HABITAT AND WATER MANAGEMENT PLAN
for the
Sherman Island Whale's Mouth Wetland Habitat Restoration Project

Prepared By:
California Department of Water Resources

and

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INTRODUCTION

The **Sherman Island Whale's Mouth Wetland Habitat Restoration Project (Project)** will create approximately 600 acres of permanently flooded wetlands on Sherman Island. The Project will be located on property owned by the Department of Water Resources (DWR; Figure 1). The goals of the project are:

- Control and reverse subsidence by using permanent flooding techniques;
- Create wetland and riparian habitat and monitor biological enhancement;
- Provide carbon sequestration benefits and evaluate the net greenhouse gas (GHG) benefits by restoring permanently flooded emergent wetlands on highly organic soils;
- Demonstrate the applicability of tested management practices to Delta and Suisun Marsh.

The Project will provide subsidence reversal benefits and develop knowledge that can be used by operators of private wetlands, including "duck clubs," which manage lands for waterfowl-based recreation. By maintaining permanent water, the growth and subsequent decomposition of emergent vegetation is expected to control and reverse subsidence. The parcel is expected to provide year-round wetland habitat for waterfowl and other wildlife.

To achieve final restoration goals, these wetlands will be managed through a system of water supply structures (including siphons, ditches, and swales), berms to ensure proper water management depths and site access, and water outflow control structures. Proper water management is critical for establishing and maintaining healthy habitat conditions in all managed wetlands. Managing water for the appropriate time of application, duration of inundation, and depth are the three key factors to support the desired vegetation and wildlife communities in a managed marsh. The restored permanent wetlands will require regular and attentive water deliveries, draw downs, and overall management to achieve the project's goals.

Throughout the year, water levels will be managed to encourage the establishment and maintenance of annual, perennial, emergent, and submerged aquatic vegetation. Subsequently, these vegetation communities will provide habitat for a variety of wetland dependent wildlife. Water management provides the means to vary water levels within and between units to distribute nutrients, decrease stagnant conditions, provide quality habitat, and minimize vector production.

PROJECT SUMMARY

The Project Site is located on Sherman Island Assessor's Parcel Number 158-0090-016-0000, in southwest Sacramento County, CA and is shown on the Antioch North, CA USGS topographic quadrangle. This un-sectionalized portion of Sherman Island would be considered to be generally located within Sections 4, 5, 8, and 9, Township 2N Range 2E. This land is owned by the Department of Water Resources (DWR).

Sherman Island is approximately 10,000-acre island in the western Delta approximately 70 mi southwest of the City of Sacramento. Historically, the project area was a marsh that was diked off from the Sacramento River and drained between 1850 and 1873 to facilitate agriculture. As a result of more than 130 years of farming practices, irrigation, and exposure of soils to air, the project area has subsided as much as 20 ft. A high water table currently makes the Project Site unsustainable as a long-term agricultural area.

Before the Delta was diked, drained, and farmed, it was subject to significant seasonal fluctuations in freshwater inflows, which worked in concert with large tidal ranges. Natural levees were formed by sediments deposited during spring floods and stabilized by vegetation. Dominant vegetation within the natural levees included tules - marsh plants that live in fresh and brackish water. Decomposing tules and reed vegetation formed the peat soils over thousands of years. In waterlogged conditions, decaying tules decompose slowly to release carbon dioxide and methane, which is trapped in the soils by water. Once the soil was diked and then dried, the peat soils decompose, which leads to compaction and subsidence.

Subsidence has reduced the distance from the soil surface to the water table. The resulting high water table makes the Site unsustainable for crop production, although much of the Site is currently used for corn production and pasture.

Recent environmental concerns in the Delta have prompted DWR to re-evaluate how properties in the region are managed. DWR is particularly interested in incorporating land-use practices that reduce or reverse subsidence. Research has shown that wetlands that are permanently flooded halt and can reverse subsidence, as well as sequester GHG. Therefore, DWR is interested in restoring the entire project site back to the palustrine emergent wetland type that existed in the early part of last century. In addition, subsidence reversal and GHG in the project area will be monitored and evaluated with the hope of undertaking similar projects elsewhere in the Delta. Management of the restored wetlands will be undertaken by DWR and/or a wetland manager.

