U.S. FISH AND WILDLIFE SERVICE
STONE LAKES NATIONAL WILDLIFE REFUGE

STONE LAKES BASIN WATER HYACINTH AND WATER PRIMROSE CONTROL PROGRAM REVISED AQUATIC PESTICIDE APPLICATION PLAN (APAP)
June 2022

Program Area:

The Stone Lakes Basin (Basin) lies within the lower watersheds of Morrison Creek and the Cosumnes River in the northern Sacramento San Joaquin Delta (Delta) and is bordered by the Sacramento River to the west and the Mokelumne River to the south. The Basin lies within Sacramento County, ten miles south of the city of Sacramento and bordering the city of Elk Grove to the east.

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 former Southern Pacific Railroad to the west, and Lost Slough to the south. To date, the Service manages approximately 6,211 acres within the approved boundary. Most of the Refuge lies within the 100-year floodplain.

Since the mid-1990's, the Refuge has collaborated with several private, local, and state entities as a participant in the Stone Lakes Basin Water Hyacinth Control Group (SLBWHCG). Participants historically in the SLBWHCG included: the Stone Lakes National Wildlife 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 several other private landowners.

Field crews with the Service conduct chemical control of water hyacinth on approximately 700 acres of open water habitats on Lower Beach Lake, the borrow channel for the former Southern Pacific Railroad Dredger Cut (SP Cut), North Stone Lake, South Stone Lake and its tributaries (e.g., Sacramento Drainage Canal, Timm Slough, and Lambert Road ditch). Control activities occur in natural lakes and sloughs as well as irrigation/drainage ditches and channels. Treated waterways lie within lands owned by the Service, the State of California, Sacramento County, and several private landowners.

Water exchange and movement in the Basin is 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.

In addition to wetland habitats, land cover types in the vicinity of where hyacinth control activities occur include seasonal wetlands, riparian corridors, dry grasslands, irrigated wet meadow/pasture, and agricultural croplands.

Target Species of Control: Water Hyacinth and Water Primrose

The target aquatic vegetation to be controlled under this program consists of non-native, invasive water hyacinth (*Eichhornia crassipes)* and Uruguay water primrose (*Ludwigia hexapetala)*, creeping water primrose (*Ludwigia peploides*) and hybrids (primrose). These plants can block movement of water for flood control, agricultural irrigation, and water management for habitat purposes. Left unchecked, large, thick mono-specific mats of hyacinth and water

primrose can cover 100% of open water habitats, cause siltation of waterways, clog irrigation pumps, restrict boating and other recreation, produce mosquitoes, increase mosquito borne diseases such as West Nile Virus by providing harborage for adult and larval mosquitoes, deplete dissolved oxygen levels for fish and other aquatic life, and shade out native submersed aquatic vegetation. As a result, large hyacinth and primrose 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: Water hyacinth is a floating aquatic plant (family Pontederiaceae) which was first reported in California in 1904 in a Yolo County slough. These plants form dense floating mats that can completely cover open water. The plants can reproduce through seeds and by stolons that can break off and float and infest new areas. The dense growth can impede water movement, block growth of native plants, increase mosquito borne diseases such as West Nile Virus by providing harborage for adult and larval mosquitoes, and reduce available habitat for waterbirds and fish. Water hyacinth plants reproduce at an astounding rate. During one growing season (March-October), 25 plants can expand to cover 2.5 acres of water surface (Barrett 1989). Therefore, control is particularly needed at the onset of hyacinth growing season and during flowering to reduce the seed source to maintain open water.

Water primrose: Primrose is a rooted aquatic plant (family Onagraceae) which forms dense mats in waterways, reaching above and below the water surface. Growth of primrose has expanded exponentially in the past several years as plants have hybridized in the Stone Lakes Basin and now blocks waterways and is invading adjacent riparian habitat in the South Stone Lake Unit (Areas 7, 9, 10 in Figure 1). The primrose has spread throughout the waterways anchored along shorelines and islands that extend 20-100' into the water body. These plants also change their growth habitat and grow upright on land as well, creating impenetrable barriers to wildlife in adjacent riparian areas. Control efforts will be focused on maintaining open channels in waterways and reducing large infestations greater than 1 acre or more than 10 LF from the shoreline.

