dicot
Raphanus sativus	wild radish	introduced	annual, biennial	forb/herb	dicot
Rorippa curvisiliqua	yellow cress	native	annual, biennial	forb/herb	dicot
CALLITRICHACEAE (water-starwort family)					
Callitriche trochlearis	water starwort	native	annual	forb/herb	dicot
CAMPANULACEAE (bellflower family)					
Downingia bicornuta var. *bicornuta*	downingia	native	annual	forb/herb	dicot
Downingia ornatissima var. ornatissima	folded calicoflower	native	annual	forb/herb	dicot
Legenere limosa	legenere	native	annual	forb/herb	dicot
CAPRIFOLIACEAE (honeysuckle family)					
Sambucus nigra (syn. *Sambucus mexicana*)	elderberry	native	perennial	shrub, tree	dicot
Symphoricarpos albus var. *laevigatus*	snowberry	native	perennial	subshrub, shrub	dicot
CARYOPHYLLACEAE (pink family)					
Cerastium glomeratum	sticky chickweed	introduced	annual	forb/herb	dicot
Silene gallica	catchfly	introduced	annual, biennial	forb/herb	dicot
Spergula arvensis ssp. *arvensis*	starwort	introduced	annual	forb/herb	dicot
Spergularia bocconii	sand-spurry	introduced	annual	forb/herb	dicot
Stellaria media	common chickweed	introduced	annual	forb/herb	dicot
CHENOPODIACEAE (goosefoot family)					
Chenopodium album	lamb's quarters	native, introduced	annual	forb/herb	dicot
Chenopodium ambrosioides	Mexican tea	introduced	annual, perennial	forb/herb, subshrub	dicot
Chenopodium multifidum	chenopodium	introduced	annual	forb/herb	dicot
Salsola tragus	russian tumbleweed	introduced	annual	forb/herb	dicot
CONVOVULACEAE (morning-glory family)					
Convolvulus arvensis	bindweed	introduced	perennial	vine, forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
CRASSULACEAE (stonecrop family)					
Crassula aquatica	water pygmyweed	native	annual	forb/herb	dicot
CUCURBITACEAE (cucumber family)					
Marah fabaceus	manroot	native	perennial	vine, forb/herb	dicot
CUSCUTACEAE (dodder family)					
Cuscuta pentagona	dodder	native	annual, perennial	vine, forb/herb	dicot
CYPERACEAE (sedge family)					
Carex praegracilis	carex	native	perennial	graminoid	monocot
Cyperus eragrostis	sedge	native	perennial	graminoid	monocot
Cyperus erythrorhizos	redroot flatsedge	native	annual, perennial	graminoid	monocot
Cyperus esculentus	yellow nut sedge	native, introduced	perennial	graminoid	monocot
Eleocharis macrostachya	spike rush	native	perennial	graminoid	monocot
Schoenoplectus acutus (syn. *Scirpus acutus var. occidentalis*)	hardstem bulrush	native	perennial	graminoid	monocot
Schoenoplectus mucronatus (syn. *Scirpus mucronatus*)	bog bulrush	introduced	perennial	graminoid	monocot
Scirpus robustus	alkali bull rush	native	perennial	graminoid	monocot
Schoenoplectus glaucus (syn. *Scirpus tuberosus*)	scirpus	introduced	perennial	graminoid	monocot
EUPHORBIACEAE (spurge family)					
Chamaesyce maculata	spotted sandmat	native	annual	forb/herb	dicot
Eremocarpus setigerus	turkey mullin, doveweed	native	annual	forb/herb	dicot
FABACEAE (pea family)					
Glycyrrhiza lepidota	wild licorice	native	perennial	forb/herb	dicot
Lotus corniculatus	trefoil	introduced	perennial	forb/herb	dicot
Lotus unifoliolatus var. unifoliolatus (syn. *Lotus purshianus* var. *purshianus*)	lotus	native	annual	forb/herb	dicot
Lupinus albifrons var. *albifrons*	lupine	native	perennial	subshrub, shrub	dicot
Lupinus bicolor	annual lupine	native	annual	forb/herb	dicot
Medicago polymorpha	California burclover	introduced	annual, perennial	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Medicago sativa	alfalfa	introduced	annual, perennial	forb/herb	dicot
Melilotus alba	white sweetclover	introduced	annual, biennnial, perennial	forb/herb	dicot
Melilotus indica	yellow sweetclover	introduced	annual	forb/herb	dicot
Trifolium depauperatum var. *depauperatum*	balloon clover	native	annual	forb/herb	dicot
Trifolium dubium	hopclover, shamrock	introduced	annual	forb/herb	dicot
Trifolium fucatum	bull clover	native	annual	forb/herb	dicot
Trifolium hirtum	rose clover	introduced	annual	forb/herb	dicot
Trifolium microdon	thimble clover	native	annual	forb/herb	dicot
Trifolium variegatum	whitetip clover	native	annual	forb/herb	dicot
Trifolium willdenovii	tomcat clover	native	annual	forb/herb	dicot
Vicia sativa ssp. *nigra*	common vetch	introduced	annual	vine, forb/herb	dicot
Vicia villosa	hairy vetch	introduced	annual, biennnial, perennial	vine, forb/herb	dicot
FAGACEAE (beech family)					
Quercus douglasii	blue oak	native	perennial	tree	dicot
Quercus lobata	valley oak	native	perennial	tree	dicot
Quercus wislizenii	live oak	native	perennial	tree	dicot
Centaurium muehlenbergii	centaury	native	annual, biennial	forb/herb	dicot
Erodium botrys	broad leaf cranes bill	introduced	annual, biennial	forb/herb	dicot
Erodium cicutarium	red stemmed filaree	introduced	annual, biennial	forb/herb	dicot
Erodium moschatum	white-stemmed filaree	introduced	annual, biennial	forb/herb	dicot
GERANIACEAE (geranium family)					
Geranium carolinianum	Carolina geranium	native	annual, biennial	forb/herb	dicot
Geranium dissectum	geranium	introduced	annual, biennial	forb/herb	dicot
HYDROPHYLLACEAE (waterleaf family)					
Nemophila menziesii	baby blue-eyes	native	annual	forb/herb	dicot
Nemophila pedunculata	nemophila	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
IRIDACEAE (iris family)					
Sisyrinchium bellum	blue-eyed grass	native	perennial	forb/herb	monocot
JUGLANDACEAE (walnut family)					
Juglans californica var. *hindsii*	black walnut	native	perennial	tree	dicot
JUNCACEAE (rush family)					
Juncus arcticus ssp. *littoralis* (syn. *Juncus balticus*)	baltic rush	native	perennial	graminoid	monocot
Juncus bufonius	toad rush	native	annual	graminoid	monocot
Juncus patens	rush	native	perennial	forb/herb	monocot
Juncus phaeocephalus	rush	native	perennial	graminoid	monocot
Juncus xiphioides	irisleaf rush	native	perennial	graminoid	monocot
LAMIACEAE (mint family)					
Lamium amplexicaule	henbit	introduced	annual, biennial	forb/herb	dicot
Lycopus americanus	bugleweed	native	perennial	forb/herb	dicot
Marrubium vulgare	white horehound	introduced	perennial	subshrub, forb/herb	dicot
Mentha pulegium	pennyroyal	introduced	perennial	forb/herb	dicot
Pogogyne douglasii	Douglas' mesamint	native	annual	forb/herb	dicot
Pogogyne ziziphoroides	Sacramento mesamint	native	annual	forb/herb	dicot
Stachys ajugoides	hedge nettle	native	perennial	forb/herb	dicot
Trichostema lanceolatum	vinegar weed	native	annual	forb/herb	dicot
LAURACEAE (laurel family)					
Umbellularia californica	California bay tree	native	perennial	tree, shrub	dicot
LILIACEAE (lily family)					
Asparagus officinalis ssp. *officinalis*	asparagus	introduced	perennial	forb/herb	monocot
Brodiaea elegans ssp. elegans	harvest brodiaea	native	perennial	forb/herb	monocot
Chlorogalum pomeridianum	soap root	native	perennial	forb/herb	monocot
Dichelostemma capitatum ssp. *capitatum*	blue dicks	native	perennial	forb/herb	monocot
Triteleia hyacinthina	white brodiaea	native	perennial	forb/herb	monocot
Triteleia laxa	Ithuriel's spear	native	perennial	forb/herb	monocot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
LYTHRACEAE (loosestrife family)					
Ammannia coccinea	ammannia	native	annual	forb/herb, subshrub	dicot
Lythrum hyssopifolia	hyssop loosestrife	introduced	annual, biennial	forb/herb	dicot
Lythrum tribracteatum	threebract loosestrife	introduced	perennial	forb/herb	dicot
MALVACEAE (mallow family)					
Abutilon theophrasti	velvetleaf	introduced	annual	forb/herb	dicot
Malva neglecta	cheeses	introduced	annual, biennnial, perennial	forb/herb	dicot
Malvella leprosa	alkali mallow	native	perennial	forb/herb	dicot
OLEACEAE (olive family)					
Fraxinus latifolia	Oregon ash	native	perennial	tree	dicot
ONAGRACEAE (evening primrose family)					
Epilobium brachycarpum	willowweed	native	annual	forb/herb	dicot
Epilobium canum	zauschneria	native	perennial	subshrub, forb/herb	dicot
Epilobium ciliatum	willow weed	native	perennial	forb/herb	dicot
Epilobium pygmaeum	epilobium	native	annual	forb/herb	dicot
Ludwigia peploides ssp. *peploides*	water primrose	native	perennial	forb/herb	dicot
PAPAVERACEAE (poppy family)					
Eschscholzia californica	California poppy	native	annual, perennial	forb/herb	dicot
PLANTAGINACEAE (plantain family)					
Plantago coronopus	buckhorn plantain	introduced	annual, biennial	forb/herb	dicot
Plantago elongata	little plantain	native	annual	forb/herb	dicot
Plantago lanceolata	English plantain	introduced	annual, biennnial, perennial	forb/herb	dicot
PLATANACEAE (plane-tree family)					
Platanus racemosa	California sycamore	native	perennial	tree	dicot
POACEAE (grass family)					
Alopecurus saccatus	foxtail	native	annual	graminoid	monocot
Avena fatua	wild oats	introduced	annual	graminoid	monocot
Briza minor	quaking grass	introduced	annual	graminoid	monocot
Bromus carinatus	California brome	native	annual, perennial	graminoid	monocot
Bromus diandrus	ripgut brome	introduced	annual, perennial	graminoid	monocot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Bromus hordeaceus	soft chess	introduced	annual	graminoid	monocot
Bromus madritensis ssp. *rubens*	foxtail chess	introduced	annual	graminoid	monocot
Crypsis schoenoides	swamp grass	introduced	annual	graminoid	monocot
Crypsis vaginiflora	swamp timothy	introduced	annual	graminoid	monocot
Cynodon dactylon	bermuda grass	introduced	perennial	graminoid	monocot
Deschampsia cespitosa	tufted hairgrass	native	perennial	graminoid	monocot
Distichlis spicata	salt grass	native	perennial	graminoid	monocot
Echinochloa crus-galli	water grass	introduced	annual	graminoid	monocot
Elymus glaucus	blue wild rye	native	perennial	graminoid	monocot
Elymus trachycaulus	wheat grass	native	perennial	graminoid	monocot
Eragrostis mexicana	Mexican lovegrass	native	annual	graminoid	monocot
Schedonorus phoenix (syn. *Festuca arundinacea*)	tall fescue	introduced	perennial	graminoid	monocot
Festuca brevipila (syn. *Festuca trachyphylla*)	hard fescue	introduced	perennial	graminoid	monocot
Hordeum brachyantherum	meadow barley	native	perennial	graminoid	monocot
Hordeum jubatum	foxtail barley	native	perennial	graminoid	monocot
Hordeum marinum ssp. *gussonianum*	mediterranean barley	introduced	annual	graminoid	monocot
Hordeum murinum ssp. *leporinum*	foxtail barley	introduced	annual	graminoid	monocot
Koeleria macrantha	junegrass	native	perennial	graminoid	monocot
Leymus triticoides	creeping wild rye	native	perennial	graminoid	monocot
Leptochloa uninervia	Mexican sprangletop	native	annual, perennial	graminoid	monocot
Lolium perenne ssp. *multiflorum* (syn. *Lolium multiflorum*)	annual rye grass	introduced	annual, perennial	graminoid	monocot
Melica californica	California melic	native	perennial	graminoid	monocot
Muhlenbergia rigens	deer grass	native	perennial	graminoid	monocot
Nassella cernua	nodding needlegrass	native	perennial	graminoid	monocot
Nassella pulchra	purple needle grass	native	perennial	graminoid	monocot
Paspalum dilatatum	dallis grass	introduced	perennial	graminoid	monocot
Phalaris californica	California canarygrass	native	perennial	graminoid	monocot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Phalaris minor	canary grass	introduced	annual	graminoid	monocot
Phalaris paradoxa	hood canarygrass	introduced	annual	graminoid	monocot
Phleum pratense	cultivated timothy	introduced	perennial	graminoid	monocot
Poa annua	annual bluegrass	introduced	annual	graminoid	monocot
Poa bulbosa	bulbous bluegrass	introduced	perennial	graminoid	monocot
Polypogon monspeliensis	rabbit foot grass	introduced	annual	graminoid	monocot
Setaria pumila	bristly foxtail	introduced	annual	graminoid	monocot
Sorghum halepense	johnsongrass	introduced	perennial	graminoid	monocot
Taeniatherum caput-medusae	medusahead	introduced	annual	graminoid	monocot
Vulpia myuros	rat tail fescue	introduced	annual	graminoid	monocot
POLYGONACEAE (buckwheat family)					
Polygonum amphibium var. *emersum*	water smartweed	native	perennial	forb/herb	dicot
Polygonum arenastrum	common knotweed	introduced	annual, perennial	forb/herb	dicot
Polygonum lapathifolium	willow smartweed	native	annual	forb/herb	dicot
Polygonum persicaria	thumbprint smartweed	probably introduced	annual, perennial	forb/herb	dicot
Polygonum punctatum	annual smartweed	native	annual, perennial	forb/herb	dicot
Rumex conglomeratus	clustered dock	introduced	perennial	forb/herb	dicot
Rumex crispus	curly dock	introduced	perennial	forb/herb	dicot
Rumex maritimus	golden dock	native	annual, biennial	forb/herb	dicot
Rumex pulcher	fiddle dock	introduced	perennial	forb/herb	dicot
POLEMONIACEAE (phlox family)					
Linanthus montanus	mustang clover	native	annual	forb/herb	dicot
Navarretia leucocephala	whitehead navarretia	native	annual	forb/herb	dicot
PONTEDERIACEAE (water-hyacinth family)					
Eichhornia crassipes	water hyacinth	introduced	perennial	forb/herb	dicot
PORTULACEAE (purslane family)					
Calandrinia ciliata	red maids	native	annual	forb/herb	dicot
Claytonia parviflora	miners lettuce	native	annual	forb/herb	dicot
Claytonia perfoliata ssp. *mexicana*	miners' lettuce	native	annual	forb/herb	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Montia fontana	water chickweed	native	annual	forb/herb	dicot
PRIMULACEAE (primrose family)					
Anagallis arvensis	scarlet pimpernel	introduced	annual, biennial	forb/herb	dicot
RANUNCULACEAE (buttercup family)					
Clematis ligusticifolia	virgin's bower	native	perennial	vine	dicot
Ranunculus bonariensis var. *trisepalus*	buttercup	native	annual	forb/herb	dicot
Ranunculus muricatus	spiny-fruited buttercup	introduced	annual, biennnial, perennial	forb/herb	dicot
Rosa californica	California rose	native	perennial	subshrub	dicot
Rubus armeniacus (syn. *Rubus discolor)*	himalayan blackberry	introduced	perennial	subshrub	dicot
Rubus ursinus	California blackberry	native	perennial	subshrub	dicot
RUBIACEAE (madder family)					
Cephalanthus occidentalis var. *californicus*	California button willow	native	perennial	tree, shrub	dicot
Galium tricornutum	rough corn bedstraw	introduced	annual	forb/herb	dicot
SALICACEAE (willow family)					
Populus fremontii	Fremont's cottonwood	native	perennial	tree	dicot
Salix exigua	sandbar willow	native	perennial	tree, shrub	dicot
Salix gooddingii	Goodding's willow	native	perennial	tree	dicot
Salix laevigata	red willow	native	perennial	shrub	dicot
Salix lasiolepis	arroyo willow	native	perennial	tree, shrub	dicot
Salix lucida ssp. *lasiandra*	yellow willow	native	perennial	tree, shrub	dicot
SCROPHULARIACEAE (figwort family)					
Castilleja attenuata	valley tassels	native	annual	forb/herb	dicot
Castilleja campestris ssp. *campestris*	owl's clover	native	annual	forb/herb	dicot
Castilleja campestris ssp. *succulenta*	succulent owl's clover	native	annual	forb/herb	dicot
Castilleja exserta	purple owl's clover	native	annual	forb/herb	dicot
Kickxia spuria	sharppoint fluellin	introduced	annual	forb/herb	dicot
Diplacus aurantiacus ssp. aurantiacus (syn. *Mimulus aurantiacus*)	orange bush monkeyflower	native	perennial	subshrub, shrub	dicot

