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DIVISION OF WATER QUALITY

Attachment E – Notice of Intent

WATER QUALITY ORDER NO. 2013-0002-DWQ
GENERAL PERMIT NO. CAG990005

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR RESIDUAL AQUATIC PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM ALGAE AND AQUATIC WEED CONTROL APPLICATIONS

I. NOTICE OF INTENT STATUS (see Instructions)

Mark only one item	A. New Applicator	B. Change of Information: WDID# 5A34AP00003	
	C. ☐ Change of ownership or responsibility: WDID#		

II. DISCHARGER INFORMATION

A. Name U.S. Fish and Wildlife Service (Stone Lakes National Wildlife Refuge)			
B. Mailing Address 1624 Hood-Franklin Road			
C. City Elk Grove	D. County Sacramento	E. State CA	F. Zip 95757
G. Contact Person Bart McDermott	H. E-mail address bart_mcdermott@fws.gov	I. Title Refuge Manager	J. Phone 916-775-4421

III. BILLING ADDRESS (Enter Information *only* if different from Section II above)

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip
G. E-mail address	H. Title	I. Phone	

IV. RECEIVING WATER INFORMATION

A. Algaecide and aquatic herbicides are used to treat (check all that apply):

1. ☒ Canals, ditches, or other constructed conveyance facilities owned and controlled by Discharger.
   Name of the conveyance system: SP Cut, Sacramento Drainage Canal (portions)
2. ☒ Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Discharger.
   Owner's name: Sacramento County, Whitney, Loretz, Serra, Collins
   Name of the conveyance system: ~~SP Cut, Sacramento Drainage Canal, Lambert Ditch~~
3. Directly to river, lake, creek, stream, bay, ocean, etc.
   Name of water body: Lower Beach Lake, North and South Stone Lakes

B. Regional Water Quality Control Board(s) where treatment areas are located (REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9): Region 5
(List all regions where algaecide and aquatic herbicide application is proposed.)

V. ALGAECIDE AND AQUATIC HERBICIDE APPLICATION INFORMATION

A. Target Organisms: ____
Non-native Aquatic Weeds (water hyacinth)

B. Algaecide and Aquatic Herbicide Used: List Name and Active ingredients
Roundup Custom (Glyphosate)
Reward (Diquat Dibromide)

C. Period of Application: Start Date January 1 End Date December 31

D. Types of Adjuvants Used: Competitor (Modified vegetable oil)

VI. AQUATIC PESTICIDE APPLICATION PLAN

Has an Aquatic Pesticide Application Plan been prepared and is the applicator familiar with its contents?
☒ Yes ☐ No

If not, when will it be prepared? _____

VII. NOTIFICATION

Have potentially affected public and governmental agencies been notified? ☒ Yes ☐ No

VIII. FEE

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?
☐ YES ☐ NO ☒ NA

IX. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the General Permit, including developing and implementing a monitoring program, will be complied with."

A. Printed Name: Bart McDermott

B. Signature: _____ **Date:** 1/15/15

C. Title: Wildlife Refuge Manager

XI. FOR STATE WATER BOARD STAFF USE ONLY

WDID:	**Date NOI Received:**	**Date NOI Processed:**
Case Handler's Initial:	**Fee Amount Received:** $	**Check #:**
☐ **Lyris List Notification of Posting of APAP**	**Date** _____	**Confirmation Sent** _____

Aquatic Pesticide Application Plan

For the State General NPDES Permit for Residual Aquatic Pesticide Discharge to the Waters of the United States from Aquatic Weed Control Program Applications

General Permit No. CAG990005 (General Permit)
WDID # 5A34AP00003

Prepared by:

Stone Lakes National Wildlife Refuge
U.S. Fish and Wildlife Refuge

Submitted to:
Russell Norman
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

1. Description of the Water System

In 1992, the U.S. Fish and Wildlife Service (Service) established a 17,640-acre Project Boundary for the Stone Lakes National Wildlife Refuge (Refuge), defined approximately by Morrison Creek to the north, Franklin Boulevard to the east, the Southern Pacific Railroad Dredger Cut waterway to the west, and Lost Slough to the south. To date, the Service manages approximately 6,550 acres within the approved boundary (Figure 1).

This Refuge is part of a system of lands that protect fish, wildlife and habitat throughout the United States. The mission of the National Wildlife Refuge System (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."