The project will restore palustrine emergent wetlands and enhance existing emergent wetlands on site by upgrading existing and installing new water management infrastructure including berms, seasonally flooded islands, water control structures, and water conveyance channels on site. When the project is completed, water will be maintained in the project area year-round. Restoring permanent wetlands on Delta islands has been shown to halt and reverse subsidence. This project will combine the wildlife benefits of wetland restoration with the importance of reversing Delta island subsidence. All earthwork associated with the project is scheduled to begin in May 2014 and be completed by October 2014. Planting will commence during the fall of 2014 and continue through spring 2015. All work will be done within the Site.

Proper water management is critical for maintaining healthy habitat conditions in all managed wetlands. This permanent wetland will require regular and attentive water deliveries, draw downs, and overall management to achieve the project goals. Water depths, duration of inundation, and timing of flooding are the three key features of water management and all contribute to support the desired vegetation and wildlife communities.

WATERFOWL REQUIREMENTS

The Project will be managed to provide a variety environmental functions and values. One of those is wildlife habitat, particularly for breeding and wintering waterfowl. This project differs from other traditional Central Valley waterfowl areas in that it has been designed to maintain permanent vegetation and open water areas throughout. While permanent emergent wetlands are less productive for wintering waterfowl than seasonal wetlands, permanent emergent wetlands provide greater benefit for breeding waterfowl.

Breeding Season

California's breeding duck population is dominated by mallards, although wood ducks, gadwall, and cinnamon teal ducks are also common nesters in the Central Valley. These dabbling ducks need three primary habitat types for successful breeding: pair water, upland nesting areas, and brood water. When properly managed, the site will have an appropriate mixture of permanent wetland vegetation and open water with adjacent upland nesting habitats to encourage waterfowl reproduction.

Pair water refers to habitats used by breeding ducks while establishing territories and accumulating fat and protein reserves prior to nesting. These areas are typically used as brood ponds later in the season. Pair water typically consists of shallow ponds adjacent to upland nesting areas that have abundant invertebrate populations.

Waterfowl nesting occurs between early March and mid-June in upland vegetation adjacent to permanent water. Desirable nesting cover for most waterfowl consists of robust vegetation of approximately 12 inches or more in height within several hundred feet of permanent water. Although hens rely primarily on body reserves for energy during nesting, they do take "nest breaks" to feed.

Upon successfully hatching a clutch, hens lead their hatchlings to nearby brood water. Here, hens rely on invertebrates as their primary food source for rebuilding body mass depleted from egg laying, while ducklings rely on invertebrates for the next several months during their period of rapid growth prior to fledging. Wetlands with adequate cover and abundant invertebrate food supplies are necessary for optimal hatchling survival. Relatively tall wetland plants such as cattails (*Typha* sp.), tules (*Schoenoplectus acutus* or *californicus*), and other robust emergent vegetation provide cover for many species of wildlife, particularly young ducklings, which need to be able to escape predators.

Wintering Season

Upwards of 4 to 5 million waterfowl winter in the Central Valley. While the areas of the Sacramento Valley near the Sutter Buttes and the Grasslands region of the San Joaquin Valley traditionally support the majority of these birds, wetland habitats in the Delta region are also important. The most productive habitat for wintering waterfowl in the Central Valley is managed seasonally flooded marsh, or moist soil wetlands. These managed habitats support abundant high-calorie seed sources.

Wintering waterfowl have two main habitat requirements: areas with high-calorie foods and resting areas. The Delta region was historically permanently flooded marsh with dense emergent vegetation. This vegetation was dominated by hard-stem bulrush, or tules. While tules do not produce as many energy rich seeds as seasonal wetland plants, they nevertheless provide quality food sources and sheltered resting areas that are protected from storms and predators. Other quality plant food sources in permanent wetlands are submerged aquatic vegetation including widgeon grass and sago pondweed. These plants grow in deeper water than emergent vegetation and have extremely rich seeds, tubers, and associated invertebrate food resources.

Dense tule stands can also provide sheltered rest areas that are protected from storms and predators. Ponds, sloughs, and channels lined with tules are good foraging areas and also make excellent resting areas.