Scientific name	Common name	U.S. Nativity	Duration	Growth habit	Group
Mimulus glaucescens (syn. *Mimulus guttatus*)	shieldbract monkeyflower	native	annual	forb/herb	dicot
Mimulus latidens	broadtooth monkeyflower	native	annual	forb/herb	dicot
Mimulus tricolor	tricolor monkeyflower	native	annual	forb/herb	dicot
Triphysaria eriantha ssp. *eriantha*	ohnny jump-up	native	annual	forb/herb	dicot
Triphysaria pusilla	dwarf owl's-clover	native	annual	forb/herb	dicot
Veronica peregrina ssp. *xalapensis*	purslane speedwell	native	annual	forb/herb	dicot
Veronica persica	persian speedwell	introduced	annual	forb/herb	dicot
SOLANACEAE (potato family)					
Nicotiana quadrivalvis	coyote tobacco	native	annual	forb/herb	dicot
Physalis lanceolata	ground cherry	native	perennial	forb/herb	dicot
TYPHACEAE (cat-tail family)					
Typha angustifolia	cattail	introduced	perennial	forb/herb	monocot
Typha latifolia	narrow leaf cattail	native	perennial	forb/herb	monocot
URTICACEAE (nettle family)					
Urtica dioica	stinging nettles	native and introduced	perennial	forb/herb	dicot
Urtica urens	dwarf nettle	introduced	annual	forb/herb	dicot
Phyla nodiflora	phyla	native	perennial	forb/herb	dicot
VERBENACEAE (Verbena family)					
Verbena bonariensis	verbena	introduced	annual, biennnial, perennial	subshrub, forb/herb	dicot
VISCACEAE (Christmas mistletoe family)					
Phoradendron macrophyllum ssp. *macrophyllum* (syn. *Phoradendron tomentosum* ssp. *macrophyllum*)	mistletoe	native	perennial	subshrub, shrub	dicot
VITACEAE (grape family)					
Vitis californica	wild grape	native	perennial	vine	dicot
ZYGOPHYLLACEAE (Creosote-bush family)					
Tribulus terrestris	puncturevine	introduced	annual	forb/herb	dicot

All plant scientific names confirmed by: USDA, NRCS. 2006. The PLANTS Database (http://plants.usda.gov, August 2006). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Appendix K. Glossary

Adaptive Management. The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels.

Alkalinity. Refers to the extent to which water or soils contain soluble mineral salts. Waters with a pH greater than 7.4 are considered alkaline.

Alluvium. Clay, sand, or other sediment that is gradually deposited by moving water (see also alluvial-fan).

Alternatives. Different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues. (1) A reasonable way to fix the identified problem or satisfy the stated need. (40 CFR 150.2) (2) Alternatives are different means of accomplishing refuge purposes and goals and contributing to the System mission (Draft Service Manual 602 FW 1.5).

Animal Unit Month (AUM). The amount of forage necessary to maintain one 1,000-pound animal for one month.

Aquatic. Pertaining to water, in contrast to land. Living in or upon water.

Aquatic Habitat. The physical, chemical, and vegetative features that occur within the water of lakes, ponds, reservoirs, rivers, irrigation canals, and other bodies of water.

Aquifer. An underground layer of porous rock, sand, or gravel containing large amounts of water.

Artifact. An object made by humans; usually in reference to primitive tools, vessels, weapons, etc.

Basin. A depressed area with little or no surface water; an area where water flows in, but where surface water does not flow out.

Biodiversity (biological diversity). Refers to the full range of variability within and among biological communities, including genetic diversity, and the variety of living organisms, assemblages of living organisms, and biological processes. Diversity can be measured in terms of the number of different items (species, communities) and their relative abundance, and it can include horizontal and vertical variability. The variety of life, including the variety of living organisms, the genetic differences among them, and the communities in which they occur.

Biological Control. The use of organisms or viruses to control weeds or other pests.

Biological Integrity. Biotic composition, structure, and functioning at the genetic, organism, and community levels consistent with natural conditions, including the natural biological processes that shape genomes, organisms, and communities.

Carnivore. An animal that kills and eats other animals.

Categorical Exclusion (CE, CX, CATEX, CATX). A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a Federal agency pursuant to the National Environmental Policy Act (40 CFR 1508.4).

CFR. Code of Federal Regulations.

Community. The combined populations of all organisms in a given area, and their interactions. For example, the frogs, fish, algae, cattails, and lily pads in a backyard pond make up a community.

Compatible Use. A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the Mission of the System or the purposes of the refuge (Draft Service Manual 603 FW 3.6).

Comprehensive Conservation Plan (CCP). A document that describes the desired future conditions of the refuge or planning unit; and provides long-range guidance and management direction to accomplish the purposes of the refuge, helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates.

Concern. See Issue.

Cultural Resource. The physical remains of human activity (artifacts, ruins, burial mounds, petroglyphs, etc.) and conceptual content or context (as a setting for legendary, historic, or prehistoric events, such as a sacred area of native peoples) of an area. It includes historical, archaeological and architectural significant resources.

Cultural Resource Inventory. A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).

Cultural Resource Overview. A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field offices background or literature search described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).

Easement. A privilege or right that is held by one person or other entity in land owned by another.

Ecosystem. The sum of all interacting parts of the environment and associated ecological communities within a particular area; an ecological system. Many levels of ecosystems have been recognized. Very few, if any ecosystems are self-contained; most influence, or are influenced by, components or forces outside the system. For administrative purposes,

we have designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries, and their sizes and ecological complexity vary.

Effect. A change in a resource, caused by a variety of events including project attributes acting on a resource attribute (direct), not directly acting on a resource attribute (indirect), another project attributes acting on a resource attribute (cumulative), and those caused by natural events (e.g., seasonal change).

Emergent Vegetation. Rooted, aquatic plants that have most of their vegetative (nonroot) parts above water.

Endemic Species. Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality.

Endangered Species. Any species that is in danger of extinction throughout all or a significant portion of its range and listed as such by the Secretary of the Interior in accordance with the Endangered Species Act of 1973. Endangered species are afforded protection under the Act as amended and under various State laws for State-listed species.

Environmental Assessment (EA). A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

Environmental Health. Abiotic composition, structure, and functioning of the environment consistent with natural conditions, including the natural abiotic processes that shape the environment

Ethnography. The branch of anthropology that deals descriptively with specific cultures, especially those of non-literate peoples.

Evapotranspiration. The collective processes by which water is transferred from the surface of the earth, including from the soil and the surface of water-bodies (through evaporation) and from plants (through transpiration).

Exotic and Invading Species (Noxious Weeds). Plant species designated by Federal or State law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insects or disease; or nonnative, new, or not common to the United States, according to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the Unite States and to the public health.

Fallow. Allowing land that normally is used for crop production to lie idle.

Finding of No Significant Impact (FONSI). A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Flyway. A route taken by migratory birds between their breeding grounds and their wintering grounds. Four primary migration routes have been identified for birds breeding in North America: the Pacific, Central, Mississippi, and Atlantic Flyways.

Foraging. The act of feeding; another word for feeding.

Forbs. Herbaceous dicotyledonous plants.

Fragmentation. The process of reducing the size and connectivity of habitat patches.

GIS. Geographic Information System. Refers to such computer mapping programs as ArcView, ArcInfo, ERDAS, etc.

Goal. Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Draft Service Manual 620 FW 1.5).

Grain. A single, hard seed of a cereal grass.

Habitat. Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Integrated Pest Management (IPM). Methods of managing undesirable species, such as weeds, including education; prevention, physical or mechanical methods or control; biological control; responsible chemical use; and cultural methods.

Invertebrate. Animals that do not have backbones. Included are insects, spiders, mollusks (clams, snails, etc.), and crustaceans (shrimp, crayfish, etc.).

Irrigation Drainwater. Ideally, subsurface water which flows from irrigated land and generally transports higher concentrations of dissolved salts than the water applied to the land.

Irrigation Return Flow. Water which reaches surface drainage by overland flow or through groundwater discharge as a result of applied or natural irrigation.

Issue. Any unsettled matter that requires a management decision, e.g., an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition.

Lethal Dose 50 (LD50). The LD50 or colloquially, semi-lethal dose of a particular substance is a measure of how much constitutes a lethal dose. The related units of an LD50/30 or an LD50/60 are used to refer to a dose that without treatment will be lethal to 50% of the population within (respectively) 30 or 60 days.

Mitigation. To avoid or minimize impacts of an action by limiting the degree or magnitude of the action; to rectify the impact by repairing, rehabilitating, or restoring the affected environment; to reduce or eliminate the impact by preservation and maintenance operations during the life of the action.

Moist-Soil. A process where water is drawn down intentionally or naturally to produce mudflats (i.e., moist soil) that are required for germination of many desirable plants.

National Environmental Policy Act (NEPA). An act which encourages productive and enjoyable harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and atmosphere, to stimulate the health and welfare of humans. The act also established the Council on Environmental Quality (CEQ). Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (from 40 CFR 1500).

National Wildlife Refuge (Refuge or NWR). A designated area of land or water or an interest in land or water within the system, including national wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas (except coordination areas) under the Service jurisdiction for the protection and conservation of fish and wildlife. A complete listing of all units of the Refuge System may be found in the current "Report of Lands Under Control of the U.S. Fish and Wildlife Service."

National Wildlife Refuge System, Refuge System, or System. Various categories of areas that are administered by the Secretary for the conservation of fish and wildlife, including species that are threatened with extinction; all lands, waters, and interest therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management or waterfowl production areas.

Native Species. Species that normally live and thrive in a particular ecosystem.

NEPA. National Environmental Policy Act of 1969.

No Action Alternative. An alternative under which existing management would be continued.

Objective. A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Make objectives attainable, time-specific, and measurable.

Plant Community. An assemblage of plant species of a particular composition. The term can also be used in reference to a group of one or more populations of plants in a particular area at a particular point in time; the plant community of an area can change over time due to disturbance (e.g., fire) and succession.

Playa. A shallow basin where water collects and is evaporated.

Population. All the members of a single species coexisting in one ecosystem at a given time.

Preferred Alternative. This is the alternative determined (by the decision maker) to best achieve the Refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management. The Service's selected alternative at the Draft CCP stage.

Prescribed Fire. The skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, , etc., that allows confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish planned benefits to one or more objectives of habitat management, wildlife management, or hazard reduction.

Priority Public Uses. Compatible wildlife-dependent recreation uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).

Proposed Action. The Service's proposed action for Comprehensive Conservation Plans is to prepare and implement the CCP.

Public Involvement. A process that offers impacted and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

Public Scoping. See public involvement.

Purposes of the Refuge. "The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit." For refuges that encompass congressionally designated wilderness, the purposes of the Wilderness Act are additional purposes of the refuge.

Raptor. A bird of prey, such as a hawk, eagle, or owl.

Refuge. Short of National Wildlife Refuge.

Refuge Operating Needs System (RONS). The Refuge Operating Needs System is a national database that contains the unfunded operational needs of each refuge. We include projects required to implement approved plans and meet goals, objectives, and legal mandates.

Refuge Purposes. The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, a refuge unit, or refuge subunit (Draft Service Manual 602 FW 1.5).

Salinity. An expression of the amount of dissolved solids in water.

Shorebirds. Long-legged birds, also known as waders, belonging to the Order Charadriiformes that use shallow wetlands and mud flats for foraging and nesting.

Sound Professional Judgment. A finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of the Refuge Administration Act and other applicable laws.

Species. A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification.

Step-Down Management Plan. A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives.

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Draft Service Manual 602 FW 1.5).

Threatened Species. Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, and one that has been designated as a threatened species in the Federal Register by the Secretary of the Interior. Threatened species are afforded protection under the Endangered Species Act of 1973.

Upland. An area where water normally does not collect and where water does not flow on an extended basis. Uplands are non-wetland areas.

Vernal Pool. Seasonally flooded depressions found on ancient soils with an impermeable layer such as a hardpan, claypan, or volcanic basalt. The impermeable layer allows the pools to retain water much longer then the surrounding uplands; nonetheless, the pools are shallow enough to dry up each season. Vernal pools often fill and empty several times during the rainy season. Only plants and animals that are adapted to this cycle of wetting and drying can survive in vernal pools over time.

Vision Statement. A concise statement of what the planning unit should be, or what we hope to do, based primarily upon the Refuge System mission and specific refuge purposes, and other mandates. We will tie the vision statement for the refuge to the mission of the Refuge System; the purpose(s) of the refuge; the maintenance or restoration of the ecological integrity of each refuge and the Refuge System; and other mandates.

Waterfowl. A group of birds that include ducks, geese, and swans (belonging to the order Anseriformes).

Watershed. The entire land area that collects and drains water into a river or river system.

Wilderness Review. The process we use to determine if we should recommend Refuge System lands and waters to Congress for wilderness designation. The wilderness review process consists of three phases: inventory, study, and recommendation. The inventory is a broad look at the refuge to identify lands and waters that meet the minimum criteria for wilderness. The study evaluates all values (ecological, recreational, cultural), resources (e.g., wildlife, water, vegetation, minerals, soils), and uses (management and public) within the Wilderness Study Area. The findings of the study determine whether or not we will recommend the area for designation as wilderness.