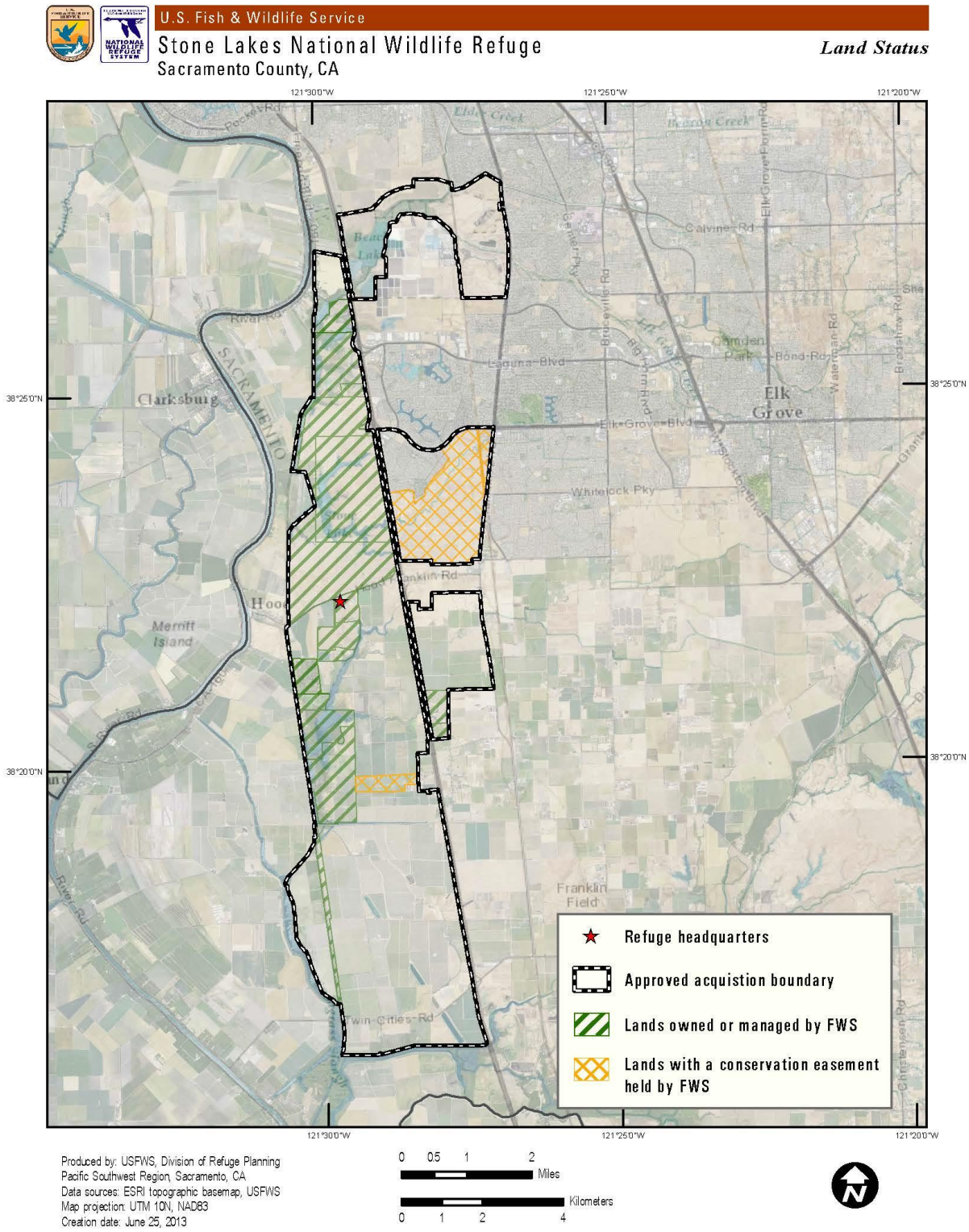
In 2007, the Refuge completed the Comprehensive Conservation Plan (CCP) to guide management of fish, wildlife, plants, other natural resources and visitor use on the Refuge for the next 15 years. Current management practices were evaluated and plans were developed for restoration of habitats as well as control of non-native plants and weeds. Since 1995, the Refuge has adopted an active aquatic weed management program in the Beach-Stone Lake Basin (Basin) which lies within the lower watersheds of Morrison Creek and the Cosumnes River in the northern Sacramento San Joaquin Delta (Delta) through the Stone Lakes Basin Water Hyacinth Control Group (SLBWHCG). Participants in the SLBWHCG included: the Refuge, California Department of Boating and Waterways (DBW), Sacramento Regional County Sanitation District (SRCSD), Sacramento County Department of Water Resources, Florin Resource Conservation District, Sacramento-Yolo Mosquito and Vector Control District, Vino Farms, Sutter Home, and a number of private landowners.