Description of Control Program, Rates of Application and Control Tolerances

Under this program, the Service and cooperators will use the following aquatic pesticides: glyphosate formulated for aquatic use (ex: Roundup Custom) and imazamox (ex: Clearcast) with the vegetable oil-based surfactant, Competitor, applied from boats, aerially or ground apparatus (e.g., trailer, back-pack sprayer). Glyphosate (Roundup Custom) and imazamox (Clearcast) are lower-toxicity herbicide which may minimize the environmental and ecosystem impacts of controlling non-native, invasive floating aquatic vegetation (FAV). USEPA fish and macroinvertebrate toxicity classification is considered "Practically non-toxic". The aquatic formulation of both herbicides received USEPA approval through the reduced risk program in 2008 (SERA 2010).

Glyphosate (Roundup Custom EPA Reg. No. 524-343-ZG): Glyphosate has been part of the NPDES permit since 2005. This herbicide is a relatively slow acting broad spectrum, non-selective, systemic herbicide. Glyphosate was first approved for use in the United States in 1973. The herbicide is water soluble and is absorbed across the plant surface and translocated throughout the plant. Studies show that glyphosate is not persistent in the water column. Glyphosate binds tightly to sediment, removing the active ingredient from water. The half-life of glyphosate in pond water ranges from 12 days to 10 weeks (EXTOXNET 1996). Glyphosate will be applied at a maximum rate of 120 ounces per acre, per label recommendations, equivalent to

5.06 pounds of active ingredient per acre. All applications with the approved adjuvant will be done as specified by the label to help minimize drift and increase efficacy.

Imazamox (Clearcast, EPA Reg No. 241-437-67690): This revised EPAP adds imazamox to control primrose and hyacinth. California Department of Pesticide Regulation (CDPR) approved imazamox for aquatic use in August 2012. Imazamox was approved for terrestrial use by the USEPA in 1997 and by the CDPR in 2002. Imazamox is part of the USEPA's Office of Pesticide Program Conventional Reduced Risk Program which expedites the review and regulatory decision-making process of conventional pesticides that pose less risk to human health and the environment than other existing herbicides (Washington DOE 2012). Pesticides are typically included in the reduced risk program when they have advantages over existing pesticides, such as lower impact on human health, lower toxicity to non-target organisms, lower potential for groundwater contamination, lower required use rates, lower potential for resistance, and/or compatibility with integrated pest management practices (USDA Agricultural Research Service. 2017. AIPCP Programmatic Biological Assessment 461 pp).

Imazamox is a relatively fast-acting systemic herbicide. It is rapidly absorbed into the foliage and translocated throughout the plant by phloem and xylem tissues (Washington DOE 2012). Imazamox inhibits plant growth within the first 24 hours, with visual symptoms appearing about one week after treatment. Symptoms include yellowing leaves and general discoloration. Various efficacy trials from the Department of Boating and Waterways (California Dept of State Parks), USDA-Agricultural Research Station, and University of California-Davis indicate that imazamox provides very good control of water hyacinth and good control of primrose (USDA Agricultural Research Service. 2017. AIPCP Programmatic Biological Assessment 461 pp.) The primary method of degradation of imazamox in surface water is photolytic (Washington DOE 2012), which is influenced by water depth, water clarity and season of use and continues via microbial action to carbon dioxide. The half-life in water ranges from 5 to 15 days (Washington DOE 2012). In well-lit waters, imazamox breaks down quickly and the USEPA concluded that it is unlikely to pose a risk to fish, invertebrates, birds, or mammals in dark or turbid waters, when there is a flow of water (Washington DOE 2012).

Imazamox will be applied at a rate of 32 to 64 ounces per acre, per label requirements. This is equivalent to 0.25 to 0.50 pounds active ingredient per acre. Imazamox is most effective when applied to actively growing plants. Imazamox will be applied with an adjuvant at rate of one quart per 100 gallons of solution, and field crews will wait 10-14 days between treatments at the same site if follow-up treatments are required.