These food sources supply the energy needed to replenish waterfowl body fat reserves following fall migration and to build additional fat reserves to fuel the upcoming spring migration. Wintering waterfowl need to conserve energy as much as possible. Waterfowl that are frequently disturbed lose energy quickly from the demands of taking flight.

WATER MANAGEMENT INFRASTRUCTURE AND MAINTENANCE

Infrastructure

The Project site is divided into four separate wetland management units (Figure 3). Each unit is separated from the other units and the adjacent properties by a berm. This allows for flexibility for maintaining, raising, or drawing down water within and between each unit.

Approximately 27 water control structures will be installed. The interior of the site will be divided up into 7 managed wetland units, separated by 47,000 lineal feet of proposed interior berms, and crossed with conveyance swales, in order to facilitate appropriate water and vegetation management capabilities. Water levels in each unit will be managed independently to restore the desired emergent wetland conditions throughout the site. When the project is completed, water is proposed to be maintained in the project area year-round, effectively creating a permanent wetland.

Water will be conveyed within the wetland system via gravity flow from the higher elevation units to the lower elevation units until it finally makes its way back to the District's drainage canal, to the east of the project boundary. The ultimate outcome of the restoration project will be approximately 600 acres of freshwater emergent wetlands. Each wetland unit will be a mosaic of open water channels and emergent vegetation comprised predominantly of species such as California bulrush (*Schoenoplectus californicus*) and narrow leaved cattails (*Typha angustifolia*). Other native plant restoration components will include installation of native trees and shrubs compatible with their respective hydrologic regime as well as a substantial amount of upland transitional area, all of which will provide great diversity and increased habitat opportunity for wildlife.

Interior water conveyance channels will be excavated in the wetland management units to provide water delivery and circulation to all areas of the Site. The conveyance channels will provide numerous wetland and wildlife benefits to the project area. Material excavated to construct the channels will provide material for the buttress berm and the interior and perimeter berms. Construction of conveyance channels will convert existing wetland and upland areas into permanent open water that will facilitate water conveyance.

The channels will be managed to encourage the growth of submerged aquatic and floating wetland vegetation and discourage the growth of invasive species. Open water areas will provide waterfowl with areas to land, loaf, and feed. It is anticipated that the presence of permanent open water will increase the amount of waterfowl breeding and brood rearing in the project area.

Conveyance channels will have an approximately 15-ft wide bottom with gradual, 5:1 side slopes. Most of the existing agricultural drainage ditches on Sherman Island have rectangular configurations. A gradual channel side slope will allow for easy wildlife movement across the channels while reducing channel erosion by encouraging vegetation growth along the channel's edges. Depth of channel excavation will vary depending on existing topography.

In addition to the channels, larger open water areas will also be created through excavation. These larger open water areas will be connected to the conveyance channels and have the same bottom elevations. They will serve as waterfowl brood rearing areas in the spring and loafing/storm-shelter locations in the winter. Material borrowed from these areas will be incorporated into the interior and perimeter berms or used to construct loafing islands.

Water to the site will be delivered by existing gravity siphons along the San Joaquin River Levee. These siphons have fish screens that are maintained by the District and DWR. At this time it is anticipated that siphons 1, 2, 3 and 4 (as shown if figure 3) will be utilized as the primary source of water. Siphon 1 is a 14 inch pipe that is capable of discharging approximately 3000-3500 gallons per minute. Siphon 2 is a 12 inch pipe that is capable of discharging approximately 2500-3000 gallons per minute. Siphon 3 is a 12 inch pipe that is capable of discharging approximately 2500-3000 gallons per minute. Siphon 4 is a 10 inch pipe that is capable of discharging approximately 1750-2200 gallons per minute. Water will be conveyed within the wetland system via gravity flow from the higher elevation units to the lower elevation units until it finally makes its way back to the District's drainage canal, approximately 3,400 feet north of the proposed pumping station.

Improvements to the outlet of the functional siphon may include replacing outlet valves, installing flow meters, and installing additional appurtenances as needed to improve the control of the water supply to the Site. All siphon improvements will take place on the interior (land) side of the San Joaquin River levee. Water delivered to the Site will circulate through the system to maintain appropriate water quality conditions and prevent stagnation.