The goal of the group was to control and reduce the spread of water hyacinth throughout the Basin. This 711 acre water system includes the following water bodies: 1)Southern Pacific Railroad Dredger Cut (SP Cut waterway); 2)North Stone Lake; 3) South Stone Lake and its tributaries (Timm Slough); 4) Sacramento Drainage Canal; 5) Lambert Ditch.

2. Description of the Treatment Area

Control activities occur on approximately 711 acres, which include the natural lakes and sloughs as well as man-made irrigation or drainage ditches and channels associated with the areas listed above. This area was divided into 12 application sites at the beginning of control efforts in 2005, according to approximate hydrologic subunits, and concentrations of hyacinth and control efforts. One additional site was added when the Refuge expanded in 2011 (Figure 2). The majority of the area is within lands owned by the Service. Other treatment areas occur on property owned by the State of California, Sacramento County, and some private landowners.

Figure 1. Map of Project Boundary and land managed with the Stone Lakes National Wildlife Refuge



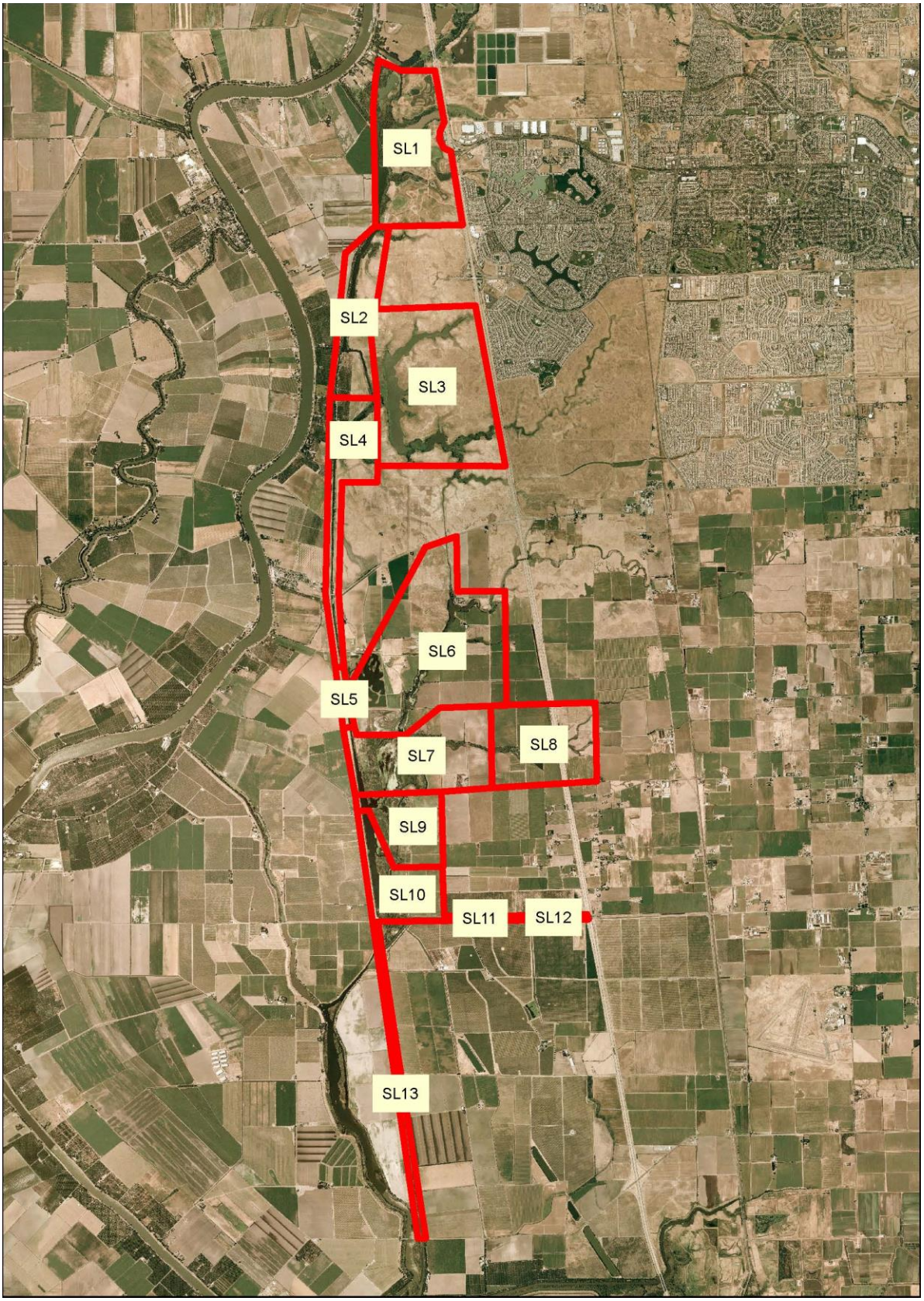


Figure 2. Map of 13 application sites for control of water hyacinth on the Stone Lakes NWR