There are no label restrictions regarding dissolved oxygen. According to the label, waters treated with imazamox will not be used for irrigation until concentrations are less than 50 ppb and requires a 24-hour period after treatment to irrigate from still and quiescent waters. There are no wait restrictions for irrigation when imazamox is applied to flowing waters at a rate of less than or equal to 2 quarts (64 ounces) per acre to waters with an average depth of at least four feet. There are no restrictions on livestock watering, swimming, fishing, domestic use, or use of treated water for agricultural sprays (SePRO 2010). To reduce drift, imazamox will be used with a surfactant, and applied with as course spray nozzle as possible and a height of approximately no more than four feet above the plant canopy. Imazamox will not to be applied in a temperature inversion, or when wind speeds are greater than 10 miles per hour.

Competitor Adjuvant (CA Reg No. 2935-50173): The adjuvant Competitor is a modified vegetable oil containing a non-ionic emulsifier system used to reduce drift, increase deposition and retention of the herbicide on the plant. The product label recommends surface applications of 32 ounces per acre.

Control Tolerance: As a result of hyacinth control efforts over the past 25 years, the extent of plant infestations has decreased. Mats greater than 1 acre in size have been reduced, but the rapid rate of growth and seed source in fluctuating water levels along the water's edge warrant continued control efforts. Aggressive control of water hyacinth plants is required particularly when water movement or winds cause plants to break lose and infest other portions of waterways. Similarly, primrose continues to expand and is easily dispersed throughout the Basin. Therefore, active chemical control of plants will be attempted wherever plants are found unless adjacent to sensitive species such as elderberry shrubs, where measures to reduce impacts will be used such as further reducing drift or treating under rookeries after birds have fledged ((see BMP#5).

Application and Treatment Sites:

Application and treatment areas lie within approximately 700 acres of open water habitats in Lower Beach Lake, SP Cut, North Stone Lake, and South Stone Lake. Waterways consist of natural lakes and sloughs as well as man-made ditches and channels. Application and treatment areas are within lands owned by the Service, the State of California, Sacramento County, and/or private landowners (Figure 1). Application areas are adjacent to a rural agricultural setting or lands managed as wildlife habitats. All application sites consist of perennial waterways and wetlands that support water year-round. No spraying occurs within 300 feet of any inhabited dwelling.

In some areas, hyacinth and primrose occupy waterways that may be bordered by steep, eroded banks or dense overhanging, riparian habitats (e.g., valley oaks, cottonwoods, willows). Many backwater sloughs or ponds along the periphery of lakes and channels are characterized by shallow water (< 0.5 feet) and mudflats, bordering emergent vegetation, such as cattail (*Typha* spp.), bulrush (*Scirpus* spp.), and bur-reed (*Sparganium* spp.), and floating aquatic plants, duckweed (Lemna spp.) and mosquito fern (*Azolla* spp.), and submergent aquatic vegetation, such as coontail (*Ceratophyllum* spp.), watermilfoil (*Myriophyllum* spp.), and Brazilian waterweed (*Egeria densa*). Hyacinth and water primrose plants may occur along the margins of waterbodies in continuous or scattered bands, on shallow portions of lakes where they lodge on submergent aquatic vegetation, or in large, mono-specific mats extending from bank to bank across channels, ditches, or lake tributaries. Plants may also accumulate around surface water pumps, docks, or inside culverts.

Waterbodies where applications and treatments occur may support a wide array of fish and wildlife, including resident fish, mammals, and reptiles, and migratory birds. Special status species such as the giant garter snake, western pond turtle, valley elderberry longhorn beetle, and Swainson's hawk also may occur in the area.

Alternative control methods and their limitations:

Alternative control methods for non-pesticide control of water hyacinth may include, but are not limited to:

- Mechanical shredding and harvesting have been used in the Delta by the CA Dept of Boating and Waterways (DBW). The challenges with this control method include the cost and finding "spoil sites" where material can be placed after removal, and potential harvest of wildlife during operations such as frogs, turtles, and fish. Harvesting costs are estimated at $40,800 per acre ((USDA Agricultural Research Service. 2017. AIPCP Programmatic Biological Assessment 461 pp.) Also, environmental permitting required

for this intrusive control method necessitates additional expense in staff time. Mechanical shredding and harvesting of hyacinth plants in the Stone Lakes Basin has had limited success due to the thickness of plant mats, shallowness of waterways, tidal fluctuations, and plants occurring in mixed stands with water primrose and other emergent vegetation. Finally, without follow-up treatments, potential re-growth and re-invasion by plant fragments remaining after shredding may prolong infestations. Nonetheless, the Refuge will continue to explore opportunities to evaluate alternative control methods, such as mechanical shredding, in cooperation with the California State Parks and the State Water Resources Control Board (SWRCB). Mechanical treatment of primrose is not feasible currently.