Several existing agricultural drainage ditches occur within the interior and exterior of the Site. These ditches connect to the master drainage system of the western portion of Sherman Island. The drainage ditches within the proposed project boundaries will be incorporated into the internal water conveyance system (swale system). A ditch along the exterior perimeter on the western, northern and southern sides of the restoration area will be constructed to ensure drainage from the surrounding landscape, and will include proper drainage for the District's toe ditches.

Maintenance

The project's water management infrastructure is designed for durability although some annual and regular maintenance will be required. The siphons will be inspected frequently (several times a week during irrigation months) to ensure efficient operation. Flash board riser water control structures will require periodic inspections to ensure proper and efficient water management.

Both interior and exterior berms must be inspected for evidence of erosion around water control structures and outlet pipes. Additional inspection of berms and levees is required to identify any holes. Animal burrows and other holes should be repaired and filled immediately to prevent berm failure. Drainage and supply ditches will be maintained and cleaned as needed to allow for efficient water flow.

WATER MANAGEMENT GUIDELINES

Proper water management in any managed wetland is essential for providing quality wetland conditions that support the desired functions and values. Water depths, timing, and duration of inundation, dictate the vegetation community present in any wetland. In a managed wetland, a pre-determined hydrologic regime can be implemented to produce a particular vegetation community and provide the conditions necessary to support the desired wildlife community.

Desired Wetland Condition

Proper vegetation composition and distribution is necessary for controlling subsidence, sequestering GHG, and minimizing vector production. For this project, the optimal vegetation community will be composed of a mixture of cattails and bulrush as these plants are adapted to withstand persistent flooded conditions. Vegetation density should be maximized to control and reverse subsidence. Conversely, open areas are desirable for waterfowl habitat and vector control. To balance these objectives, the established wetland vegetation community should have up to 70% vegetative cover to ensure sufficient open water pathways throughout the entire site. Each wetland management unit will have a varying ratio of vegetation to open water depending on ground elevations and maximum water surface elevations.

A permanently flooded wetland structure achieves multiple objectives. Subsidence control and reversal is achieved through persistent flooded conditions and robust emergent vegetation. Wildlife habitat is improved by providing a diverse mixture of open water and vegetation. Mosquito and vector control is facilitated with multiple open water areas, which provides access for treatment. Waterfowl hunting is facilitated by providing foraging areas, hunter access throughout the marsh, and providing waterfowl resting areas.

Water Depths, Duration, and Timing

The project will be managed to achieve a relatively constant water level that will provide the desired vegetation/ open water distribution. However, during the project's first year, water will be managed substantially different than subsequent years to encourage the rapid establishment of desirable wetland vegetation. Water depths for the first growing season will be managed to provide optimal germination conditions for cattails and tules on approximately 40% of the area of each wetland management unit. The first several months of the growing season will be critical for monitoring and evaluating the germination extent and rate. Water levels must be managed at first to encourage and then limit germination in order to achieve the desired vegetation to open water ratio.

Precise and careful management of unit water surface elevations is essential to prevent establishment of robust vegetation across the entire unit. When germination reaches the desired coverage, water levels will be raised to prevent additional germination while not drowning the new growth. During this time, germination will be evaluated weekly and water levels adjusted accordingly. If the desired vegetation coverage is not achieved during the first year, this procedure will be followed each successive year until the desired vegetation community is achieved.

Following the establishment of the desired vegetation community, water levels will be managed consistently on an annual basis to maintain wetland vegetation consistent with the project's goals.

Sherman Island Drainage System

Reclamation District 341 is responsible for the operation and maintenance of the drainage system within Sherman Island. This infrastructure consists of a network of drainage ditches and discharge pumps. The Project is part of the western drainage sub-system for the Island. This ditch network collects surface and groundwater from the western half of Sherman Island then channels it to the pumping station on the southwestern side of the island and ultimate discharge into the Sacramento River. The ditches surrounding the project will drain into the existing main ditch on the eastern edge of the site and drain back into the District's main drainage canal. This ditch connects directly to the pump station (Figure 2).