Wildfire. A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).

Wildlife. All nondomesticated animal life; included are vertebrates and invertebrates.

Wildlife-Dependent Recreational Use. "A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation." These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. We also will consider these other uses in the preparation of refuge CCPs; however, the six priority public uses always will take precedence.

Appendix L. Summary of Public Involvement/ Comments and Consultation/ Coordination

This page is intentionally left blank, for the 2006 public Draft of the Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan (CCP). This appendix will be provided in the Final CCP.

Appendix M. Mailing List

This page is intentionally left blank, for the 2006 public Draft of the Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan (CCP). This appendix will be provided in the Final CCP.

Appendix N. List of Preparers

David Bergendorf: National Wildlife Refuge Planner, CA/NV Refuge Planning Office
Jeanne Clark: Writer/Editor, Private Consultant
Clay Courtright: Former Wildlife Biologist, Stone Lakes National Wildlife Refuge
Miki Fujitsubo: Former National Wildlife Refuge Planner, CA/NV Refuge Planning Office
Thomas Harvey: Project Leader, Stone Lakes National Wildlife Refuge
Amy Hopperstad: Volunteer Coordinator, Stone Lakes National Wildlife Refuge
Leslie Lew: Former National Wildlife Refuge Planner, CA/NV Refuge Planning Office
Laurie Litman: Writer/Editor, Private Consultant
Alex Morton: National Wildlife Refuge Planner, CA/NV Refuge Planning Office
Mark Pelz: Chief of National Wildlife Refuge Planning, CA/NV Refuge Planning Office
Beatrix Treiterer: Assistant Refuge Manager, Stone Lakes National Wildlife Refuge

Appendix O. Integrated Pest Management Plan for Mosquito-Associated Threats

DRAFT
Integrated Pest Management Plan for Mosquito-Associated Threats
Stone Lakes National Wildlife Refuge
August, 2006

I. Introduction

Stone Lakes National Wildlife Refuge (Refuge) collaborates with the Sacramento-Yolo Mosquito Vector Control District (District) in monitoring and controlling mosquitos to ensure the human health concerns of neighboring communities are addressed. The Refuge is located within Sacramento County, 10 miles south of downtown Sacramento and bordered by the city of Elk Grove on the east. The potential for mosquitos to be produced or harbored on the Refuge is a concern to nearby residents and urbanized areas immediately adjacent to the Refuge are well within the flying range of many species of mosquitos. Because of this and commitments made by the U.S. Fish and Wildlife Service (Service) in the Final Environmental Impact Statement (1992) establishing the Refuge approved boundary, the Service entered into a Memorandum of Understanding (MOU) in 1993, to ensure the public health and well-being of residents would not be adversely affected by mosquitos from the Refuge. This Integrated Pest Management (IPM) Plan for Mosquito and Associated Threats will facilitate implementation of the MOU and ensure mosquito management practices are consistent with Service IPM policies and regulations regarding management of the national wildlife refuge (NWR) system.

Refuge Description

Stone Lakes National Wildlife Refuge was established in 1994 becoming the 505th NWR. The approved Refuge boundary encompasses 17,640 acres, of which approximately 6,200 acres are currently managed by the Service. Stone Lakes NWR lies between the Coast and Diablo Ranges to the west and the Sierra Nevada to the east. Most of the Refuge lies within the 100-year floodplain of the Mokelumne and Cosumnes rivers. Interstate highway 5 roughly bisects the Refuge north to south. Annual temperature in the area averages approximately 61.0 F degrees and annual precipitation averages approximately 17.93 inches; virtually all of the precipitation occurs during the winter months. Summer is typically hot (>100 °F) and dry; winter temperatures are generally moderate (50-60 °F). Habitats on the Refuge consist of upland grasslands (55 percent), riparian forest and associated shrublands (7 percent), open water (7%), seasonal and permanent wetlands including vernal pools and irrigated pastures (26 percent), and croplands (5 percent). Land uses adjacent to the Refuge include farming (vineyards, orchards and row crops), grazing, and suburban housing developments.

Memorandum of Understanding (MOU)

The 1993 MOU between the District and the Refuge outlines a mosquito management program that includes consultation on wetland design and water management, use of physical, biological and chemical control agents to control mosquito larvae and adults, and

cooperative research on landbird populations. Both the Refuge and the District agree that biological, cultural and physical control methods are preferred over chemical measures and that wetlands can be designed and managed to minimize mosquito production. In summary, the MOU provides for: 1) allowing the District to review planned Refuge wetland construction projects; 2) providing the District an annual summary of the upcoming Refuge water management program and notification of flood ups and irrigations; 3) the District providing a proposed annual mosquito abatement operating plan to the Refuge, 4) the Refuge submitting pesticide use proposals (PUP's), as needed, for any chemical mosquito control agents requested by the District; 5) providing access to the District for mosquito monitoring and control as defined in an annual Special Use Permit (SUP); and 6) with notification and coordination, application of larvicides or adulticides by the District, when treatment thresholds are exceeded.

II. Mosquito Borne Disease

Disease History

Due partly to its climate, California has a history of serious arboviral disease problems that are not expected to diminish. Western equine (WEE) and St. Louis encephalitis (SLE) viruses are endemic and intermittently represent significant public health threats throughout the state. St. Louis encephalitis, historically a rural disease in the western USA, has now moved into the expanding metropolitan areas of southern California. Several international arboviral diseases have recently been introduced to the United States, such as dengue, Venezuelan equine encephalitis, and West Nile virus (WNV). WEE tends to be most serious in very young children, whereas elderly people are most at risk to SLE and WNV (CA Dept. of Heath Services 2003). WEE and WNV can also cause diseases in horses and emus, and WNV kills a wide variety of endemic and imported birds. Mosquito control is practically the only known method of protecting people and animals from WEE, SLE, and WNV. With the exception of available vaccines to protect horses against WEE and WNV, there are no known specific treatments or cures for the diseases caused by these viruses (CA Dept. of Health Services 2004).

West Nile virus was introduced into New York City during 1999 and has subsequently expanded its occurrence dramatically throughout North America. It was first documented as becoming established in California in 2004 when a total of 822 human cases were verified, primarily in southern California (Table 1). Of the 58 counties in the state, 23 reported virus activity during 2004, based on a range of monitoring methods, including: mosquito pools, sentinel chicken flocks, wild birds, or equine and human cases (CA Dept. of Heath Services 2004, CA West Nile Virus website 2006). During 2005, 54 counties were documented as supporting virus activity as it moved northward into the Central Valley and the northern state. In 2005, Sacramento County was recognized as a focus of WNV activity in the state.

Table 1. West Nile virus human cases in California (2004-2006). Numbers in parentheses are totals for Sacramento and Yolo counties.

Year	Human Cases	Human Fatalities
2004	822	25
	(4)	(0)
2005	935	19
	(189)	(1)
2006	50	1
(as of 08/18/06)	(16)	(0)

A number of characteristics of the Sacramento region may have contributed to this, including: (1) number of days per year temperatures exceed 95 degrees Fahrenheit., (2) abundance of mosquito production habitat particularly rice fields, irrigated pasture, dairies, and wetlands, (3) abundance of local migratory bird populations, (4) burgeoning human population interfacing with nearby agricultural lands, (5) heavy spring rains, and (6) the relative abundance of the primary WNV vector, *Culex tarsalis* (P. Sanders, SYMVCD, pers. comm.). During 2004-2005, human cases were documented in the state from approximately the first week of July through the first week of November. To date, there have been 16 human WNV cases in Sacramento and Yolo counties and one mortality in Butte County. WNV activity has been detected in a total of 43 counties. The five major species of birds most commonly found dead and testing positive for WNV in the state have been American crow, Western scrub-jay, yellow-billed magpie, American robin, and house finch.

A statewide encephalitis virus surveillance program has been in place since the 1960s that tracks mosquito abundance and enzootic transmission (transmission within the same geographic area) to provide an early warning of the potential for human infection. WEE and SLE have been recorded in the Central Valley since the 1940s reappearing intermittently after periods of apparent extinction. Though SLE has been rare since 1972, WEE enzootic transmission in the Sacramento Valley appears to be cyclic, recurring at 10 year intervals (Reisen et al. 1995). WEE is transmitted enzootically during the summer between wild birds and *Culex tarsalis*, while *Ocheloratus melanimon* is involved in a secondary cycle with rabbits in the Central Valley during the late summer (Reeves 1990). The mechanisms by which the viruses overwinter and are able to persist despite periods of apparent extinction are still unclear though they have been the subject of intense study for over 50 years (Kramer 1999). There are currently two main hypotheses, one, that WEE overwinters by chronic infection of one or more species of birds, and two, that the virus persists between seasons in adult mosquitos. Humans and horses are infected tangentially by mosquitos but are dead-end hosts for the virus. Data collected from county health clinics by the Encephalitis Virus Surveillance indicating a low rate of infection in humans even during periods of elevated enzootic transmission may reflect a lowered rate of mosquito-human contact. This reduction in the exposure of humans to mosquito bites is likely due to cultural factors like the prevalence of televisions and air conditioners that encourage the population to spend more time indoors during dusk, the main period of mosquito activity. Expanded mosquito control and water management programs have also reduced *Culex tarsalis* populations.

Mosquitos

The mosquito species identified by the District for monitoring and control at the Refuge are *Culex tarsalis*, *Anopheles freeborni*, *Ochlerotatus vexans, Ochlerotatus melanimon, Ochlerotatus nigromaculis,* and *Aedes increpitus*. *Culex tarsalis* is the primary vector of WEE and SLE in California and is also considered to be a significant vector of WNV (CA Dept. of Health Services 2003). *Anopheles freeborni* can transmit the malaria parasite to humans and is common in the rice growing regions of California. *Ochlerotatus melanimon* is involved in the encephalitis virus (sleeping sickness) cycle, and is considered a secondary vector for WNV (SYMVCD 2004).

Mosquito Biology

Mosquitos are dipterans with aquatic immature stages and an aerial adult stage. Eggs must come in contact with water in order to hatch. Mosquitos have four aquatic larval stages (instars) plus an aquatic pupal stage. The aerial adult emerges from the pupal stage onto the surface of the water, expands its wings, hardens its exoskeleton, and flies off. It takes from three to 12 days for a mosquito to complete its life cycle in northern California, depending on seasonal and environmental factors and the particular mosquito species involved. In general, the warmer the ambient temperature, the fewer days are required from hatching to emergence.

Ochlerotatus (floodwater) mosquitos (*O. melanimon, O. nigromaculis, O. vexans*)
The *Ochlerotatus* life cycle is initiated with the flooding of ground that has undergone a dry period. In the Sacramento Valley, the dry period may occur at any time from May through September. Once flooded, eggs that had been laid during the previous wet cycle hatch, pupate, and emerge as adults. Gravid females lay their eggs singly on damp soil, in leaf litter, in cracks in the soil, at the edges of drying ponds, or at the bases of grasses and other plants. Each female lays approximately 150 eggs per ovarian cycle. These eggs are very drought resistant, which allows them to survive during the summer. These mosquito species overwinter in the egg stage and to a much lesser extent in the larval stage. *Ochlerotatus* mosquitos (primarily *O. melanimon*) are the most abundant produced on Refuge habitats, primarily during late summer and fall flooding. Numerous *O. melanimon* can also be produced as a result of wetland irrigations in late spring through early summer. During these times, mosquito eggs hatch, pupate, and reach the adult stage rapidly. *Ochlerotatus* are most numerous on Refuges during the fall when the majority of wetlands are flooded. Multiple hatchings of eggs commonly occur due to the timing of the different broods of eggs and differences in flooding schedules for individual areas. During the warmer months, it generally takes 3-10 days for these mosquitos to develop from egg to adult (i.e., after initial flooding). Adult females of the three species of *Ochlerotatus* mentioned above are all aggressive, relative to other species, and are biters of primarily mammals. During the day, females will bite if disturbed or if a host presents itself, but generally are more active at dusk. Biting and swarming (mating) activities are typically crepuscular (occurring at twilight). When newly emerged, these mosquitos do not readily move away from their emergence sites. As they age, however, they will move about much more freely. Although all three species of *Ochlerotatus* are produced in this area, *O. melanimon* has consistently been the most numerous and the cause of most concern as both as a nuisance and a public health risk. *Ochlerotatus* mosquitos have been documented as secondary vectors for California Encephalitis and WNV.

Culex tarsalis (Encepalitis Mosquito)
Culex tarsalis occur in northern California in very large numbers during the summer. Females lay their eggs on the water surface in bunches called rafts. Each raft contains around 100-150 eggs, hatching about 24 hours after being laid. The immature stages can be found in almost any source of water except treeholes. During the summer, development from egg to adult takes about 9 days in the Sacramento Valley. This species is dramatically multivoltine (producing several broods), with adults emerging continuously throughout the summer. Abundant larva are commonly found in rice fields, poorly drained pastures, wetlands, sewer treatment plants, log decks, dairy farms, and seepages. Within Refuge habitats, *C. tarsalis* can be abundant in seasonal marsh and watergrass production units that have been flooded for more than two weeks during the fall. Adults spend daylight hours resting in secluded places such as cellars or animal burrows. Biting and swarming activities are crepuscular. Peak populations occur in late June or early July. *C. tarsalis* are primarily biters of birds, but will bite humans, livestock, and other mammals if the opportunity presents itself. *C. tarsalis* are strong fliers. Mark-release-recapture studies conducted in Sutter County in 1989 and 1990 showed that adult *C. tarsalis* could move up to 3 miles in just one night. *C. tarsalis* are the primary vector for Western Equine Encephalitis, St. Louis encephalitis, and WNV in humans.

Anopheles freeborni
A. freeborni also occur in northern California and are numerous during the summer. Rice fields are the primary production areas for this species although the immature stages are also found in ditches, seepages, sloughs, and wetlands. Females lay their eggs singly on the surface of the water where they hatch approximately 24 hours later. On the average, it takes 12 days for *A. freeborni* to develop from egg to adult in the Sacramento Valley. *A. freeborni*

are most abundant in persistent wetlands, thus Refuge perennial marsh can produce *A. freeborni* during the summer months. However, relatively stable water levels and a relative abundance of mosquito predators (fish, dragonflies, and aquatic beetles) tend to minimize adult mosquito emergence from these habitats.

This species is also multivoltine, with the ability to produce a continuous supply of newly emerged adults under the right habitat conditions. Adults rest during the day and engage in biting and swarming activities during crepuscular periods. In the fall, females go into diapause (overwintering stage) until January, February, or March when they come out of diapause and seek blood meals on warm days. After obtaining a blood meal, many females resume their overwintering stage until April or May. *A. freeborni* populations peak in late July or August. The females will readily bite humans and livestock. Area-wide, they are the most common nuisance mosquito for humans. Studies on *A. freeborni* in California have indicated long flight ranges from source areas. Work done in Sutter County found that this species could fly 2-3 miles in one night. This species is considered to be the most important vector of malaria in the Western United States.