- Hand-picking of water hyacinth is labor intensive and requires use of air boats or hand-propelled watercraft (e.g., canoe, kayak) to access control sites and then transfer plants to vehicles for disposal at upland areas. Except for a limited number of small, isolated sites, most water hyacinth mats remaining in the Basin are inaccessible for practical removal by hand. However, hand removal will continue to be employed, where appropriate (i.e., near sensitive habitats or water diversions). Hand removal of water primrose is difficult because the plant is rooted to the bank which is often inaccessible.

- Mechanical removal with heavy equipment is possible in some ditches and channels within the Basin that are accessible with a long reach excavator, equipped with a specialized bucket for aquatic weeds. Where plants are removed from waterways, additional expenses are incurred for trucking to an upland disposal site. In addition, backwater areas where hyacinth occurs are often inaccessible for land-based equipment. Moreover, many sites support sensitive aquatic habitats for special status species and use of heavy equipment could cause adverse environmental effects to T&E species such as giant garter snake and necessitate additional permitting. Nearly all waterbodies in the Basin are located at mean sea level and no water manipulations such as de-watering of areas is possible.

- Biological control methods have been explored in cooperation with research and state agencies including DBW. The Refuge will continue to partner 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 plant hoppers (*Megamelus scutellaris)*. Previous attempts have been unsuccessful at establishing and maintaining populations of biological control insects at sufficient densities to control hyacinth stands.

- Installation of floating booms 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 most 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.

- Installation of metal or plastic screens on culverts to limit reinfection of previously cleared areas and movement of hyacinth plants during the irrigation season. Screens require regular monitoring to ensure debris does not impede water flow and they can be

damaged by beavers, river otters, and humans.

- Removal of plants using long reach excavators with modified buckets in ditches or areas accessible by long reach on roads or levees. This method will be used where feasible and is most effective where the excavator or working from existing levees/roads and can remove the plants and be placed in a non-sensitive area to decompose.

- Release of biological control agents to reduce plant densities. The SLBWHCG will continue to cooperate with DBW, USDA-ARS, and CDFA to evaluate the feasibility of biological control methods. Previous attempts to establish hyacinth-eating weevils and moths in the Delta have been unsuccessful at establishing adequate populations to affect hyacinth infestations. No biological control methods currently exist for primrose.

Herbicide Applicator Responsibilities

All staff that apply herbicides have a QAC or work directly under a one or more persons who have obtained a Qualified Applicators Certificate (QAC) Category F (Aquatic), administered by the CDPR. Applicators are required to be proficient in the following:

- Reading and understanding pesticide labels
- Proper methods for mixing and applying pesticides
- Proper use of personal protective equipment
- Recognizing pesticide poisoning symptoms

Applicators are trained to apply aquatic herbicides in a manner consistent with labeled rates. Staff is trained to read and understand pesticide labels and to properly handle, mix, and apply pesticides (in accordance with California Food and Agriculture Code and Title 3 of the California Code of Regulations). Applicators are trained to follow pest control recommendations as well as any specific restrictions imposed by the County Agricultural Commissioners.

Applicators are trained on daily protocols, avoidance and minimization measured to protect species under the ESA, and chemical treatment restrictions. Chemical treatment restrictions include maintaining distance from sensitive species such as elderberry plants of sufficient size to host the threatened Valley elderberry long horned beetle, giant garter snakes along the banks or in the water, heron and egret rookeries and Swainson's hawk nests. **If any sensitive species are detected at the site, the application crew should not treat the area.** To avoid elderberry shrubs, applicators

At the end of each day, the crew will enter treatment information into a daily spray log with information on the species treated, weather conditions, site location, spray rate and amount of herbicide and surfactant applied, and total acreage treated, along with any relative notes. Staff will prepare a Pesticide Use Report to the County Agricultural Commissioner that includes the amount of herbicide used, acreage, and number of applications monthly.