VEGETATION MANAGEMENT

Regular maintenance of the desired wetland vegetation will be necessary following its successful establishment. The project's goal for a permanent wetland condition supporting quality wildlife habitat can only be achieved in the long-term through proper maintenance and management of both wetland and upland vegetation. Ideally, the project should require only minimal management of wetland vegetation and limited annual management of upland vegetation. The desired wetland vegetation community consists of approximately 70% vegetative cover from cattails and tules along with seasonal wetland vegetation located on the islands and submerged aquatic vegetation in the deeper water. The desired upland vegetation is perennial and annual grasses and forbs on the perimeter and interior berms and uplands.

Flooding for Emergent Vegetation

Wetland vegetation management through control of water depths is the most effective tool for controlling vegetation growth in permanent wetlands. This tool not only provides the conditions for optimal spread of desirable vegetation, but can also limit its spread to create the desired mixture of emergent vegetation to open water. In general, water depths of less than 12 inches during the growing season will promote seed germination and have little control of rhizomatous vegetation. Water depths in this range are optimal to encourage the growth of emergent vegetation. Water depths between 12 and 36 inches will prevent germination but allow for the spread of vegetation by rhizomes. Once the desirable vegetation community is established, water depths during the summer season should be maintained in this range to limit continued spread of emergent vegetation. Water depths of greater than 36 inches will prevent seed germination as well as the spread of emergent vegetation via rhizomes. Persistent water depths of greater than 36-inches during the growing season will eventually eliminate emergent vegetation from these deep flooded areas. Water depths in the conveyance channels should be maintained in this range to maintain water conveyance capabilities.

Draw Downs

Wetland draw downs are an important management tool for permanent wetlands. Draw downs reinvigorate wetland nutrient cycles and stimulate vegetation growth. A wetland under draw down conditions mimics a drought cycle. Draw downs will depend on site conditions and may not be necessary for a period of up to 7 years following establishment of desired vegetation community. Within this time frame, the wetland units should be drawn down on a rotational basis where not more than one unit drawn down at any one time. This will ensure that adequate habitat remains available on most of the site.

Beginning the fourth year following the establishment of the desired vegetation community, each wetland unit should be drawn down and completely dried on a rotating schedule for several months of the growing season (May through September). This management technique would occur every 5-7 years to reinvigorate the marsh, to control problematic vegetation by mowing or herbicide application, as a best management practice to limit mosquito production, and/or to repair berms and water control structures as needed.

Habitat Islands and Riparian Vegetation

Habitat islands are an important component of the Project. Islands have a diverse array of species, habitat structure and eco-tones. As such, careful consideration of flooding depths and duration must be evaluated for each unit during fluctuation of water levels. Generally, Tules respond faster to water fluctuations than trees or shrubs. Due to the rhizome root system, if Tules are flooded out by depths greater than 2.5-3 feet, populations can recover quickly by reducing the flooding depth and promoting new germination. However, with woody species the flooding tolerances are less. Generally, wetland tree and shrub species as well as riparian species prefer saturated to slightly inundated condition. Surface water conditions resulting in significant flooding of trees and shrubs for durations longer than a several days in the summer and a few weeks during the winter months may kill woody species permanently. This may be necessary for long term increases in water depths for subsidence reversal purposes. However, increases in water depths for non-native invasive species control and or promotion of other native wetland plant communities should be limited to the tolerable constraints of the woody species during normal practices. A good indicator of the limits of tolerable conditions can be noted by observing signs of stress from the trees and shrubs located in the deepest flooded areas of each unit. Signs of stress can include yellowing or browning of leaves, twig dieback or buds failing to open.

It is anticipated that over the course of many years, through accretion that the upland portions of habitat islands will eventually be transformed into wetland habitat. This planned natural progression will likely continue to provide habitat diversity as it will become a deciduous forested and deciduous scrub-shrub wetland habitat amongst a larger area of emergent wetland.

Irrigation of Islands

During hot summer months when irrigation water is readily available, increasing surface water elevations to irrigate habitat islands may be beneficial for tree, shrub and herbaceous species survival as well as non-native species control. After vegetation establishment, surface water elevations should be increased by 0.5 to 1 foot for about 1 week during summer months. The irrigations will also help control upland invasive species like Himalayan blackberry (*Rubus armeniacus*), perennial pepperweed (*Lepidium* sp.), and cocklebur (*Xanthium strumarium*).