3. Description of Weeds to be Controlled

The aquatic vegetation to be controlled consists of non-native, invasive water hyacinth (*Eichhornia crassipes*). This free-floating plant can block movement of water for flood control, agricultural irrigation, and water management for wildlife habitat purposes. Large, thick (up to 4.5 feet tall), mono-specific mats of hyacinth eliminate open water habitats, cause siltation of waterways, restrict boating and other recreation, produce mosquitoes, and deplete dissolved oxygen levels. As a result, large hyacinth infestations reduce habitats for a variety of migratory waterbirds, fishes, mammals, and special status species such as the giant garter snake and western pond turtle.

Water hyacinth has spread throughout the Stone Lakes Basin and was first reported in California in 1904 in a Yolo County slough. Water exchange and movement in the Basin are influenced by storm water runoff, surface diversions for farming and wetland management, ground water fluctuations, and limited tidal influence. Exchange between the treatment area and more tidally-influenced waterways to the south (e.g., Snodgrass Slough, lower Mokelumne River) occurs via seven flap gates and one slide gate as part of the Lambert Road bridge flood control structure.

4. Aquatic Herbicides to be Used, Degradation byproducts, Method of Application, Surfactants and Adjuvants

Two aquatic herbicides have been and will continue to be used to treat water hyacinth: Roundup Custom (glyphosate) and Reward (diquat). Glyphosate is used over 90% of the time for control efforts, because of its effectiveness and low toxicity. This herbicide is used when the plants are actively growing and are larger in size (> 8-12” tall). Reward is a dessicant and contact herbicide and is more effective on smaller plants when plants are not growing as rapidly and when glyphosate becomes ineffective. The surfactant used for both products is Competitor, which is a Modified Vegetable Oil containing a non-ionic emulsifier system.

Glyphosate is subject to microbial degradation in soil and water, and degrades to aminomethyl phosphonic acid, phosphate and carbon dioxide. The half-life of glyphosate in water is 7-14 days, although when added to surface waters to control aquatic weeds, residues in the water rapidly decline because of absorption into the aquatic plants where it is firmly bound as the plants decay and sink to the bottom mud.

The major degradation product of diquat is 1,2,3,4-tetrahydro-1-oxopyrido[1,2a]-5-pyrazinium ion (TOPPS). Photodegradation of diquat is extensive in water. Diquat monopyridone is formed to only a limited extent. On further irradiation, TOPPS is degraded to picolinamide, picolinic acid, formic acid, oxalic acid, carbon dioxide and other volatile fragments.

When diquat is added to surface waters to control aquatic weeds, residues in the water rapidly decline, because of the absorption of diquat into the aquatic plants, where it firmly binds until the plants decay and disintegrate into the bottom mud. Diquat is then irreversibly

bound to the soil particles, leaving the water free of diquat residues. Half-lives of diquat in natural waters are generally less than 48 hours.

The method of application for diquat is from airboats, small boats or terrestrial spray tanks using spray guns that reach 3-15' depending on the spray pattern. The method of application for glyphosate is the same but includes aerial applications from helicopters if large mats are present. Airboats are used more than 85% of the time because of maneuverability and access to plants in shallow water, and along banks with overhanging vegetation.

5. Factors influencing Decision to Use Pesticides for Weed Control

The Refuge utilizes integrated pest management techniques to control weeds in all habitat types. The CCP outlined objectives and strategies for controlling water hyacinth including working with local landowners, academic and governmental institutions, and other partners in the Stone Lakes Basin in developing chemical, biological and mechanical control methods.

Over the past 20 years, the Refuge has experimented with a variety of methods to control the hyacinth plants with limited success. These methods include mechanical harvesting of plants, hand picking, biological controls, removal of culverts and infrastructure to improve access, and placing barriers (booms) in waterways to control the movement of the plants in this dynamic water system. Although these methods still play a role in control efforts, chemical control remains the most successful means of treatment to maintain open water habitats in the Basin.

Mechanical Control through Shredding: The cost of mechanical treatment of water hyacinth by boats equipped with shredding devices was evaluated by the San Francisco Estuary Institute (SFEI) in 2004. Costs ranged greatly and were dependent on plant stature and the physical constraints of control sites. Estimated costs ranged from $338 to as much as $7,441 per acre. Also, environmental permitting required for this intrusive control method necessitated additional expense in staff time. In general, shredding of hyacinth plants in the Delta has had limited success due to the thickness of plant mats, shallowness of waterways, tidal fluctuations, and plants occurring in mixed stands of aquatic emergent vegetation. Also, the regeneration of some of plant fragments remaining viable after shredding could re-infect areas without follow-up treatments. Nonetheless, the Service continues to explore opportunities to evaluate these types of alternative control methods.