III. Monitoring Mosquito Populations

District monitoring activities are designed to assess the abundance of immature (larvae and pupae) and adult mosquito populations. Monitoring activities conducted on the Refuge may include: larval sampling, adult light and host-seeking traps and adult leg counts. Monitoring by District staff may occur as often as 3-4 times per week during the summer irrigation (May 1st-July 31st) and fall flood up (August 1st-October15th). If temperatures are above average beyond October 15, District staff may continue to require access to the Refuge for monitoring.

Light and carbon dioxide traps are used to capture adult mosquitos for monitoring purposes. Dip counts are used to estimate the numbers of immature mosquitos and to determine the need for larval mosquito control. The dipper method entails using a long-handled ladle (ca 500 ml) called a dipper to collect water samples from possible mosquito sources. Captured immature mosquitos are identified taxonomically as precisely as possible. All Refuge units supporting wetlands or irrigated land potentially may be monitored using the dipper method. However, units supporting managed wetlands would be targeted. Sampling locations for larvae may include wetland margins and shorelines and riparian habitats for adults.

As provided for in the MOU, the monitoring activities described above are conducted under a Special Use Permit (SUP) that the Refuge intends to continue issuing annually to the District.

1. Larval Mosquito Thresholds

Guidelines for control of immature or larval mosquitos follow integrated pest management principles and are defined in a District Mosquito and Mosquito-Borne Disease Management Plan (Appendix I), available on their website (http://www.fightthebite.net) (Boyce 2005). In keeping with the MOU, the District requests annual approval from the Refuge to control mosquitos by treating areas where larval stages of *Culex tarsalis*, *Ochlerotatus melanimon, Oc. nigromaculis, Anopheles freeborni* or *Aedes* spp. may exceed thresholds. According to the District Management Plan, the threshold for initiating a larval control response will be a density of 0.1 mosquito larvae per 350-ml dipper of water for all species.

2. Adult Mosquito Thresholds

The District Management Plan defines criteria for five possible levels of adult mosquito activity and control responses (Appendix II). The thresholds for Level 1 (Standard or Routine) adult mosquito control are 10 *Culex tarsalis* female mosquitos per light trap night or 100 per CO_2 baited trap per night. For *Aedes* spp. the thresholds for Level 1 control are 50 female mosquitos per light trap night or 150 per CO_2 baited trap per night. Under Level I, the thresholds for landing (leg) count collections are exceeded when two or more *Aedes* or *Ocheloratus* spp. land on an individual during a one-minute interval. Level 1 control in the District Management Plan is consistent with Level 1 (Normal Season) in the California Department of Health Services Mosquito-Borne Virus Surveillance and Response Plan (CA Dept. of Heath Services 2004).

The District Management Plan calls for a Level 2 control response when a mosquito-borne virus is confirmed from a dead bird or mosquito pool within District boundaries. The threshold for levels 2-5 adult control is 10 *Culex tarsalis* or *Cx. Pipiens* female mosquitos per light trap night or 25 per CO_2 baited trap per night. For *Aedes* spp. the thresholds for Level 2-5 control responses are 25 female mosquitos per light trap night or 50 per CO_2 baited trap per night. Level 2 control in the District Management Plan is equivalent to Level 2 (Epidemic Conditions) in California Department of Health Services Mosquito-Borne Virus Surveillance and Response Plan (CA Dept. of Heath Services 2004). According to the District Management Plan, levels 2-5 adult treatment thresholds remain at the reduced level until control activities are terminated for the mosquito season. The thresholds used by the District are based on historical monitoring that indicate all mosquitos have the potential to transmit a wide range of diseases. Thresholds also minimizes annoyance levels to nearby communities from adult mosquitos.

IV. Surveillance of Mosquito-Borne Disease

Vectorborne disease surveillance and associated health threat determinations are made by the California Vectorborne Disease Surveillance System (CVDS), a cooperative project of the Mosquito and Vector Control Association of California, the California Department of Health Services (CDHS), and the University of California at Davis. The UC Davis Center for Vectorborne Diseases (CVEC) analyzes samples collected from mosquito pools, sentinel chickens and dead birds and publishes results in the California Arbovirus Surveillance Bulletins. The samples are collected by the District.

The District arbovirus surveillance program includes testing of mosquito populations, sentinel chickens and wild birds for WEE, SLE and WNV. The information generated by the encephalitis program provides an early indication of local arboviral activity. Small populations of mosquitos from sites that have a history of disease activity are sampled and tested by the mosquito abatement district. Carbon dioxide traps attract and capture mosquitos which are subsequently identified, sorted and grouped into pools. The pools are sent to the CVEC where they are tested for encephalitis viruses. Mosquitos are collected annually from March to November.

As part of monitoring conducted by the District for the presence of mosquito borne public health diseases, a sentinel chicken flock is maintained on private property adjacent to the Refuge Headquarters Unit. Service Region 1 policies prevent placement of sentinel chicken flocks on wildlife refuges because of the risk of avian diseases passing from chickens to migratory birds. Sentinel chickens are exposed to the environment and to mosquitos moving through the area that may choose to feed on them. Regular blood samples are periodically taken from the chickens to detect any mosquito-vector pathogen activity. Once

the flock exhibits positive viral titers and sero-conversion occurs, the California Department of Health Services is alerted to the potential threat to public health due to mosquito borne diseases.

For approximately the last ten years, Refuge staff and the District have conducted a collaborative research effort to collect blood samples from resident and migratory birds captured on the Refuge. The wild bird sera samples are processed and tested for the presence of WEE, SLE and WNV virus antibodies at the District laboratory. These cooperative efforts also provide the Service with important data regarding the status of migratory bird populations occurring on the Refuge.

Contacts:

Dave Brown Manager, Sacramento-Yolo Mosquito and Vector Control District
8631 Bond Road
Elk Grove, CA. 95624
Phone (916) 685-1022
Fax (916) 685-5464

Chris Voight Executive Director, The Mosquito and Vector Control Association of California
cvoight@mvcac.org

Dr. Vicki Kramer, Chief, Vectorborne Disease Section, California Department of Health Services
vkramer@dhs.ca.gov

Dr. Bruce F. Eldridge, Emeritus Professor, University of California at Davis
bfeldridge@ucdavis.edu

For information on sentinel chicken flock data:
Mr. Stan Husted, Senior Public Health Biologist, Vectorborne Disease Section, California Department of Health Services
shusted@dhs.ca.gov

For information on mosquito virus isolations:
Barbara Cahoon-Young, Laboratory Manager, Arborvirus Research Laboratory, UC Davis Center for Vectorborne Disease Research
bcahoon@ucdavis.edu

Reporting

1. The District will notify the Refuge Manager in the event of detection of virus activity within or near the Refuge and the method of disease surveillance yielding positive results.

2. Refuge staff will participate in collections of wild bird sera for testing and will monitor any unusual bird die-offs that may be caused by WNV or other diseases. Wild bird mortality due to WNV can provide an early warning of the risk of transmission to the public via mosquitos.

V. Treatment Options

Mosquito control at the Refuge follows an ordered succession, using nonchemical treatments first (i.e., wetland and water delivery system design, water control strategies, vegetation management, mosquitofish, guppies, and other biological agents, etc.), resorting to chemical treatment only when necessary, as determined through standard mosquito monitoring procedures. Among chemical treatments, adulticides will be used as a last resort. Refuge staff work with the District to minimize production of mosquitos on the Refuge by means of habitat management and biological controls and are mindful of abiotic sources of mosquito production (e.g., tanks, buckets, equipment holding water) and promptly eliminate them if discovered.

Habitat Management

Refuge habitat management techniques that support mosquito abatement consist of: (1) design of managed wetlands, (2) efficient water management, and (3) physical manipulation of vegetation. These are mostly preventative measures to eliminate or reduce mosquito breeding habitat or conditions before it develops. If habitats were managed entirely for mosquito abatement, wildlife habitat values would be compromised. Therefore, Refuge staff strive to incorporate management techniques for mosquito abatement into ongoing wildlife habitat efforts. In an officially determined health emergency, mosquito abatement would become a higher priority than habitat management.

Wetland Design and Water Management

Water management techniques for minimizing mosquito production include timing and duration of flooding, the speed at which individual units are flooded up, irrigated, or drawn down and the stability of water levels. The Refuge is only able to conduct efficient water management on managed wetlands impoundments with pumps and water control structures where they can be manipulated to reduce mosquito production. These occur on the Beach Lake, Headquarters, and South Stone Lake units. Elements incorporated into the design of these wetlands that promote minimizing mosquito breeding include contouring of wetland margins, construction of drainage swales, and sizing of water control structures for relatively rapid flood up and de-watering. Steeper sloped wetlands support narrower perimeter margins where warm, shallow, vegetated conditions provide optimal breeding habitat for many species of mosquitos.

Managed permanent and summer water wetlands produce the fewest numbers of mosquitos and pose the least concern for the District. Permanent wetlands are flooded to a depth of approximately three feet which minimizes their use by floodwater mosquitos and encourages abundant populations of mosquito predators (e.g., fish, dragonflies). Deep, open water provides water circulation and generates wave action that reduces micro-habitats suitable for mosquito breeding.

Seasonal wetland impoundments with water control structures are managed to provide wildlife habitat while minimizing the potential for mosquito production. Water delivery infrastructure is sized for rapid flood up, irrigations, and draw down, providing at least two means by which mosquito production is reduced. Slow irrigations, especially over large units, usually result in multiple hatches of adult mosquitos. For example, if it takes five days to inundate a unit, a new hatch of eggs (i.e., typically *Ochlerotatus melanimon*) could be produced every day resulting in five separate cohorts of larvae/pupae and subsequent adult mosquitos emerging over a five day period. The alternative is to flood up rapidly, covering the entire unit within one day if possible. This will not reduce the overall amount of mosquitos produced but it will result in a more synchronous egg hatch and adult emergence. This will facilitate a more efficient control effort, requiring fewer applications for the same objective.

The timing of the fall flood up can substantially affect both mosquito production and wildlife habitat values. Delaying the initial fall flood up also delays associated initial mosquito production and may reduce the need for mosquito abatement if temperatures have already dropped sufficiently to discourage mosquitos. Historically, Sacramento Valley wetlands flooded naturally and much later, in the fall or early winter, based largely on the Sacramento River overflowing its banks. However, current managed wetland flooding regimes are dictated largely by water availability through irrigation districts and the need to provide wetlands for early migrating waterbirds during August-September. For example, providing roosting habitat for sandhill cranes is a priority at the Refuge which requires flooding up by mid-September, when they first arrive in the valley. Though this practice conflicts with District abatement recommendations, sandhill crane habitat considerations are given precedence over mosquito control. In the event of a threat to public health and/or unusually warm fall temperatures that would encourage mosquito production, delaying fall flood up remains an option.

Effective communication between Refuge staff and the District remains a critical requirement for coordinated mosquito management. In addition to submitting an annual summary of planned water management to the District, Refuge staff provide advance notifications of flood ups and irrigations so mosquito monitoring and possible treatments can be scheduled at an optimal time. Such notifications can result in applications of adulticides not being required since the District then has an opportunity to control larval populations, thus controlling adult emergence rates. For example, the Refuge attempts to flood wetlands early in the week so that mosquito hatches do not occur over the weekend when District staff are not in the field.

Physical Manipulation of Vegetation

Vegetative structure in wetlands provides habitat features that generally favor mosquito production. The benefits of vegetation include egg-laying sites, protection from the elements, and escape cover. The literature suggests that reduction of vegetation by burning or mowing (Batzer and Resh 1992) can reduce mosquito production significantly.

Mowing, herbicide applications, disking, or burning are the most common methods of reducing accumulations of vegetation in wetlands on the Refuge. Depending on the extent of vegetation they support, managed wetlands may be manipulated during the dry season to support a target mix of open water to emergent vegetation: approximately 50% vegetation to 50% open water. These manipulations improve wildlife habitat by promoting wetland plants of more food value for migratory waterfowl, increasing edge habitat, and the overall openness of wetland units, making them more attractive to shorebirds and species such northern pintail, green-winged teal, and sandhill crane. These treatments also reduce the extent of mosquito breeding habitat and improve accessibility to mosquito larvae by mosquito fish and other natural predators. Seasonal wetlands lacking in water control structures cannot be as easily managed but wetland perimeters may be mowed or disced both to improve conditions for mosquito fish and as well as to increase their value for waterbirds.

Major portions of Refuge waterways (e.g., South Stone Lake, SP Cut) have been invaded by the invasive aquatic plants, water hyacinth and Brazilian elodea (Egeria densa). Left unchecked, these continuous floating or submerged mats of vegetation can encourage mosquito production by providing harborage from predation, concentration of organic foods, and interference with wave action and water circulation. The Refuge was a founding member and has the lead role in the Stone Lakes Basin Water Hyacinth Control Program, along with the District and the Sacramento Regional County Sanitation District. This program contributes to both mosquito abatement and wildlife habitat improvement goals.

In summary, habitat management techniques promoting mosquito abatement include:

- Construct wetland impoundments with appropriate slopes and adequate water management capacities
- Flood up/irrigate quickly to discourage multiple hatches
- Maintain a depth of 2-3 feet of water in permanent wetlands
- Control emergent vegetation to maintain 50 percent open water in managed wetlands
- Disc/mow pond perimeters in seasonal wetlands to maintain open water and access by fish
- Control invasive aquatic weeds
- Notify the District of planned flood up/irrigation events

Biological Controls

Reducing production of mosquitos in a wetland ecosystem is partially dependant upon maintaining a diversity of habitats that support various predators and parasitic species that can then control mosquito populations. Predators and parasites can take sizable numbers of mosquitos but if conditions support the rapid development of mosquitos, then natural predation can be augmented by the addition of insectivorous (insect eating) fishes. The District has introduced three species of insectivorous fish to the Refuge, mosquito fish (*Gambusia affinis*), guppies (*Poecilia reticulata*) and the native threespine stickleback (*Gasterosteus aculeatus*).

Mosquitofish

Mosquitofish have played an active role in mosquito larvae control at refuges within California's Sacramento Valley over the last twenty years. Mosquitofish exhibit a tremendous tolerance for a wide range of water temperatures. Previously acclimated fish may tolerate minimum and maximum temperatures of 33° and 104°F (0.6° and 40°C), although sudden drastic changes of temperature are often lethal. Preferred temperatures appear to lie between 77° and 86°F (25° and 30°C). When surface water temperatures approach higher lethal limits, mosquitofish usually swim down to cooler water strata. Conversely, in the cooler seasons mosquitofish will move into shoal areas to reach the sun-warmed shallow waters. Other environmental factors that influence mosquito fish survival include densities of mosquito larvae, aquatic vegetation, availability of alternative forage organisms, presence of predaceous bird and fish populations, water depth and flow patterns, and several water quality criteria. For the fish to be effective, there must be no limitations to their normal distribution, rapid reproduction, and population recruitment. In general, mosquitofish are stocked in very small numbers because they quickly reproduce to the maximum population levels that a particular habitat may sustain.

Mosquitofish are transported by tanker truck directly to mosquito sources. Primary stockings of fish in semi-permanent wetlands are usually conducted at a minimal initial rate of 0.1 lb per acre. When necessary, these applications are augmented up to 1.0 lb per acre, based on larval dipping data. The District has stocked Refuge waters with mosquitofish every year since 1996. Most of the mosquitofish have been planted in the Lewis unit, but some have also been placed in small ponds on the Sun River and Beach Lake properties.