Monitoring Plan

All monitoring of the effects of aquatic herbicide applications to control water hyacinth and primrose in the Stone Lakes Basin will be conducted according to the Monitoring Reporting Program (MRP) requirements summarized in Water Quality Order No. 2004-0009-DWQ. Protocol for the MRP will be described in detail in the first annual report to be provided on March 1, 2023, and annually thereafter.

The portion of Stone Lakes Basin targeted for use of aquatic herbicides to control water hyacinth consists of a total of 12 application sites (Figure1). Application sites are defined according to approximate hydrologic subunits, where hyacinth and water primrose is

concentrated, and most control efforts will be conducted. Since there are fewer than 20 application sites, water samples for the MRP will be collected at two sites annually. A total of four samples will be collected annually from the two sites to characterize receiving waters for: (1) background monitoring, (2) event monitoring, and (3) post-event monitoring. Additional environmental parameters to be recorded during sampling will 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.

Water samples for laboratory analyses and other environmental parameters for the MRP will be collected by staff of the Sacramento Regional County Sanitation District (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.

Best Management Practices (BMPs)

The Refuge has developed a set of BMPs to meet the General Permit requirement that dischargers comply with all pesticide label instructions, DPR and Department of Health Services (DHS) requirements, and any permits issued by the CAC. The General Permit (Section D.5.m) also specifies steps that must be followed to identify and implement appropriate BMPs that maximize efficacy of control efforts and minimize adverse environmental impacts.

BMP #1 – Herbicide Handling Requirements

All personnel involved with the application of herbicides will be trained in herbicide handling in accordance with Food and Agricultural Code and Title 3 Code of Regulations pertaining to Pesticides and Pest Control Operations.

Storage: All WHCP and SCP herbicides will be stored in a secured warehouse in accordance with the California Food and Agriculture Code and Title 3 Code of Regulations.

Transport: Herbicides will be delivered by truck or boat to specific treatment sites on the day of treatment. They will be transported in their original containers or labeled containers, securely fastened to the truck or boat, in a manner that will prevent spillage onto or off of the vehicle or vessel. Spill kits and MSDS sheets will be provided when traveling in any vehicle.

Mixing, Loading and Applications: DBW staff shall use undiluted herbicides from containers of 5 gallons or less; only the herbicide containers being used will be opened at the application site. All mixing, loading, and application operations will be conducted in accordance with all label requirements and will be performed or under the direct supervision of a licensed pesticide applicator.

Disposal of Herbicide Containers: Herbicide containers will be triple rinsed and disposed of according to herbicide label and applicable regulations.

BMP #2 – Spray Equipment Maintenance and Calibration

Spray equipment shall be maintained in good condition so that equipment is spraying at proper rate depending on which herbicide is being used. Equipment shall be calibrated a minimum of every month which will include a check on all hoses, spray guns, clamps, and pumps.

BMP #3 – Spill Avoidance

All herbicide spills will be treated immediately using the following measures:

- Boats – herbicides will be securely fastened to floats in their original, watertight containers. Each boat shall carry a marker buoy with an attached anchor line to mark any herbicide, and water movement from the spill site, in the event of a spill.
- Vehicles – herbicides will be transported in their original, watertight containers, in a manner that will prevent spillage. MSDS and herbicide labels will be carried during transportation.

In the event of a spill, the crew will immediately contact the Field Supervisor and Refuge Manager and the following procedures will be followed:

Reporting Spills on Water

- The location of the spill will be noted
- The Field Supervisor and Refuge Manager will be immediately notified
- The amount of herbicide spilled will be assessed

The Specialist will mark the take record the location on cell phone map application and note the approximate location with any permanent land markers. Photographs of the spill will be taken. If deemed necessary, the Refuge will monitor the area for herbicide residues and environmental impacts.

Reporting Spills on Land

If a spill occurs on a public roadway, the crew will immediately notified the Refuge Manager and the USFWS Hazmat Coordinator

In the event a spill occurs, the focus will be to stop additional discharge and contain the spilled material. Spill kits will be used to immediately contain and absorb the material. Contaminated absorbent material shall be placed in a sealable disposable container suitable for transporting. The container will be labeled with its contents, including herbicide name and signal word and disposed of in accordance with the label and all applicable laws and regulations. The spill and its cleanup will be documented with photos (if possible) and the date/time registered. Copies of these photos will be attached to any spill reports filed.