Supplemental Planting

Mortality of planted woody species, generally between 20-50 percent, is common for restoration projects. It is very extremely important to replant areas that are prone to erosion in order to establish a diverse vegetative component throughout the project area. Supplementing transitional areas such as berms and islands with additional plantings can be achieved during normal maintenance of berms. Typically, willow tree and shrub branches will need to be trimmed along the access portions of the berms. This maintenance should be conducted during the late fall and winter months when possible. During these months branches can be cut into “Stakes” which can then be planted in areas where additional plantings are desired.

Mowing and Herbicides

Mechanical and chemical removal of problematic vegetation is an important component for habitat management. Wetland vegetation will need to be controlled if plant coverage expands beyond 80% or if the swales and potholes become overgrown with emergent vegetation. Aerial photos can be used to evaluate the percentage of vegetation coverage. Any unit with a vegetation problem will need to be drawn down and dried to allow mower access.

Upland vegetation on the tops of berm should be mowed annually to provide vehicular access to water control structures for regular maintenance, and access by larger equipment for special maintenance needs. Upland vegetation should not be mowed during the avian nesting season between March 1 and June 30.

Annual control of weedy vegetation will be required on annual basis to promote the desired wetland and upland vegetation communities and avoid and control exotic/invasive species. These exotic/invasive species include Himalayan blackberry (*Rubus armeniacus*), common reed (*Phragmites australis*), perennial pepperweed (*Lepidium* sp.), cocklebur (*Xanthium strumarium*), and other species as identified in the field. Each of these species has the capability to overtake both wetland and upland communities. Deeper water levels within the wetland area will help to control the spread of these species. These species can be problematic if not controlled vigorously along the edges of the wetland areas. In areas in which mowing is not practical, chemical control using an herbicide labeled for application in wet environments is recommended. Glyphosate formulated herbicides are effective for controlling annual weeds as well as common reed if applied correctly. Perennial pepperweed can be controlled with imazapyr or chlorsulfuron formulated herbicides. Himalayan blackberry can be controlled using triclopyr in dry areas. All herbicide applications must follow application rates and procedures identified on the packaging label, and will be applied by a certified/licensed applicator.

PEST MANAGEMENT

Pest management is often a necessary management activity for manipulated wetlands in the Central Valley and Sacramento-San Joaquin Delta regions. Mammalian and invertebrate pests can be problematic for the successful operation of the project and achieving the projects goals and must be controlled when warranted.

Mammals

Wetlands and riverine habitats in the Central Valley are preferred habitats for muskrats and beavers. These rodents can damage wetland management infrastructure by burrowing into berms, levees, and around water control structures. If left unchecked, these excavations can ultimately compromise the structural integrity of the water management infrastructure.

To minimize the potential damage these rodents can have on water management infrastructure, several of the berms have been designed with 3:1 side slopes. Gradual slopes limit burrowing activity compared with steep slopes such as a 1:1. In berms constructed at 3:1 slopes, annual inspection is necessary to fill any burrows.

Beavers are instinctively drawn to the sound of flowing water. When the source of the sound is located, beavers will attempt to build a dam and halt the flow of water. Water control structures will be cleared of any debris that may prevent adequate water flow.

Mosquitoes

Wetlands in the Central Valley and Sacramento-San Joaquin Delta are well known for their capabilities to produce mosquitoes. Because of its flooded pasture land uses, Sherman Island in particular produces some of the highest numbers of mosquito larvae in the western Delta. The island is within the Sacramento-Yolo Mosquito and Vector Control District (SYMVCD). The SYMVCD regularly inspects and controls mosquito larvae on the island using larvacide control methodologies. In an effort to minimize mosquito production from this project, the SYMVCD has been an active participant in the planning process.

With the current threat of West Nile and the potential spread of the H5N1 avian influenza, using water and habitat Best Management Practices (BMPs) to limit the growth and spread of mosquitoes is important. The BMPs included in Attachment B have been incorporated and utilized during the development and long-term management of the project to minimize the growth of mosquito populations.