Guppies and Threespine Sticklebacks

The District is evaluating the use of guppies and threespine sticklebacks for mosquito larvae control. Literature suggests that guppies will do an excellent job of controlling mosquitos during the summer months but will not survive the cold winter months. Using this species in areas that are prone to winter flooding will ensure that these fish will not impact threatened or endangered species occurring within the floodplain. Threespine sticklebacks prefer to feed on benthic organisms rather than on the surface where mosquito larvae are found, but where the benthic community is insufficient, the Sticklebacks will expand their feeding range to the surface. Sticklebacks were only planted at the Refuge in 2001, while guppies were used in 2002 and 2003.

Chemical Controls

Larvicides/Pupacides

The District proposes to control mosquitos by treating areas infested with larval stages of *Culex tarsalis*; *Ochlerotatus melanimon, Oc. nigromaculis, Anopheles freeborni* and *Aedes* spp. The District would use the biological larvicides *Bacillus thuringiensis isrealensis* (Bti) and *Bacillus sphaericus* (Bsp) and the insect growth inhibitor methoprene. Use of the petroleum distillate Golden Bear (GB1111) as a pupacide was discontinued after 2000 and has been replaced with the monomolecular film Agnique. These treatments would be applied via ground methods. Based on December 2005 Service Delegation of Approval Authority for the California Nevada Operations (CNO) area, refuge managers now have authority to approve use of Bti, Bsp, methoprene, and Agnique.

Bti is a microbial insect pathogen used to control larval stages of mosquitos and black flies. It is a naturally occurring anaerobic spore forming bacteria that is mass produced using modern fermentation technology. Bti produces protein endotoxins that are activated in the alkaline mid-gut of insect species and subsequently bind to protein specific receptors of susceptible insect species resulting in the lethal response (Lacey and Mulla 1990). Bti must therefore be ingested by the target insect to be effective. It is most effective on younger mosquito larval instars but does not affect pupae or adult mosquitos. The District prefers to use Bti because of the low impacts to the environment and non-target organisms and its effectiveness in reducing the numbers of mosquito larvae. The Bti formulations Vectobac 12AS or Vectobac G would be employed at the Refuge by the District. Bti may be applied at the Refuge between March and October.

Like Bti, Bsp is a microbial insect pathogen with a similar mode of action (Walton 1998). Formulated Bsp products used as mosquito larvicides consist of bacterial spores and protein endotoxins. The granular formulation of Bsp, Vectolex CG, would be applied by the District. Both Bti and Bsp may be applied as a spot treatment to small areas or broadcast over larger areas. Use of Bsp is permitted between June 1 and September 30 and applications would likely be made within 7-10 days of initial flooding to control third and fourth instar larva.

Methoprene is a synthetic insect growth regulator (IGR) that mimics juvenile hormones (Tomlin 1994). It interferes with the insect's maturation stages preventing the insect from transforming into the adult stage, thereby precluding reproduction. Methoprene is a contact insecticide that does not need to be ingested. It is most effective on early larval instars but does not affect pupae or adult mosquitos (ETN 1996a). Treated larvae will pupate, but will not emerge as adults. The District proposes to use the formulated methoprene product Altosid in pellets or A.L.L. Growth Regulator. Use of methoprene is permitted between June 1 and September 30.

The monomolecular film, Agnique, reduces water surface tension. This interferes with larval orientation at the air-water interface and/or increases wetting tracheal surfaces, thus suffocating the organism. As the film spreads over the water surface, it tends to concentrate mosquito pupae, which may increase mortality from crowding stress (Dale and Hulsman 1990). Use of Agnique is permitted between June 1 and September 30.

Area Subject to Larvicides

Applications of larvicides may occur in managed permanent wetlands (106 acres), irrigated pastures (490 acres) and occasionally perennial wetlands (193 acres), totaling approximately 790 acres. The shorelines of open water areas may be treated. In addition, the District will treat ditches, culverts and low areas not classified as wetlands.

As a result of IPM practices and cooperation between the Refuge and the District, larval control applications on the Refuge have been limited to small acreages during any single treatment (less than five acres). The total Refuge acreage that may be treated varies with rainfall conditions each year. During drought years mosquito populations tend to be low, and during wet years mosquito populations tend to be high. From 2000-2004, the range in total acreage treated varied from a low of 104 acres in 2000 to a high of 477 acres in 2004. The majority of the treatments occur from August to October, but in some years applications of Bti have begun as early as March and have extended into November.

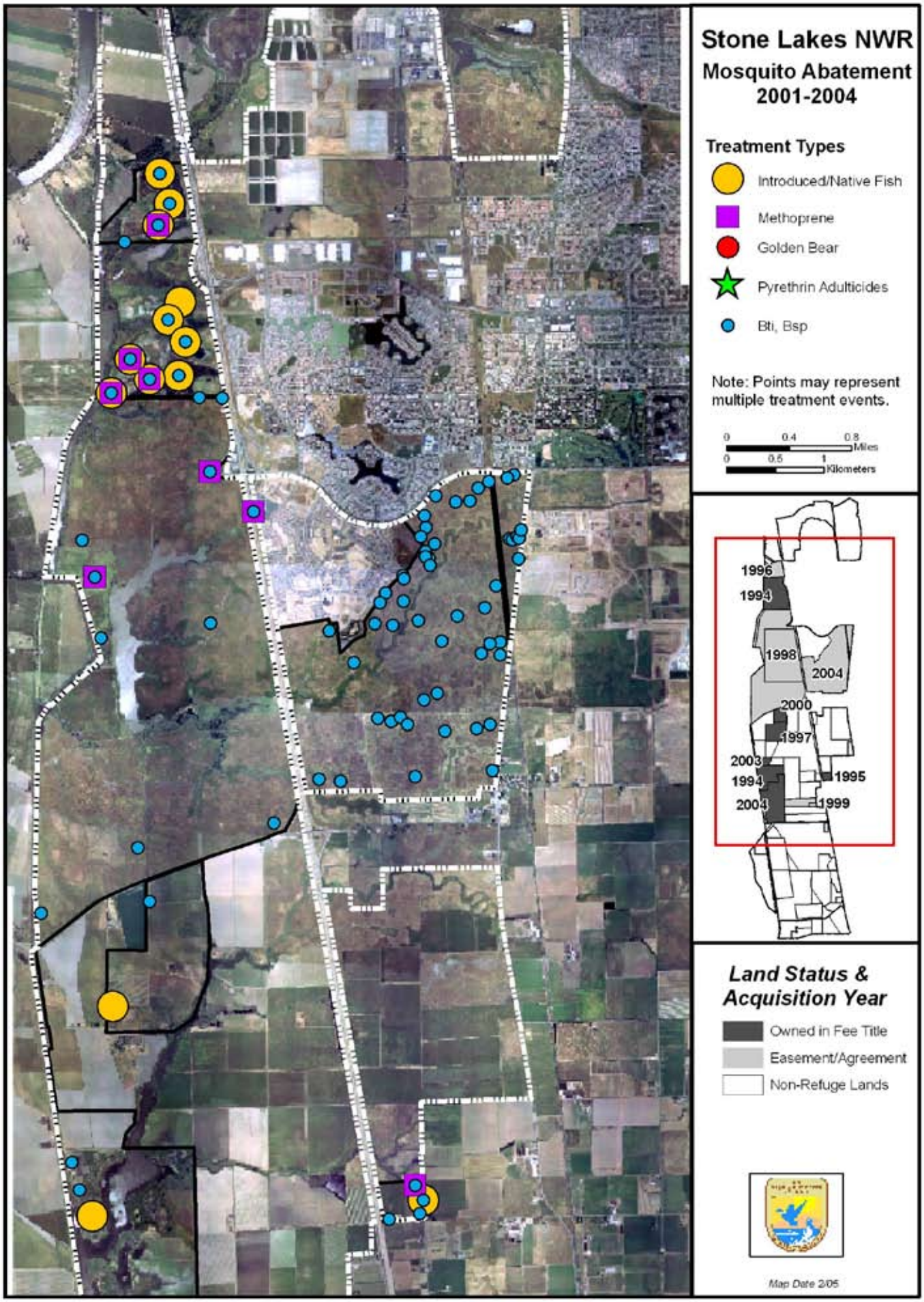
Adulticides

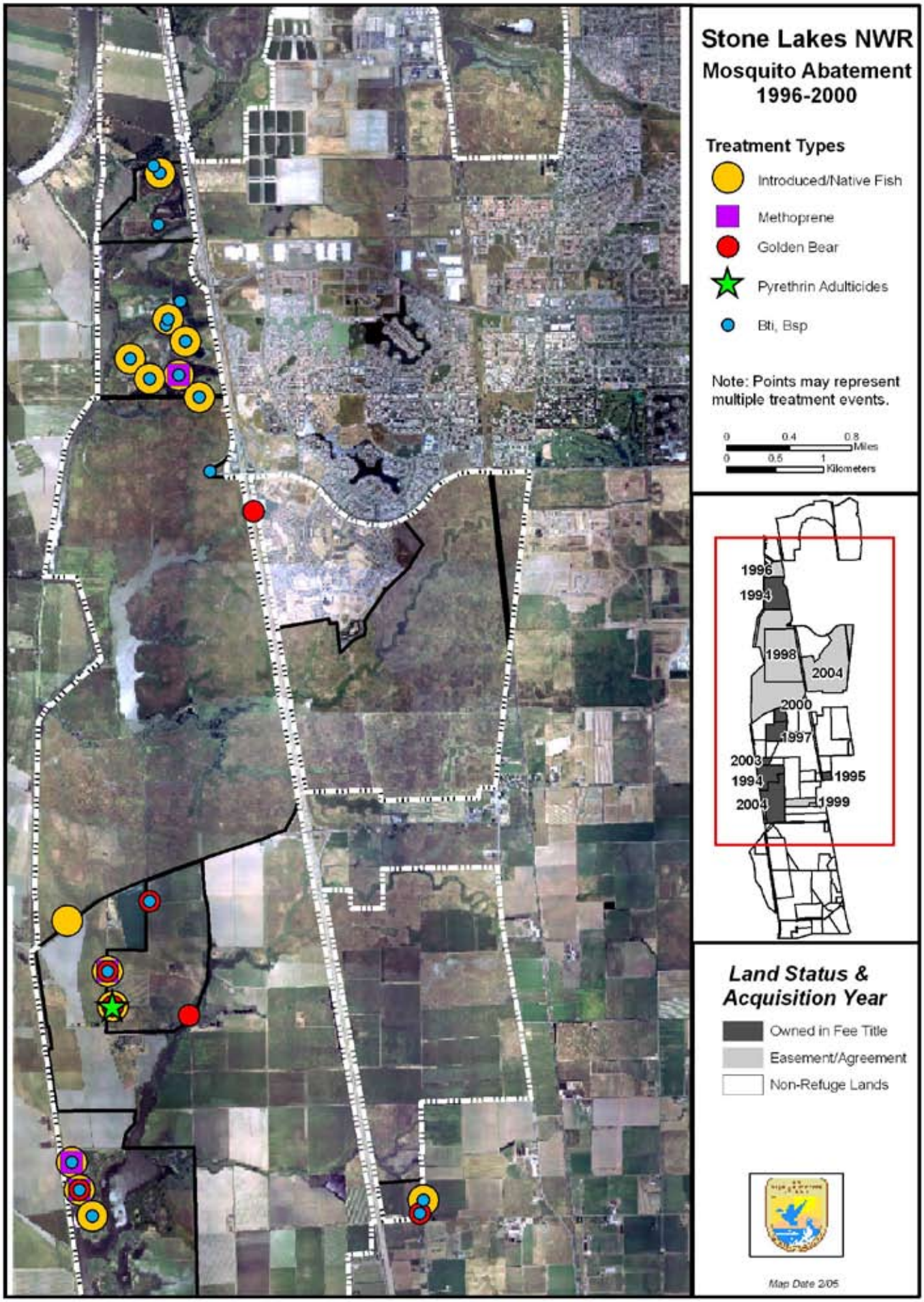
If efforts to control immature mosquitos fail to prevent the adult mosquito population from exceeding thresholds, and a documented historical or current health threat exists, the District proposes to treat infested areas with a mosquito adulticide. The District has requested annual approval for use of liquid formulations of synthetic pyrethrins, such as Pyrenone 25-5 or Pyrocide 7338. The District also requests and has received approval for use of the adulticide Trumpet (Naled) but it has not been used on the Refuge to date. Use of all adulticides is limited to June 1 through September 30, with a possible extension if unusually hot weather occurs together with a documented public health threat. Based on the December 2005 Service Delegation of Approval Authority for the CNO area, refuge managers have authority to approve use of pyrethrins for controlling mosquitos near facilities used by staff and visitors and in terrestrial sites (not aquatic sites or wetlands). Approval of use of pyrethrins in aquatic or wetland settings or Trumpet necessitates submittal of Pesticide Use Proposals to the CNO and Washington offices.

Pyrethrins are non-systemic contact poisons which quickly penetrate the nerve system of the insect and cause paralysis and subsequent death (ETN 1994, Tomlin 1994). A few minutes after application, the insect cannot move or fly away. But, a "knockdown dose" does not mean a killing dose. Pyrethrins are swiftly detoxified by enzymes in the insect. Thus, some pests will recover. To delay the enzyme action so a lethal dose is assured, commercial products are formulated with synergists such as piperonyl butoxide, which inhibit detoxification (Tomlin, 1994). Trumpet (Naled) is a non-systemic, broad-spectrum organophosphate insecticide which affects the nervous system of adult mosquitos and other insects by cholinesterase inhibition. When treatments occur, Pyrethrins and Trumpet, would be applied as an ultra-low volume (ULV) mist by ground. To minimize pesticide drift, dispersing vehicles follow routes on existing roads set up to fog downwind or outside buffers of 300 feet from areas supporting listed or proposed special status species. All chemical applications occur when wind speeds are between 2 and 8 mph.

Between 1994 when then Refuge was established and 2004, adult mosquito applications only occurred once in 1998 to five acres (0.09 gallons of Scourge) and once in 1999 to four acres (0.05 gallons of Pyrocide 7338). Both treatments were ULV ground applications at the same location, a drainage channel on the Headquarters Unit. That adulticides were utilized so infrequently, attests to the level of cooperation between District and Refuge who initiated water management and larval control measures to discourage mosquito production and adult emergence.

In 2005, West Nile Virus (WNV) became established in Sacramento and Yolo counties, triggering more aggressive and widespread mosquito control efforts. In August of 2005 the number of human WNV cases and rate of infected adult mosquitos were so high that SYMVCD initiated aerial applications of pyrethrin over significant portions of Sacramento County. The Refuge received ultra-low volume (ULV) ground applications of pyrethrin on 16 occasions between July 28 and October 12, 2005. As of August 18, 2006, 16 human cases of WNV have been documented in Sacramento and Yolo counties (Table 1) and the Refuge has been adulticided 12 times beginning on June 27.