BMP #4 –Environmental Awareness Training

Treatment crews will be instructed on how to identify special status species and implement avoidance measures and other measures required of the permit. The trainings will inform treatment crews about the potential presence of giant garter snake, valley elderberry longhorn beetle, Swainson's hawk nests and heron rookeries and that unlawful take of the animal or destruction of its habitat is a violation of the Endangered Species Act.

BMP #5 –Special Status Species Avoidance Measures

Avoidance measures to reduce or eliminate potential impacts of the program on special status species include the following:

- Avoid herbicide applications near special status species and their associated habitat, including sensitive riparian and wetland habitat and other biologically important resources.
- Verify the need for treatment by conducting preliminary site evaluations and options for treatment, including non-toxic or less toxic alternatives, and suitability of the site for treatment.
- Review maps showing locations of sensitive species including elderberry bushes, rookeries, Swainson's hawk nests and adjust control efforts to minimize disturbance or avoid area until later in the season.
- Prior to treating a site, perform a visual survey to determine whether special status plants, animals, or sensitive habitats are present.
- Conduct herbicide treatments to minimize potential for drift; do not apply herbicides if winds are greater than 10 mph.
- Operate program vessels in a manner that causes the least amount of disturbance to the habitat.

Giant Garter Snake

- Avoid disturbance of upland giant garter snake habitat (through disposal of harvested water hyacinth or land-based treatments) between May 1 and October 1.
- Dispose of all water hyacinth collected by handpicking outside of the May 1 to October 1 during the giant garter snake active season at an approved disposal facility to ensure no hibernating giant garter snakes are buried under piles of collected water hyacinth.

Valley Elderberry Longhorn Beetle

- Conduct all herbicide applications downwind of elderberry shrubs and utilize a coarse droplet size to avoid the potential for drift
- Maintain a 100-foot buffer between treatment sites and shoreline elderberry shrubs for most treatment sites
- Maintain a 50-foot buffer between selected treatment sites and shoreline elderberry shrubs where the 100-foot buffer would preclude the ability to treat water hyacinth. Only treat sites using a 50-foot buffer when winds are less than 3 mph.
- Compare the health of elderberry shrubs at control sites (not adjacent to treatment sites) with elderberry shrubs located adjacent to treatment sites. If elderberry shrubs adjacent to treatment sites show signs of adverse effects, develop additional mitigation measures to protect elderberry shrubs.
- Utilize disposal areas [for handpicking] that are at least 100 feet away from elderberry shrubs.

BMP #6 - Evaluation of Possible Alternatives

Waste discharge requirements included in Water Quality Order No. 2013-0002-DWQ indicate that "Dischargers should examine the alternatives to algaecide and aquatic herbicide use to reduce the need for applying algaecides and aquatic herbicides. Other available BMPs should be evaluated to determine if there are feasible alternatives to the selected aquatic pesticide application project that could reduce potential impacts to water quality and non-target organism."

Since inception of the control program in 1995, the Refuge continuously considers other BMPs to determine if feasible alternatives exist that could reduce potential water quality impacts. Practices which have been attempted, and continue to be in use (albeit to a limited degree), are discussed in this APAP includes:

- Mechanical control methods (including manual control)
- New biological control methods not previously considered. All biological control methods are still in the research stage to determine which native and naturalized insect species will provide long-term control.
- Combinations of control methods (e.g., mechanical methods followed by chemical methods). In this case, short-term immediate control could be gained using mechanical harvesting so that less aquatic herbicides potentially may be applied.
- Mycoherbicides (natural fungal pesticide), an approach thought to be more environmentally friendly, is still in the experimental stages.
- Prevention techniques, such as use of booms or gates to keep plants out of uninfested areas.
- Consider use of other aquatic herbicides labeled for water hyacinth control (i.e., triclopyr and diquat) and combinations of aquatic herbicides (e.g., diquat and complexed copper). To date, other aquatic herbicides are either are not as effective as the selected control methods or have too great an impact on the Delta environment.

Based on the evaluation of available alternative control options, the DBW has determined there are no feasible alternatives to the selected aquatic weed management measures currently used by the DBW for the WHCP and SCP.

Literature Cited:

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EXTOXNET. 1996. Glyphosate. Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis. pmep.cce.cornell.edu/profiles/extoxnet.