Hand picking: Shallow water conditions and widespread submergent aquatic vegetation in the Basin make hand-picking of water hyacinth time consuming and requires use of air boats or hand-propelled watercraft (e.g., canoe, kayak) to access control sites. Additional boats are needed to transfer plants to vehicles for disposal at upland areas. Except for a limited number of sites, the majority of water hyacinth mats in the Basin are too large for practical removal by hand. However, hand removal will continue to be employed, where appropriate (i.e., near sensitive habitats or water diversions).

Mechanical removal with heavy equipment: Mechanical removal from shore with heavy equipment such as long reach excavators can be effective, but most infested areas cannot be

reached with this equipment. Where plants are removed from waterways adjacent to public roads, additional expense can be incurred for trucking to an upland disposal site. Most backwater areas where hyacinth now occurs are inaccessible for land-based equipment. Moreover, many sites support sensitive aquatic habitats for special status species and use of heavy equipment can cause adverse environmental effects and necessitate substantial permitting. Dewatering areas has also been explored, and has been successful in seasonal wetlands that can be completely dry for an extended period of time. Most semi-permanent or permanent wetlands in the Basin are at mean sea level and remain moist year round where seeds remain viable and sprout the following season.

Biological control: In cooperation with the California Department of Boating and Waterways, the Service has cooperated and will continue to cooperate with USDA-Agricultural Research Service (USDA-ARS) and California Department of Food and Agriculture (CDFA) in any efforts to evaluate potential biological control methods, such as introducing water hyacinth-eating weevils (*Neochitina* spp.) and the moth (*Sameodes albiguttlilis*). In 2011, USDA released the water hyacinth plant hopper (*Megamelus scutellaris*) in Seven Mile Slough, approximately 6 miles south of the Refuge. Previous attempts have been unsuccessful at establishing populations at sufficient densities to affect hyacinth stands.

Culvert and infrastructure improvements: In 2010, the Refuge removed two earthen crossings with collapsing culverts in the SP Cut waterway, and replaced one of the crossings with a double railcar bridge. This improved access for airboat crews to control water hyacinth, and reduced mats by 90% in the area. The Refuge continues to evaluate other barriers to control efforts and work towards removal if feasible.

Floating booms: Floating log booms have been used to protect non-infested areas, confine established hyacinth mats, prevent passage of plants through culverts, and ensure operation of pumps. Booms are only effective if the majority of plants are concentrated in discrete areas and can be contained within the boomed area. Small plants can pass over booms during the high winds, typical of Delta summer afternoons. Booms also require regular monitoring since they are vulnerable to cutting by boaters or beavers.

6. Gates and Control Structures

The Refuge operates a number of water control structures within the Basin. When appropriate, staff will open or close structures within or adjacent to treatment sites during herbicide applications, if there is a concern that receiving waters may be affected. Staffs also work with local landowners when scheduling treatments around intake pumps to avoid any uptake of herbicides during pumping operations. Water control structures are inspected on an annual basis and repairs made if necessary.

7. State Implementation Policy (Section 5.3) Exceptions

The proposed herbicides and surfactant are not priority pollutants, and therefore do not require an exception from Section 5.3.

8. Monitoring Plan

All monitoring of the effects of aquatic herbicide applications to control water hyacinth in the Stone Lakes Basin will be conducted according to the Monitoring Reporting Program (MRP) requirements summarized in Water Quality Order No. 2013-0002-DWQ. Samples will be collected and analyzed per MRP guidelines as stated in the Table 1.

Table 1. Monitoring requirements per NPDES General Permit

Sample Type	Constituent/Parameter	Units	Sample Method	Minimum Sampling Frequency	Sample Type Required	Requird Analytical Test Method
Visual	1. Monitoring area description (pond, lake, open waterway, channel, etc.)	Not applicable	Visual Observation	All applications at all sites [1]	Background, Event and Post-event monitoring	Not applicable
	2. Appearance of waterway (sheen, color, clarity, etc.)					
	3. Weather conditions (fog, rain, wind, etc.)					
Physical	1. Temperature[2]	°F	Grab[4]	See 5 below	Background, Event and Post-event monitoring	6
	2. pH[3]	Number				
	3. Turbidity[3]	NTU				
	4. Electric Conductivity[3] @ 25 °C	µmhos/cm				
Chemical	1. Active Ingredient[7]	µg/L	Grab[4]	See 5 below	Background, Event and Post-event monitoring	6
	2. Nonylphenol [8]	µg/L				
	3. Hardness (if copper is monitored)	mg/L				
	4. Dissolved Oxygen[2]	mg/L				