Stone Lakes NWR
Mosquito Abatement
2001-2004
Treatment Types
Introduced/Native Fish
Methoprene
Golden Bear
Pyrethrin Adulticides
Bti, Bsp
Note: Points may represent multiple treatment events.
0 0.4 0.8 Miles
0 0.5 1 Kilometers
1996
1994
1998
2004
2000
1997
2003
1994
2004
1995
1999
Land Status & Acquisition Year
Owned in Fee Title
Easement/Agreement
Non-Refuge Lands
Map Date 2/05


Stone Lakes NWR
Mosquito Abatement
1996-2000
Treatment Types
Introduced/Native Fish
Methoprene
Golden Bear
Pyrethrin Adulticides
Bti, Bsp
Note: Points may represent multiple treatment events.
0 0.4 0.8 Miles
0 0.5 1 Kilometers
1996
1994
1998
2004
2000
1997
2003
1994
1995
2004
1999
Land Status & Acquisition Year
Owned in Fee Title
Easement/Agreement
Non-Refuge Lands
Map Date 2/05

VI. Toxicity and Effects to Non-Target Organisms

The dominant impact of mosquito control will relate to the toxicity and effects of the treatments on non-target organisms. The possible effects of the larvicides *Bacillus* spp. and methoprene, the pupacide Agnique, and the adulticides will be discussed separately.

Larvicides

Bacillus thuringiensis isrealensis (Bti)

Bti has practically no acute or chronic toxicity to mammals, birds, fish, or vascular plants (U.S. EPA 1998). Extensive acute toxicity studies indicated that Bti is virtually innocuous to mammals (Siegel and Shadduck 1992). These studies exposed a variety of mammalian species to Bti at moderate to high doses and no pathological symptoms, disease, or mortality were observed. Laboratory acute toxicity studies indicated that the active ingredient of Bti formulated products is not acutely toxic to fish, amphibians or crustacaceans (Brown et al. 2002, Brown et al. 2000, Garcia et al. 1980, Lee and Scott 1989, and Wipfli et al. 1994). However, other ingredients in formulated Bti products are potentially toxic. The acute toxicity response of fish exposed to the formulated Bti product Teknar® HPD was attributed to xylene (Fortin et al. 1986, Wipfli et al. 1994). Field studies indicated no acute toxicity to several fish species exposed to Bti (Merritt et al. 1989, Jackson et al. 2002); no detectable adverse effects to breeding red-winged blackbirds using and nesting in Bti treated areas (Niemi et al. 1999, Hanowski 1997); and no detectable adverse effects to tadpole shrimp 48 hours post Bti treatment (Dritz et al. 2001).

In addition to mosquitos (Family Culicidae), Bti affects some other members of the suborder Nematocera within the order Diptera. Also affected are members of the Family Simuliidae (black flies) and some chironomids midge larvae (Boisvert and Boisvert 2000, Garcia et al. 1980). The most commonly observed Bti effects to non-target organisms were to larvae of some chironomids in laboratory settings when exposed to relatively high doses (Boisvert and Boisvert 2000, Lacey and Mulla 1990, Miura et al. 1980). In field studies, effects to target and susceptible nontarget invertebrates have been variable and difficult to interpret. Field study results are apparently dependent on the number, frequency, rate and aerial extent of Bti applications; the Bti formulation used; the sample type (e.g., benthic, water column or drift); the sampling interval (e.g., from 48 hrs to one or more years after treatment); the habitat type (e.g., lentic or lotic); the biotic (e.g., aquatic communities), and abiotic factors (e.g., suspended organic matter or other suspended substrates, temperature, water depth); the mode of feeding (e.g., filter feeder, predator, scraper or gatherer); the larval development stage and larval density (Ali 1981, Boisvert and Boisvert 2000, Lacey and Mulla, 1990). Bti activity against target and susceptible nontarget invertebrates is also related to Bti persistence and environmental fate which are in turn affected by the factors associated with field study results (Dupont and Boisvert 1986, Mulla 1992). Simulated field studies resulted in the suppression of two unicellular algae species, *Closterium* sp. and *Chlorella* sp. resulting in secondary effects to turbidity and dissolved oxygen of aquatic habitats, with potential trophic effects (Su and Mulla 1999). For these reasons, Bti effects to target and susceptible nontarget organisms, and potential indirect trophic impacts in the field are difficult to predict.

Bacillus sphaericus (Bsp)

Bsp has slight to practically no acute mammalian toxicity, practically no acute avian toxicity, slight to practically no acute fish toxicity, and slight aquatic invertebrate toxicity (USFWS 1984, and FCCMC 1998). Insecticidal activity may persist longer than 20 days because Bsp can reproduce and sporulate in larval cadavers (Becker et al, 1995) and can retain its larvicidal properties after passing through the gut of a mosquito. Bsp is insoluble in water. Spores and toxin become suspended in the water column and retain insecticidal

activity in water with high organic matter content and suspended solids. Because Bsp is a more recently developed larvicide than Bti, there are fewer studies that have examined the non-target effects of this pesticide. The data available, however, indicate a high degree of specificity of Bsp for mosquitos, with no demonstrated toxicity to chironomid larvae at any mosquito control application rate (Mulla, 1984, Ali, 1986, Lacey, 1990, and Rodcharoen, 1991). Therefore risks to sensitive wildlife resources resulting from direct exposure to a single Bsp application and indirect food chain effects are expected to be negligible. However, the ability for a population to re-colonize a wetland following multiple larvicide treatments would depend on the intensity and frequency of applications at different spatial scales.

Agnique (Monomolecular film)

Monomolecular film has practically no acute mammalian or avian toxicity, and slight acute fish toxicity (USEPA 2000, USFWS 1984). The risk quotient for mammals is well below the EPA endangered species level of concern (LOC) indicating negligible risk resulting from direct exposure, Table 2 (Urban and Cook 1986). Risk quotients for birds and fish exceed EPA endangered species LOCs indicating a hazard to those taxa resulting from direct exposure. Risk to fish is limited by the insolubility of monomolecular film in water. Monomolecular film is insoluble in water, average persistence in the environment is 5 to 14 days. Indirect effects to animals dependent on invertebrate food resources are possible resulting from a reduction of those resources caused by monomolecular film. The magnitude of the impact would depend on the aerial extent of the treatment, the number of treatments, treatment frequency, and the location of the treatment relative to the areas used by invertebrate feeding animals.

Table 2. Monomolecular film risk quotients.

Animal	Acute toxicity (ppm)	EEC (ppm)	RQ	LOC (ES)
bird	> 5000 (8 D LC 50)	850 (short grass)	0.2	0.1
fish	98 (96 hr LC 50)	2600 (6" water)	26.5	0.05
mammal	>20,000 (LD 50)	850 (short grass)	0.004	0.1

EEC calculated using a rate of 0.5 gal/ac (3.6 lbs ai/ac)
LD 50 for mammals converted to 1 Day LC50 using a conversion factor of 0.1 for RQ calculation

Methoprene

Methoprene has moderate acute fish toxicity, slight acute avian toxicity, and practically no acute mammalian toxicity (USEPA 2000, and USFWS 1984). In mallard ducks, dietary concentrations of 30 parts per million (ppm) caused some reproductive impairment (USEPA 1991). This figure exceeds the estimated environmental concentration by a factor 10 (Table 1). Methoprene residues have been observed to bioconcentrate in fish and crayfish by factors of 457 and 75, respectively (USEPA 1991). Up to 95 percent of the residue in fish was excreted within 14 days (USEPA 1991). Risk quotients for birds, fish and mammals are below EPA levels of concern for endangered species indicating negligible risk to those taxa resulting from direct exposure using maximum labeled rates for mosquito control (Table 3) (Urban et al. 1986). In field studies no detectable adverse effects to breeding red-winged blackbirds using and nesting in areas treated with methoprene were observed (Niemi et al. 1999).

Methoprene affects terrestrial and aquatic invertebrates and is used to control fleas, sciarid flies in mushroom houses; cigarette beetles and tobacco moths in stored tobacco; Pharaoh's ants; leaf miners in glasshouses; and midges (Tomlin 1994). Methoprene may also be fed to livestock in a premix food supplement for control of hornfly (WHO undated). Methoprene is

Table 3. Risk assessment for Methoprene.

Animal	Acute Tox (ppm)	EEC (ppm)	RQ	LOC (ES)
Bird	> 4640 (8 D LC 50)	3.0 (short grass)	0.0006	0.1
Fish	0.4 (96 hr LC 50)	0.01 (6 inches)	0.025	0.05
Mammal	> 34,000 (LD 50)	3.0 (short grass)	0.00001	0.1

EEC calculated using a rate of 0.013 lbs ai/ac (1.0 fluid oz/ac Altosid 20 % methoprene)
LD 50 for mammals converted to 1 Day LC50 using a conversion factor of 0.1 for RQ calculation

highly toxic to aquatic invertebrates with a 48 hour EC50 (the concentration of a compound where 50 percent of its effect is observed) of 0.89 ppm for *Daphnia magna* (USEPA 1991). Laboratory studies show that methoprene is acutely toxic to chironomids, cladocerans, and some decapods (Horst and Walker 1999, Celestial and McKenney 1994, McKenney and Celestial 1996, Chu et al. 1997). In field studies, significant declines of aquatic invertebrate, mollusk and crustacean populations have been directly correlated to methoprene treatments for mosquito control (Breaud et al. 1977, Miura and Takahashi 1973, Niemi et al. 1999, and Hershey et al. 1998).

Methoprene has a ten day half life in soil, a photolysis half life of ten hours, and solubility in water is 2 ppm (Zoecon 2000). Degradation in aqueous systems is caused by microbial activity and photolysis (USEPA 1991). Degradation rates are roughly equal in freshwater and saltwater systems and are positively correlated to temperature (USEPA 1991).

Adulticides

There are only two general classes of mosquito adulticides, organophosphates and pyrethroids. The pyrethroids include both natural products called pyrethrins and synthetic molecules that mimic the natural pyrethrins, such as permethrin, resmethrin, and sumithrin. One organophosphate, Trumpet (Naled), is approved for use at the Refuge in the past but not applied to date. The two pyrethroid products approved for use at the Refuge, Pyrenone 25-5 and Pyrocide 7336 are both synthetic pyrethrins.

In general, pyrethroids have lower toxicity to terrestrial vertebrates than organophosphates. Although not toxic to birds and mammals, pyrethroids are very toxic to fish and aquatic invertebrates (Anderson 1989, Siegfried 1993, Milam et al. 2000). The actual toxicity of pyrethroids in aquatic habitats, however, is less than may be anticipated because of the propensity of these pesticides to adsorb organic particles in water (Hill et al. 1994). Pyrethrins are toxic to all invertebrates, but the method of application via ultra-low volume atomizer limits toxicity and contact with non-targets. To minimize pesticide drift, applications would take place during the evening hours, when wind speeds are reduced and temperatures decreased; this is also the period when mosquito activity is the greatest. Naled is a fast acting, nonsystemic contact and stomach organophosphate insecticide used to control aphids, mites, flies, and mosquitos. Naled is highly to moderately toxic via the oral route. It is moderately toxic through skin exposure, may cause skin rashes and skin sensitization and may be corrosive to the skin and eyes. Naled is highly to moderately toxic to birds. The reported acute oral LD50 (lethal dose 50, the dose of a substance which is fatal to 50% of the test animals) for naled is 52 mg/kg in mallard ducks, 65 mg/kg in sharp-tailed grouse, 36-50 mg/kg in Canadian geese, 120 mg/kg in ring-neck pheasants. Naled is highly to moderately toxic to fish and may be very highly toxic to aquatic invertebrate species (ETN 1996). However, Trumpet (Naled) is practically nonpersistent in the environment, with reported field half-lives of less than 1 day. It is not strongly bound to soils and is rapidly broken down if wet. Soil microorganisms break down most of the naled in the soil. It therefore should not present a hazard to groundwater (ETN 1996).

Threatened and Endangered Species

The Refuge provides potential habitat for the following federally-listed species: giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole, and vernal pool fairy shrimp. Potential impacts to these species from mosquito control activities were addressed in a number of previous Intra-Service Section 7 Consultations conducted with the Sacramento Fish and Wildlife Office (SFWO):

March 27, 1995: The SFWO concurred with the determination that use of the bacterium *Bacillus thuringiensis israelensis* (Bti) and Altocid® (methoprene) for mosquito control at Stone Lakes NWR is not likely to adversely affect the vernal pool fairy shrimp, vernal pool tadpole shrimp, giant garter snake, valley elderberry longhorn beetle, Sacramento splittail, and delta smelt (SFWO file: 1-1-95-I-0680).

January 9, 1997: The SFWO concurred with the determination that the use of the bacterium *Bacillus sphaericus* for mosquito control, is not likely to adversely affect the vernal pool fairy shrimp, vernal pool tadpole shrimp, giant garter snake, valley elderberry longhorn beetle, delta smelt, or Sacramento splittail at the Stone Lakes NWR (SFWO file: 1-1-96-I-0639).

January 31, 2001: The SFWO concurred that pest management activities at the Refuge are not likely to jeopardize the giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole shrimp, or vernal pool fairy shrimp. (SFWO file:1-1-00-F-0162).

Giant Garter Snake (Thamnophis gigas)

Mosquito control activities in giant garter snake habitat may affect giant garter snakes by harassment or injury from vehicle use. The District will only operate vehicles in existing roads; therefore, harassment or injury from vehicle use would occur only if snakes are in the roadway. Regarding the effects of the proposed pesticides, a Fish and Wildlife Service-sponsored study indicated that the short-term effects of adulticides approved for mosquito control on the Sacramento NWRC did not significantly reduce abundance or biomass of the snake's prey items, macro-invertebrates and fish, in treated wetlands (Lawler et al. 1997). However, no information is available on the toxicity of the proposed pesticides directly to the giant garter snake. Without further information, it must be assumed that exposure of giant garter snakes to these chemicals could result in direct impacts, such as loss or sublethal effects to individual animals. Adverse effects to the giant garter snake from mosquito control activities will therefore be minimized by avoiding any wetland habitat suitable for giant garter while applying chemical treatments for control of mosquitos. The application of adulticides by dispersal vehicles will be planned to fog downwind of and outside a buffer of 300 feet away from permanent emergent wetlands.

Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus)

Adverse effects on the valley elderberry longhorn beetle are not likely since the main mosquito abatement period (June-September) does not coincide with the period of adult beetle emergence (late April through mid-May or early June). Also, the riparian corridors that house the valley elderberry longhorn beetle, generally do not require treatment with chemical control agents. If control measures are needed in these areas, some granular applications of Bti or Altocid (Methoprene) may be used during February or March when adult beetles are not present.

Vernal Pools

The growth regulator Methoprene (Altosid or A.L.L) can have deleterious effects on vernal pool shrimp by delaying the development of adult shrimp and thus the number of eggs laid before the pools dry up. Because of the effects of Methoprene on fairy shrimp and a lack of information on how long the agent remains in the soil, use of the larvicide methoprene within

vernal pools or swales at any time, in either wet or dry conditions, is prohibited (USFWS 2001).