Greenfield, B. K. 2004. Evaluation of three mechanical shredding boats for control of water hyacinth (*Eichhornia crassipes*). Ecological Restoration 22(4):300-301.

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Figures:

Figure 1. Application Sites for Stone Lakes Basin Water Hyacinth Control Program

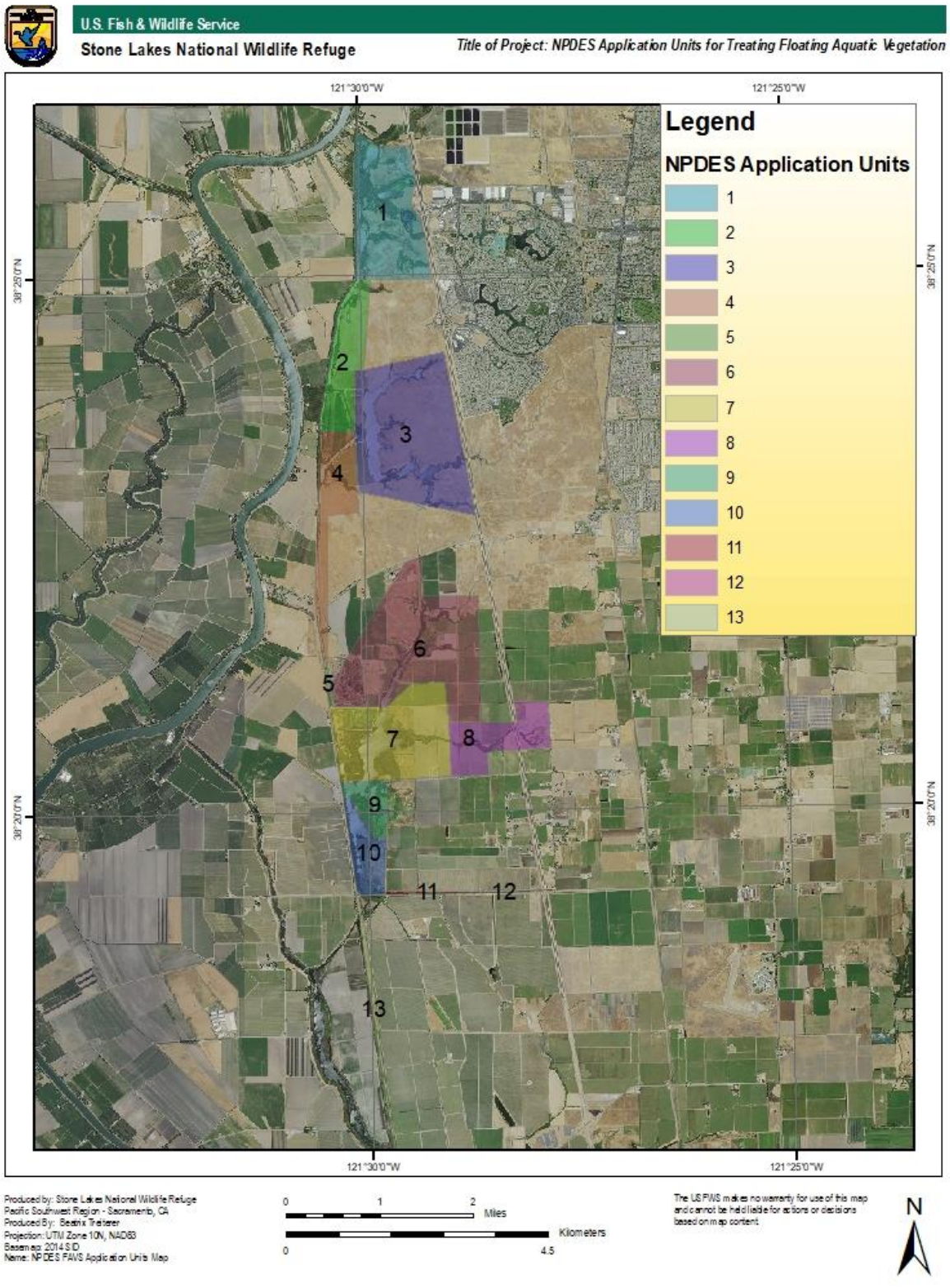

Figure 1. Application Sites for Stone Lakes Basin Floating Aquatic Weed Control Program.