1 All applications at all sites.
2 Field testing.
3 Field or laboratory testing.
4 Samples shall be collected at three feet below the surface of the water body or at mid water column depth ifthe depth is less than three feet.
5 Collect samples from a minimum of six application events for each active ingredient in each environmental setting (flowing water and non-flowing water) per year, except for glyphosate. If there are less than six application events in a year, collect samples during each application event for each active ingredient in each environmental setting (flowing water and non-flowing water). If the results from six consecutive sampling events show concentrations that are less than the receiving water limitation/trigger for an active ingredient in an environmental setting, sampling shall be reduced to one application event per year for that active ingredient in that environmental setting. If the yearly sampling event shows exceedance of the receiving water limitation/trigger for an active ingredient in an environmental setting, then sampling shall return to six application events for that active ingredient in each environmental setting. For glyphosate, collect samples from one application event from each environmental setting (flowing water and non-flowing water) per year.
6 Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. part 136.
7 2,4-D, acrolein, dissolved copper, diquat, endothall, fluridone, glyphosate, imazamox, imazapyr, penoxsulam, and triclopyr.
8 It is required only when a surfactant is used.

8.1 Monitoring Frequency and Locations, Sample Collections, Reports

The area of the Stone Lakes Basin targeted for use of aquatic herbicides to control water hyacinth was divided into 12 application sites at the beginning of control efforts in 2005. These application sites were defined according to approximate hydrologic subunits, where hyacinth is concentrated and most control efforts are conducted. In 2011, the Refuge purchased additional property and added a 13th unit along the SP Cut waterway south of Lambert Road. Because there are fewer than 20 application sites, water samples for the MRP will be collected at two sites (Sites SL 6 & SL 10 in Figures 2a & b). A total of four samples will be collected annually (two for glyphosate and two for diquat) and will follow the schedule set forth by the NPDES general permit to characterize receiving waters for: (1) background monitoring, (2) event monitoring, and (3) post-event monitoring. Additional environmental parameters to be recorded during sampling include: visual appearance of application site, water temperature, dissolved oxygen, pH, turbidity, and electrical

conductivity. Concentration of active ingredient of the two herbicides will be determined through laboratory analysis. Field measurements will be recorded on the field data sheet form Table 2.

Table 2: NPDES Monitoring Data Sheet

NPDES Monitoring Data Sheet

Site Name:	Collector:	Target Veg:	Herbicide/Surfactant:

Background Monitoring : Upstream at time of the application event or in application area just prior to (up to 24 hours in advance of) the application event.

Date:	GPS/Waypt:		H_2O Spd (ft/sec)	%Veg	Photo
Time:	Altitude:				☐
OBSERVATIONS – Circle and provide description, if applicable					
Weather: Clear / Partly Cloudy / Cloudy / Overcast / Other:			Wind:		
Water Clarity: Clear / Cloudy / Milky / Muddy / Other:					
Water Color: Clear / Brown / Red/ Green / Other:					
Visible: Films / Sheens / Coatings	Bottom Deposits: Yes / No		Fungi / Slimes / Objectionable Growth:		
Floating/ Suspended Material (algae, trash, etc.):					
Aquatic Life: Yes / No					
Potential Nuisance Conditions: Yes / No					
WATER TESTING					
Temp(°C):	**DO(mg/L):**	**EC(µs/cm):**	**Sal (ppt):**	**pH:**	

Event Monitoring: Immediately downstream of treatment area in flowing waters or immediately outside of treatment area in non-flowing waters.

Date:	GPS/Waypt:		H_2O Spd (ft/sec)	%Veg	Photo
Time:	Altitude:				☐
OBSERVATIONS – Circle and provide description, if applicable					
Weather: Clear / Partly Cloudy / Cloudy / Overcast / Other:			Wind:		
Water Clarity: Clear / Cloudy / Milky / Muddy / Other:					
Water Color: Clear / Brown / Red/ Green / Other:					
Visible: Films / Sheens / Coatings	Bottom Deposits: Yes / No		Fungi / Slimes / Objectionable Growth:		
Floating/ Suspended Material (algae, trash, etc.):					
Aquatic Life: Yes / No					
Potential Nuisance Conditions: Yes / No					
WATER TESTING					
Temp(°C):	**DO(mg/L):**	**EC(µs/cm):**	**Sal (ppt):**	**pH:**	

Post-Event Monitoring : Within the treatment area within one week after application