The majority of vernal pools and seasonal swales will be dry during the main pesticide application period (June-October). In general, naturally functioning vernal pool habitats are not significant mosquito-producing habitat and should not require chemical treatments for control of mosquito larvae. A study of vernal pools in Sacramento County suggested that when mosquito larvae were present in the pools, productivity was limited to a narrow time period just prior to drying in late spring. Therefore, vernal pools do not contribute at all to mosquito productivity in winter and early spring. In the event that the use of a larvicide does become necessary in the vicinity of vernal pools, Bti, which is relatively specific to mosquitos and flies, will be the agent of choice.

The majority of the vernal pools at the Refuge occur on the Wetland Preserve property which became part of the Refuge under a conservation easement in 2004. During the spring of 2004, before the conservation easement went into effect, numerous vernal pools were treated with Bti. Relatively warm spring temperatures in 2004 likely contributed to elevated larval populations, but other factors may also be involved. The mosquito abatement district had increased larval monitoring in the area because the Wetland Preserve property is adjacent to a new housing development and WNV had recently arrived in Sacramento County. Many of the vernal pools in the Wetland Preserve property are man-made mitigation pools that may not be functioning as naturally occurring vernal pools would. A study of naturally occurring and constructed vernal pools conducted by the District showed that while natural vernal pools produced very few mosquitos throughout most of the wet season and then produced a spike in numbers in late April, the constructed vernal pools produced significantly more mosquitos throughout the wet season as well as a spike in numbers in April (Wright 1997). In addition, the data suggested that natural vernal pools may pose a greater threat of mosquito productivity when associated with constructed pools. For these reasons, the mosquito abatement district policy is to dip-sample constructed vernal pools and adjacent natural vernal pools. Mosquito abatement treatments near vernal pools will be limited to Bti to reduce effects on endangered vernal pool species. Future mosquito abatement activities in the Wetland Preserve property will be closely monitored by Refuge staff to avoid conflicts between wildlife habitat improvement goals and mosquito control goals.

Wetlands and Waterfowl

The Refuge was established to provide habitat for migratory birds, in particular waterfowl. The District will continue to minimize disturbance and non-target effects to wildlife by limiting mosquito abatement activities between October 15 and February 15 when the majority of migratory bird species arrive on the Refuge. However, since the District continues to treat in fall until temperatures have dropped sufficiently to reduce the abundance of mosquitos, in warmer years there may well be a longer period of overlap between the arrival of migratory birds and continued mosquito abatement activities. In addition, if mosquito thresholds are exceeded, or the presence of WNV or other arboviruses are detected in or around the Refuge, then the District may need to extend mosquito surveillance and control into late fall.

In some years, most notably 2004, the District has applied Bti or planted mosquito fish as early as March when some migratory waterfowl may still be lingering before departing on their spring migration. However, Bti has not been found to be toxic to birds (USFWS 2001). In addition, it has been found that birds are not negatively affected by utilizing foods exposed to Bti or methoprene (Niemi et al. 1999). Although physico-chemico data and environmental fate data are limiting, *Bacillus* spp. are virtually non-toxic to mammals, birds and fish. Though methoprene has not been shown to pose a threat to birds from direct

exposure, it may affect insectivorous species by decreasing the invertebrate food source. However, during the last 8 years methoprene has not been applied prior to June, and was applied as late as October in only one instance. Thus, applications of methoprene have not directly or indirectly affected migratory birds utilizing the Refuge because migratory birds have not been present during mosquito abatement activities.

There is not likely to be much impact on geese and swans from pesticides because they are year round herbivores. Geese feed mainly on grasses and agricultural lands, while swans feed mainly on roots, tubers, stems, and leaves of submerged and emergent aquatic vegetation. In contrast, ducks are known to be opportunistic feeders on both plants and invertebrates, utilizing the most readily available food sources. Invertebrates, plants, and seeds compose the majority of their diet, varying with the season and the geographic location. A study in California's Sacramento Valley has shown that plant foods are dominant in fall diets of northern pintails, while invertebrate use increases in February and March (Miller 1987). Seeds of swamp timothy comprise the most important duck food in the summer-dry habitats of the San Joaquin Valley (Miller 1987). Waterfowl in general tend to feed on seeds when they reach their wintering areas, perhaps to regain energy lost during long flights (Heitmeyer 1988, Miller 1987). Thus any food chain impacts resulting from larvicide and adulticide treatments will have limited impacts to the mainly seed diet of newly arriving ducks. Their diet shifts to invertebrates after mosquito treatments are expected to be reduced in frequency, thereby allowing the invertebrate populations to recover.

Birds utilizing the Refuge during the summer months and early fall, when most of the mosquito abatement occurs, could have a greater risk of being affected by pesticide applications. These species include herons, egrets, white pelicans, mallards and wood ducks. The pesticides being applied at the Refuge have not been shown to be toxic to birds, but could potentially affect resident waterfowl indirectly by reducing invertebrate food sources. Shorebirds could also be of concern, since they feed on a wide variety of invertebrates all year, feeding which intensifies at the onset of spring migration. However, documentation of indirect food-chain effects have not come to light. Hanowski et al. (1997) studied 19 different bird species after collecting data on wetlands 2 years before treatment and 3 years after treatment of both Bti and methoprene applications and found no negative effects. Jensen et al. (1999) found that no decreases were detected in the biomass or abundance of aquatic invertebrates in seasonal wetlands from ultra-low volume applications of pyrethrin, permethrin, or malathion.

VII. Health Threat Determination

For the purpose of allowing the use of certain pesticides or bio-rational pesticides to control mosquitos, a mosquito-borne public health emergency is defined as:

Actual or threatened, imminent outbreak of western equine encephalitis, St. Louis encephalitis, West Nile encephalitis, malaria, or other mosquito vector-borne public health disease. The presence of WEE, SLE, WNV or malaria viral titers or mosquito pool titers in the mosquito population or in sentinel chickens (in accordance with test protocols developed by the CDHS Environmental Management Branch, and the U.S. Department of Health and Human Services, Center for Disease Control) will confirm that a public health emergency exists or is imminent. This threshold will have been met when the mosquito abatement district notifies the Refuge manager of a laboratory test that is positive for any of the above viruses.

The recurring presence of arboviruses in the Central Valley since the 1940s has been well documented (Reeves 1987) such that the baseline health threat level at the Refuge is 2-3, depending on monitoring. Occurrences of WNV within Sacramento County in humans, domestic animals and wildlife are expected to increase in 2005 relative to 2004 (see Disease

History above) based on observed arboviral disease cycles. The health threat level for the Refuge is therefore 4-5 (see Table 4) for 2005 and may be elevated to 6-7 if an officially determined health emergency is declared due to WNV. Historically, the mosquito abatement response has been the same at threat levels 2-3 as in threat levels 4-5, that is, adulticides and pupacides have been approved for use by the Service based on the historical health threat rather than being reserved for use only when an existing health threat has been documented. As a result, mosquito larval control activities since 1994 have been largely limited to localized (less than five acres) applications of larvicides and until 2005, only three applications of adulticides.

Table 4. Example of Mosquito-Borne Disease Health Threat and Response Matrix

Current Conditions			Refuge Response
Health Threat Category[1]	**Refuge Mosquito Populations [2]**		
No documented existing or historical health threat/ emergency	No action threshold	1	Remove/manage artificial mosquito breeding sites such as tires, tanks, or similar debris/containers.
Documented historical health threat/emergency	Below action threshold	2	Response as in threat level 1, plus: allow compatible monitoring and disease surveillance. Consider compatible nonpesticide management options to reduce mosquito production.
	Above action threshold	3	Response as in threat level 2, plus: allow site-specific compatible larviciding of infested areas as determined by monitoring.
Documented existing health threat (specify multiple levels, if necessary; e.g., disease found in wildlife, disease found in mosquitos, etc.)	Below action threshold	4	Response as in threat level 2, plus: increase monitoring and disease surveillance.
	Above action threshold	5	Response as in threat levels 3 and 4, plus: allow compatible site-specific larviciding, pupaciding, or adulticiding of infested areas as determined by monitoring.
Officially determined existing health emergency	Below action threshold	6	Maximize monitoring and disease surveillance.
	Above action threshold	7	Response as in threat level 6, plus: allow site-specific larviciding, pupaciding, and adulticiding of infested areas as determined by monitoring.

1 Health threat/emergency as determined by Federal and/or State/local public health authorities with jurisdiction inclusive of Refuge boundaries and/or neighboring public health authorities.

2 Action thresholds represent mosquito population levels that may require intervention measures. Thresholds will be developed in collaboration with Federal and/or State/local public health authorities and vector control districts. They must be species and life stage specific.

VIII. Stipulations and Reporting

1. Every attempt will be made to minimize mosquito production through wetland design, habitat (water level and vegetation) management techniques, mosquito fish or other non-chemical treatments, before larvicides or adulticides are applied. Among chemical treatments, adulticides will be considered a last resort.

2. In keeping with the MOU, the Refuge will provide the District with an annual summary of planned Refuge water management and with notification of timings of flood ups and irrigations.

3. As required under the MOU, the District will provide the Refuge Manager with an annual operating plan for anticipated mosquito monitoring and control activities that may be needed on the Refuge during the upcoming year. The plan will provide for Refuge access requirements, control thresholds, and proposed larvicides and adulticides.

4. Mosquito control will be authorized on an annual basis by a Special Use Permit (SUP) issued by the Refuge. SUP conditions will reflect any applicable restrictions required under approved Pesticide Use Proposals or Section 7 Consultations.

5. The Refuge will submit to the CNO Office all required Pesticide Use Proposals to maximize likelihood of PUP approval prior to onset of upcoming mosquito season.

6. The District will notify the Refuge manager as soon as possible when mosquito larval thresholds are exceeded and ground treatments are warranted.

7. When adult thresholds are exceeded, and in the event of a planned adulticiding, the District will contact and personally coordinate with the Refuge Manager or Assistant Refuge Manager prior to conducting the treatments to ensure control efforts do not conflict with routine Refuge operations.

8. The District will continue to consider environmental conditions, including water temperature, density of mosquito larvae, and presence of mosquito predators, when determining mosquitos on the Refuge pose a threat to public safety and whether treatments are required.

9. To minimize pesticide drift, dispersing vehicles will follow routes on existing roads set up to fog downwind or outside buffers of 300 feet from areas supporting listed or proposed special status species, including vernal pools.

10. All chemical applications will occur when wind speeds are between 2 and 8 mph.

11. Any applications of mosquito adulticides will occur outside a buffer of 300 from any permanent emergent wetlands.

12. Application of mosquito control measures is to be conducted in accordance with approved Pesticide Use Proposals.

13. Mosquito control will be authorized on an annual basis by a Special Use Permit (SUP) issued by the Refuge. SUP conditions will reflect any applicable restrictions required under approved Pesticide Use Proposals or Section 7 Consultations.

14. At the end of the season and as required under the MOU, the District will provide the Refuge Manager with an annual report summarizing mosquito control activities during the previous year.

References

Ali, A. 1981. *Bacillus thuringiensis* serovar *israelensis* against chironomids and some non-target aquatic invertebrates. Journal of Invertebrate Pathology 38: 264-272.

Anderson, R.L. 1989. Toxicity of synthetic pyrethroids to freshwater invertebrates. Environmental Toxicology and Chemistry 8: 403-410.

Batzer D. P., V. H. Resh. 1992. Macroinvertebrates of a California seasonal wetland and responses to experimental habitat manipulation. Wetlands. 12:1–7.

Boisvert, M., and J. Boisvert. 2000. Effects of *Bacillus thuringiensis* var. *israelensis* on target and nontarget organisms: a review of laboratory and field experiments. Biocontrol Science and Technology 10: 517-561.

Boyce, K. W. 2005. Mosquito and Mosquito-Borne Disease Management Plan. Sacramento-Yolo Mosquito and Vector Control District. 17 pp.

Breaud, T.P., J.E. Farlow, C.D. Steelman, and P.E. Schilling. 1977. Effects of the insect growth regulator methoprene on natural populations of aquatic organisms in Louisiana intermediate marsh habitats. Mosquito News. 37(4); 704-712.

Brown, M.D., T.M. Watson, S. Green, J.G. Greenwood, D. Purdie, and B.H. Kay. 2000. Toxicity of insecticides for control of freshwater *Culex annulirostris* (Diptera: Culicidae) to the nontarget shrimp, *Caradina indistincta* (Decapoda: Atyidae). Journal of Economic Entomology. 93(3): 667-672.

Brown, M.D., J. Carter, D. Purdie, D. Thomas, D.M. Purdie, and B.H. Kay. 2002. Pulse-exposure effects of selected insecticides to juvenile Australian Crimson-Spotted Rainbowfish (*Melanotaenia duboulayi*). Journal of Economic Entomology 95(2):294-298.

California West Nile Virus Website (www.westnile.ca.gov). 2006. California Department of Health Services, California Department of Food and Agriculture, Mosquito and Vector Control Association of California.

California Department of Health Services (CDHS). 2003. California mosquito-borne virus surveillance and response plan.

California Department of Health Services. 2004. California Mosquito-Borne Virus Surveillance and Response Plan. 51pp.

Celestial, D.M and C.L. McKenney, Jr. 1994. The influence of an insect growth regulator on the larval development of the mud crab *Rhithropanopeus harrisii*. Environmental Pollution. 85: 169-173.

Chu, K.H., Wong, C.K., and Chiu, K.C. 1997. Effects of the insect growth regulator (S)-methoprene on survival and reproduction of the freshwater cladoceran *Moina macrocopa*. Environmental Pollution. 96: 173-178.

Dale, P.E.R. and K. Hulsman. 1990. A critical review of salt marsh management methods for mosquito control, Crit. Rev. in Aquatic Science 3:281–311.

Dritz, D.A., S.P. Lawler, J. Albertson, W. Hamersky, and J.R. Rusmisel. 2001. The impact of Bti on survival of the endangered tadpole shrimp *Lepidurus packardi*. *In* Proceeding and Papers of the Sixty-ninth Annual Conference of the Mosquito and Vector Control Association of California. Jan. 21-24. pp. 88-91.

Dupont, C. and J. Boisvert. 1986. Persistence of *Bacillus thuringiensis* serovar. *israelensis* toxic activity in the environment and interaction with natural substrates. Water, Air, and Soil Pollution 29:425-438.

Extension Toxicology Network (ETN). 1994. Pyrethrin Pesticide information profile. http://ace.ace.orst.edu/info/extoxnet/pips/ghindex.html

Extension Toxicology Network (ETN). 1996a. Methoprene Pesticide information profile. http://ace.ace.orst.edu/info/extoxnet/pips/methopre.htm

Extension Toxicology Network (ETN). 1996b. Naled Pesticide information profile. http://ace.ace.orst.edu/info/extoxnet/pips/naled.htm

Florida Coordinating Council on Mosquito Control (FCCMC). 1998. Florida mosquito control: The state of the mission as defined by mosquito controllers, regulators, and environmental managers. University of Florida.

Fortin, C, D. Lapointe, and G. Charpentier. 1986. Susceptibility of brook trout (*Salvelinus fontinalis*) fry to a liquid formulation of *Bacillus thuringiensis* serovar. *israelensis* (Teknar®) used for blackfly control. Canadian Journal of Fisheries and Aquatic Science 43:1667-1670.