Date:	GPS/Waypt:		H_2O Spd (ft/sec)	%Veg	Photo
Time:	Altitude:				☐
OBSERVATIONS – Circle and provide description, if applicable					
Weather: Clear / Partly Cloudy / Cloudy / Overcast / Other:			Wind:		
Water Clarity: Clear / Cloudy / Milky / Muddy / Other:					
Water Color: Clear / Brown / Red/ Green / Other:					
Visible: Films / Sheens / Coatings	Bottom Deposits: Yes / No		Fungi / Slimes / Objectionable Growth:		
Floating/ Suspended Material (algae, trash, etc.):					
Aquatic Life: Yes / No					
Potential Nuisance Conditions: Yes / No					
WATER TESTING					
Temp(°C):	**DO(mg/L):**	**EC(µs/cm):**	**Sal (ppt):**	**pH:**	

Water samples for laboratory analyses and other environmental parameters for the MRP will be collected by staff of the SRCSD. Laboratory analysis will be conducted by a private analytical laboratory under contract to SRCSD and certified for such analysis by the California Department of Health Services. All laboratory analyses will be conducted according to U.S. EPA Guidelines. Sample collections sites are less than 6 feet in depth, and all collections will be done at mid-depth. An annual report summarizing treatments and monitoring will be submitted to the Regional Water Quality Control Board by March 1 of the year following treatment.

9. Sample Contamination Prevention

Samples will be collected upwind and not in close proximity to application equipment to ensure no contact between aquatic herbicide application equipment, containers, or personal protective equipment. Equipment will be cleaned with a non-phosphate cleaner and triple rinsed after sampling is complete and prior to moving to a new sample location. Gloves will be changed between collection sites. Samples will be tightly sealed at the point of collection and placed upright in an ice chest dedicated solely for transporting samples.

10. Best Management Practices

Best management practices to control water hyacinth begin with periodic surveys throughout the treatment area to evaluate extent of infestations, size of plants, and the proximity to sensitive areas such as heron and egret rookeries, elderberry bushes, California hibiscus or other flora and fauna species of concern. Surveys are continued throughout the year because water hyacinth plants move depending on water levels, wind and tidal influence. Often plants collect in the same locations as treatments are done, plants die off and others break away and move. Surveys will determine the placement of containment booms, type of herbicide used and feasibility of using non herbicide means of control.

10.1 Pesticide Spill Prevention and Containment

All Refuge personnel conducting herbicide applications will be or will be under the direct supervision of a California Qualified Applicator Certificate holder (QAC) from California Department of Pesticide Regulation with category “F” (Aquatic). The transport, mixing and application of herbicides will follow all label recommendations. All U.S. Fish and Wildlife Service and OSHA safety regulations regarding pesticide handling and use will also be followed. Equipment will be inspected daily prior to use to minimize the possibility of leaks or spills. In the unlikely event of an herbicide spill, the material will be prevented from entering any water bodies to the extent practicable. Refuge staff is also trained in spill prevention and cleanup. Spill equipment including absorbent materials will be on site.

10.2 Pesticide Application Rates

Application rates of both glyphosate and diquat and Competitor surfactant are developed from label recommendations, and then further refined through PCA recommendations taking into consideration size of plants, and the location of areas to be treated. Based on this, application rates for control of water hyacinth have been 0.5-0.75 gallons per acre for diquat and 0.75 gallons per acre for glyphosate.

10.3 Education Plan for Pesticide Applicators to Avoid Adverse Effects

Refuge staff who apply pesticides are licensed and complete 20 hours of continuing education hours every two years in order to maintain the QAC license. Topics for education hours include latest techniques for pesticide application, weed identification, laws and regulations

and personal protection equipment, all of which contribute to a safe working environment using proper application techniques.

10.4 Information Plan for Adjacent Landowners and Agencies Who Have Water Rights on Receiving Water

Refuge staff work with adjacent landowners to inform them when herbicide applications will be made if there is a potential conflict per label recommendations. In general, Refuge applicators do not treat around pump intakes when farmers are irrigating croplands. Appropriate gates, weirs, etc. are closed to prevent discharge of residual aquatic herbicides into receiving waters of adjacent landowners when possible.

10.5 Prevention of Fish Kills from Pesticide Application

All herbicide applications are done by licensed staff according to the pesticide label and PCA recommendations which includes practices to reduce impacts to fish. These practices include spraying half the hyacinth plants if large mats are treated to reduce depleting the oxygen levels under the mats as the plants decay. Often these mats break apart as they decay. Refuge applicators also alter the spray of the nozzle depending on the size and number of plants being treated to reduce the amount of pesticide entering the water. Applicators also minimize drift by monitoring the wind direction and speed, remaining within prescriptions for applying pesticides at all times.

11. Control Methods

The Refuge staff utilizes an Integrated Pest Management (IPM) approach in the treatment of weeds on the Refuge. The decision to treat and the method of treatment depend on the habitat type, the potential spread of the weed, impact to native or desirable species and impact to wildlife or humans if the weed is left untreated.

11.1 Evaluation of Alternative Control Methods

i. **No Action**: Water hyacinth reproduces at an astounding rate. During one growing season March-October, 25 plants can expand to cover 2.5 acres of water surface. Therefore this alternative would result in most open water habitats in the Stone Lakes Basin being covered by hyacinth within one or two years, degrading wildlife habitat, threatening water availability for irrigation, increasing mosquito populations and the threat of West Nile Virus and other mosquito borne diseases. Navigation in waterways would be reduced affecting recreation (fishing, waterfowl hunting, boating), law enforcement efforts and the ability for the Refuge to ensure public safety.

ii. **Prevention**: This technique includes coordination with adjacent landowners and other agencies adjacent to the Refuge, some of whom are part of the Stone Lakes Basin Water Hyacinth Control Group. These efforts include informing upstream or downstream landowners of infestations and control techniques. Water level fluctuations due to weather conditions (droughts/flooding), and tides, influence whether or not a particular area can be treated. Treating hyacinth plants when they are small (<6” in height) before they have broken away can help to minimize the spread

of the plants. The strategic placement of booms and culvert screens can also impede the spread of plants.

iii. **Mechanical or Physical Methods**: Over the past 20 years, the Refuge has experimented with a variety of mechanical and physical methods to control water hyacinth with limited success. These methods include mechanical harvesting of plants with a shredder, removal with an excavator, hand picking, removal of culverts and infrastructure to improve access, and placing barriers (booms) in waterways to control the movement of the plants in this dynamic water system. Shredding with a mechanical shredder was costly, access was limited to deeper water areas and plant fragments were still viable after treatment. Removal with an excavator or backhoe is an option in small areas with good accessibility such as small ditches or canals. Drawbacks include trampling of sensitive habitats, removal of non-target plant and animals during removal. Handpicking is time consuming, but remains an option for very small patches with good access. Removal of two earthen crossings has greatly improved access for chemical control and reduced infestation to other areas. Placement of floating booms can contain hyacinth for later control, but high winds can blow plants over the booms and is not a long term solution.

iv. **Cultural Methods:** This management method includes draining of a water body, burying hyacinth plants or lining ditches, canals with concrete. Water hyacinth plants that have entered seasonal wetlands during high water events have died when the wetland was drawn down, but most semi-permanent or permanent wetlands in the Basin are at mean sea level and remain moist year round where seeds remain viable and can sprout the following season.

v. **Biological Control**: The Refuge has cooperated with universities and other state and federal agencies and will continue to cooperate with efforts to evaluate potential biological control methods, such as introducing water hyacinth plant hoppers (*Megamelus scutellaris*), water hyacinth-eating weevils (*Neochitina* spp.) and moths (*Sameodes albiguttlilis*). Previous attempts have been unsuccessful at establishing populations of these species at sufficient densities to affect hyacinth stands.

vi. **Pesticide Control**: The Refuge has used diquat and glyphosate to reduce infestations of water hyacinth over the past 20 years. Glyphosate has been the most effective with aerial and airboat control efforts reducing surface acreage coverage by more than 50%. This method remains the most effective and cost efficient method for control. Staff time dedicated to control efforts has dropped from an average of 12-16 days per month when control efforts began to 4-6 days per month.

11.2 Using the Least Intrusive Method of Weed Control

Refuge staff evaluates the least intrusive method of weed control in all 13 application sites in regards to impacts to sensitive wildlife species or special status species. Refuge staff map locations of heron and egret rookeries, Swainson's hawk nests, elderberry bushes and other sensitive areas prior to initiating control efforts. Control efforts may be postponed or a different method may be chosen if sensitive habitats will be impacted or wildlife will be disturbed.

11.3 Decision Matrix

The following criteria are utilized to evaluate which control method is appropriate for a given application site (Example is for control efforts in unit SL 6):

Decision Making Criteria	No Action	Prevention	Mechanical	Cultural	Biological	Pesticide
Is the impact to the environment low or easily mitigated	No	No	Yes[1]	No	No	Yes
Is the cost feasible?	No	No	Yes[1]	No	No	Yes
Has the method been proven effective on site?	No	No	No	No	No	Yes
Are there impacts to sensitive species?	Yes	No	Yes	Yes	No	No
Are there impacts to native species?	Yes	No	Yes	Yes	No	No

[1]Booms are used to control movement of hyacinth in this unit