Garcia, R., B. Des Rochers, amd W. Tozer. 1980. Studies on the toxicity of *Bacillus thuringiensis* var. *israelensis* against organisms found in association with mosquito larvae. California Mosquito and Vector Control Association Proceedings and Papers 48:33-36.

Hanowski, J. M., G. J. Niemi, A. R. Lima, and R. R. Regal. 1997. Do mosquito control treatments of wetlands affect red-winged blackbird (*Agelaius phoeniceus*) growth, reproduction, or behavior? Environmental Toxicology and Chemistry 16(5):1014-1019.

Heitmeyer, M. E. 1988. Body composition of female mallards in winter in relation to annual cycle events. Condor 90:669-680.

Hershey, A. E., A. R. Lima, G. J. Niemi, and R R. Regal. 1998. Effects of *Bacillus thuringiensis israelensis* (Bti) and methoprene on non-target macroinvertebrates in Minnesota wetlands. Ecological Applications 8:41-60.

Hill, I. R., J. L. Shaw, and S. J. Maund.Hill, I. R., Heimbach, F., Leeuwangh, P., and Mattiessen, P. [eds.]. 1994. Review of Aquatic Field Tests With Pyrethroid Insecticides. Lewis Publishers. Boca Raton, FL (USA).

Horst, M.N., and A.N. Walker. 1999. Effects of the pesticide methoprene on morphogenesis and shell formation in the blue crap *Callinectues sapidus*. Journal of Crustacean Biology 19: 699-707.

Jackson, J. K., R.J. Horowitz, and B.W. Sweeny. 2002. Effects of *Bacillus thuringiensis israelensis* on black flies and nontarget macroinvertebratess and fish in a large river. Transactions of the American Fisheries Society 131:910-930.

Jensen, T., S. P. Lawler, and D. A. Dritz. 1999. Effects of ultra-low volume pyrethrin, malathion, and permethrin on nontarget invertebrates, sentinel mosquitos, and mosquitofish in seasonally impounded wetlands. Journal of the American Mosquito Control Association 15: 330-338.

Kramer, LD, and HM Fallah. 1999. Genetic variation among isolates of western equine encephalomyelitis virus from California. Am. J. Trop. Med. Hyg. 60: 708-713.

Lacey, L.A., and Mulla, M.S. 1990. Safety of *Bacillus thuringiensis* var. *israelensis* and *Bacillus sphaericus* to non-target organisms in the aquatic environment. *In* Laird, M., L.A. Lacey, E.W. Davidson, eds. Safety of microbial insecticides. CRC Press.

Lawler, S. P., T. Jensen, and D. A. Dritz. 1997. Mosquito management on National Wildlife Refuges: ecosystem effects study, phase II, part 1 - Effects of ultra low volume applications of pyrethrin, malathion, and permethrin on macro-invertebrates in the Sacramento National Wildlife Refuge, California. Final rep. to U.S. Fish Wildl. Serv., Coop. Agreem. No. 14-48-0001-94582. 102 pp.

Lee, B. M. And G. I. Scott. 1989. Acute toxicity of temephos, fenoxycarb, diflubenzuron, and methoprene and *Bacillus thuringiensis* var. *israelensis* to the mummichog (*Fundulus heteroclitus*). Bulletin of Environmental Contamination and Toxicology 43:827-832.

McKenney, C.L., Jr., and D.M. Celestial. 1996. Modified survival, growth, and reproduction in an estuarine mysid (*Mysidoposis bahia*) exposed to a juvenile hormone analogue through a complete life cycle. Aquatic Toxicology 35:11-20.

Merritt, R. W., E. D. Walker, M. A. Wilzbach, K. W. Cummings, and W. T. Morgan. 1989. A broad evaluation of Bti for black fly (Diptera: Simuliidae) control in a Michigan River: Efficacy, carry, and non-target effects on invertebrates and fish. Journal of the American Mosquito Control Association 5:397-415.

Millam, D.C., J.L. Farris, and J.D. Wilhide. 2000. Evaluating mosquito control pesticides for effect on target and nontarget organisms. Mosquito News 40:619-622.

Miller, M. R. 1987. Fall and winter foods of northern pintails in the Sacramento Valley, California. Journal of Wildlife Management. 51:405-414.

Miura, T., and R.M. Takahashi. 1973. Insect development inhibitors. 3. Effects on nontarget aquatic organisms. Journal of Economic Entomology. 66(4):917-922.

Miura, T.; Takahashi, R. M.; and Mulligan, F.S. 1980. Effects of the bacterial mosquito larvicide *Bacillus thuringiensis* stereotype H-14 on selected aquatic organisms. Mosquito News. 40:619-622.

Mulla, M.S. 1992. Activity, Field Efficacy, and Use of *Bacillus thuringiensis israelensis* against Mosquitos. Pp. 134-160 in de Barjac, Hugette and Donald J. Sutherland, eds. Bacterial Control of Mosquitos and Blackflies: Biochemistry, Genetics, and Applications of *Bacillus thuringiensis israelensis* and *Bacillus sphaericus*. Kluwer Academic.

Niemi, G. J., A. E. Hershey, L. Shannon, J. M. Hanowski, A. Lima, R. P. Axler, and R. R. Regal. 1999. Ecological Effects of Mosquito Control on Zooplankton, Insects, and Birds. Environmental Toxicology and Chemistry, 18(3):549-559.

Reeves, W.C. 1990. Overwintering of arboviruses. Reeves, W.C., ed. Epidemiology and Control of Mosquito-Borne Arboviruses in California, 1943-1987. Sacramento, CA: California Mosquito and Vector Control Association, 357-382.

Reisen WK, Boyce K, Yoshimura G, Lemenager D, Emmons R.W. 1995. Enzootic transmission of western equine encephalomyelitis virus in Sacramento Valley of California during 1993 and 1994. J Vector Ecol 20:153-163.

Sacramemento/Yolo Mosquito Vector Control District (SYMVCD). 2004. Vector Information.
http://www.sac-yolomvcd.com/vectorinfo.htm

Siegel, Joel, P. and J. A. Shadduck. 1992. Mammalian safety of *Bacillus thuringiensis israelensis* and *Bacillus sphaericus*. Pp. 202-217 in de Barjac, Huguette and Donald J. Sutherland, eds. Bacterial control of mosquitos and blackflies: biochemistry, genetics, and applications of *Bacillus thuringiensis israelensis* and *Bacillus sphaericus*. Kluwer Academic.

Siegfried, B. D. 1993. Comparative toxicity of pyrethroid insecticides to terrestrial and aquatic insects. Environmental Toxicology and Chemistry 12: 1683-1689.

Su. T., and M.S. Mulla. 1999. Microbial agents *Bacillus thuringiensis* ssp. *israelensis* and *Bacillus sphaericus* suppress eutrophication, enhance water quality, and control mosquitos in microcosms. Environmental Entomology 28:761-767.

Tomlin, C. 1994. The Pesticide Manual. Farnham: British Crop Protection Council/ Cambridge: Royal Society of Chemistry.

Urban, J. D. and N.J. Cook. 1986. Standard evaluation procedure: Ecological risk assessment. U. S. EPA. Office of Pesticide Programs. Hazard evaluation division

U.S. Environmental Protection Agency (USEPA). 1991. Re-registration eligibility document. Isopropyl (2E, 4E)-11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate (Referred to as methoprene). List A. Case 0030. Office of pesticide Programs. Special Review and Registration Division.

U.S. Environmental Protection Agency (USEPA). 1998. Re-registration eligibility document. *Bacillus thuringiensis.* Office of Prevention, Pesticides and Toxic Substances. EPA738-R-98-004.

U.S. Environmental Protection Agency (USEPA). 2000. Ecotoxicity online database. Division of Environmental Fate and Effects. Office of Pesticide Programs.

U.S. Fish and Wildlife Service (USFWS). 1984. Acute toxicity rating scales. Research Information Bulletin No. 84-78.

U.S. Fish and Wildlife Service (USFWS). 2001. Intra-Agency Formal Section 7 Consultation on Pest Management Activities at the Stone Lakes National Wildlife Refuge, Sacramento, California.

U.S. Fish and Wildlife Service. 1992. Final Environmental Impact Statement - Stone Lakes National Wildlife Refuge. Prepared by Jones & Stokes, Associates, Inc. for U.S. Fish and Wildlife Refuge.

Walton, W.E., M.C. Wirth, and B.A. Federici. 1998. The effect of the CytA toxin ratio on the suppression of resistance and cross-resistance to mosquitocidal *Bacillus* toxins. Mosquito Control Research Annual Report. University of California. Division of Agriculture and Natural Resources.

WHO. Undated. Data sheet on pesticides no. 47. Methoprene. World Health Organization. Food and Agriculture Organization. http://www.inchem.org/documents/pds/pds/pest47_e.htm

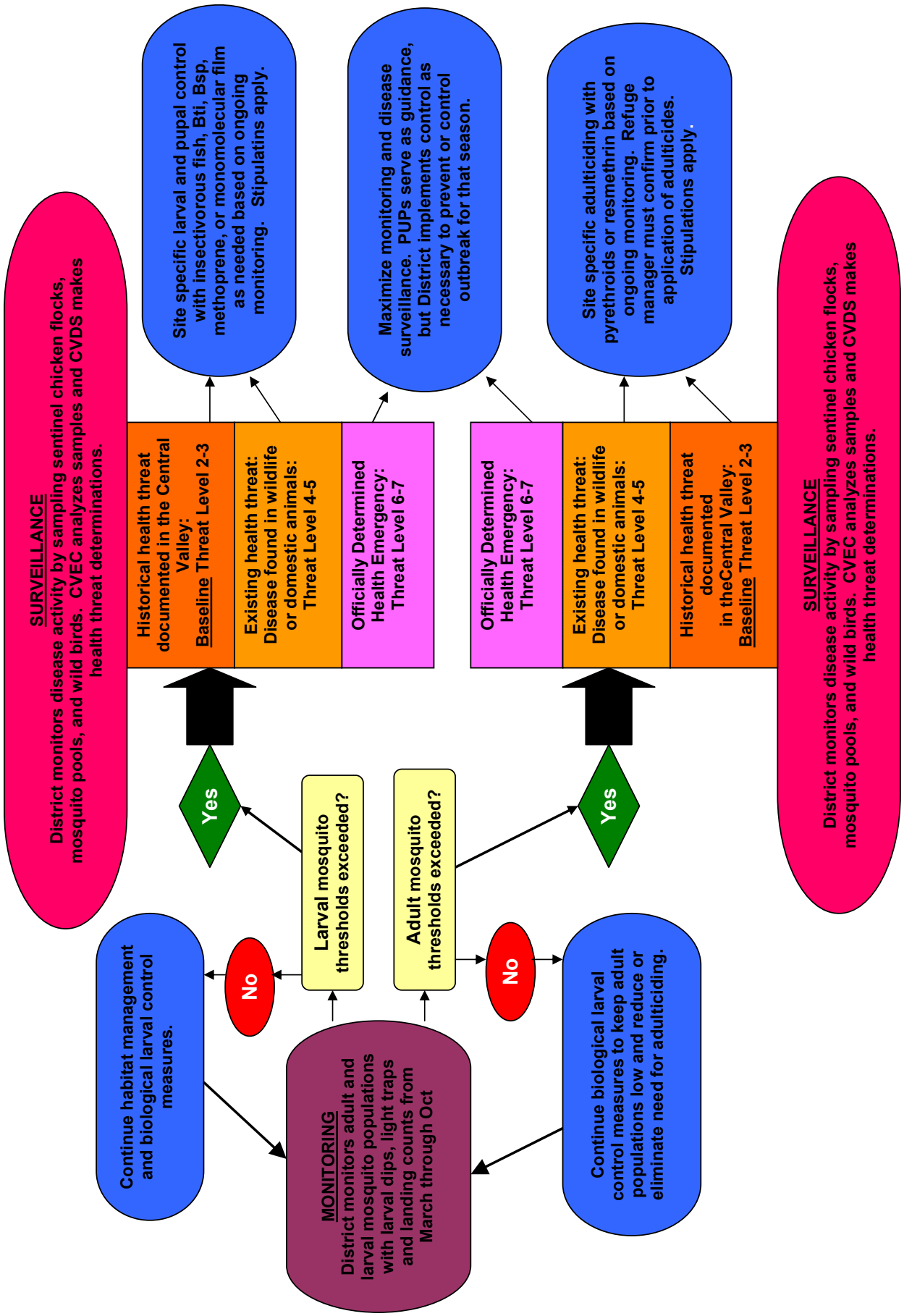
Wipfli, M.S., R.W. Merritt, and W.W. Taylor. 1994. Low toxicity of the blackfly larvicide *Bacillus thuringiensis* var. *israelensis* to early stages of brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and steelhead trout (*Oncorhynchus mykiss*) following direct and indirect exposure. Canadian Journal of Fisheries and Aquatic Science 41:1451-1458.

Wright, S. and Yoshimura, G. 1997. Mosquito Productivity in Mitigated and Natural Vernal Pools in Sacramento County. Project Report: June 1997. Sacramemento-Yolo Mosquito Vector Control District.

Zoecon. 2000. Material Safety Data Sheet Altosid Liquid Larvicide Concentrate.

Personal Communications

Sanders, P. Sacramento-Yolo Mosquito Vector Control District (SYMVCD).


SURVEILLANCE
District monitors disease activity by sampling sentinel chicken flocks, mosquito pools, and wild birds. CVEC analyzes samples and CVDS makes health threat determinations.
Historical health threat documented in the Central Valley: Baseline Threat Level 2-3
Existing health threat: Disease found in wildlife or domestic animals: Threat Level 4-5
Officially Determined Health Emergency: Threat Level 6-7
Site specific larval and pupal control with insectivorous fish, Bti, Bsp, methoprene, or monomolecular film as needed based on ongoing monitoring. Stipulatins apply.
Maximize monitoring and disease surveillance. PUPs serve as guidance, but District implements control as necessary to prevent or control outbreak for that season.
Yes
Larval mosquito thresholds exceeded?
No
Continue habitat management and biological larval control measures.
MONITORING
District monitors adult and larval mosquito populations with larval dips, light traps and landing counts from March through Oct
Adult mosquito thresholds exceeded?
No
Continue biological larval control measures to keep adult populations low and reduce or eliminate need for adulticiding.
Yes
Officially Determined Health Emergency: Threat Level 6-7
Existing health threat: Disease found in wildlife or domestic animals: Threat Level 4-5
Historical health threat documented in theCentral Valley: Baseline Threat Level 2-3
Site specific adulticiding with pyrethroids or resmethrin based on ongoing monitoring. Refuge manager must confirm prior to application of adulticides. Stipulations apply.
SURVEILLANCE
District monitors disease activity by sampling sentinel chicken flocks, mosquito pools, and wild birds. CVEC analyzes samples and CVDS makes health threat determinations.

Stone Lakes National Wildlife Refuge
1624 Hood-Franklin Road
Elk Grove, CA 95758
Telephone: 661/725-2767
Fax: 916/775-4421

California Relay Service
TTY: 1 800/735-2929
Voice: 1 800/735-2922

U.S. Fish and Wildlife Service
California/Nevada Operations Office
http://www.fws.gov/cno/

Refuge information: 1 (800) 344-WILD

September 2006