Figure 1. Sherman Island Whale's Mouth Wetland Restoration Project Site & Vicinity Map

Base maps: Antioch North, CA USGS 7.5 minute togographic quadrangles

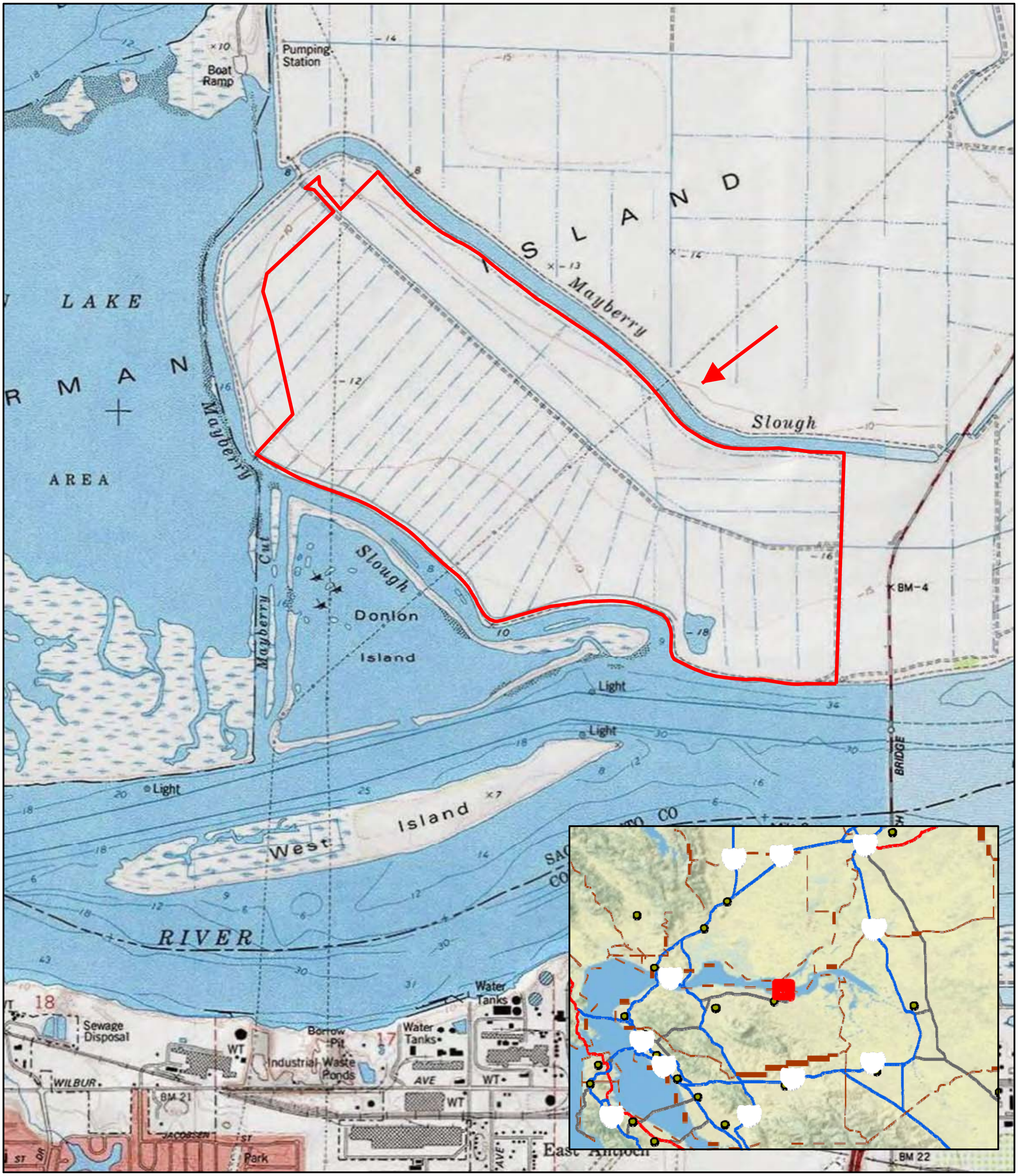

Figure 2. Infrastructure Map

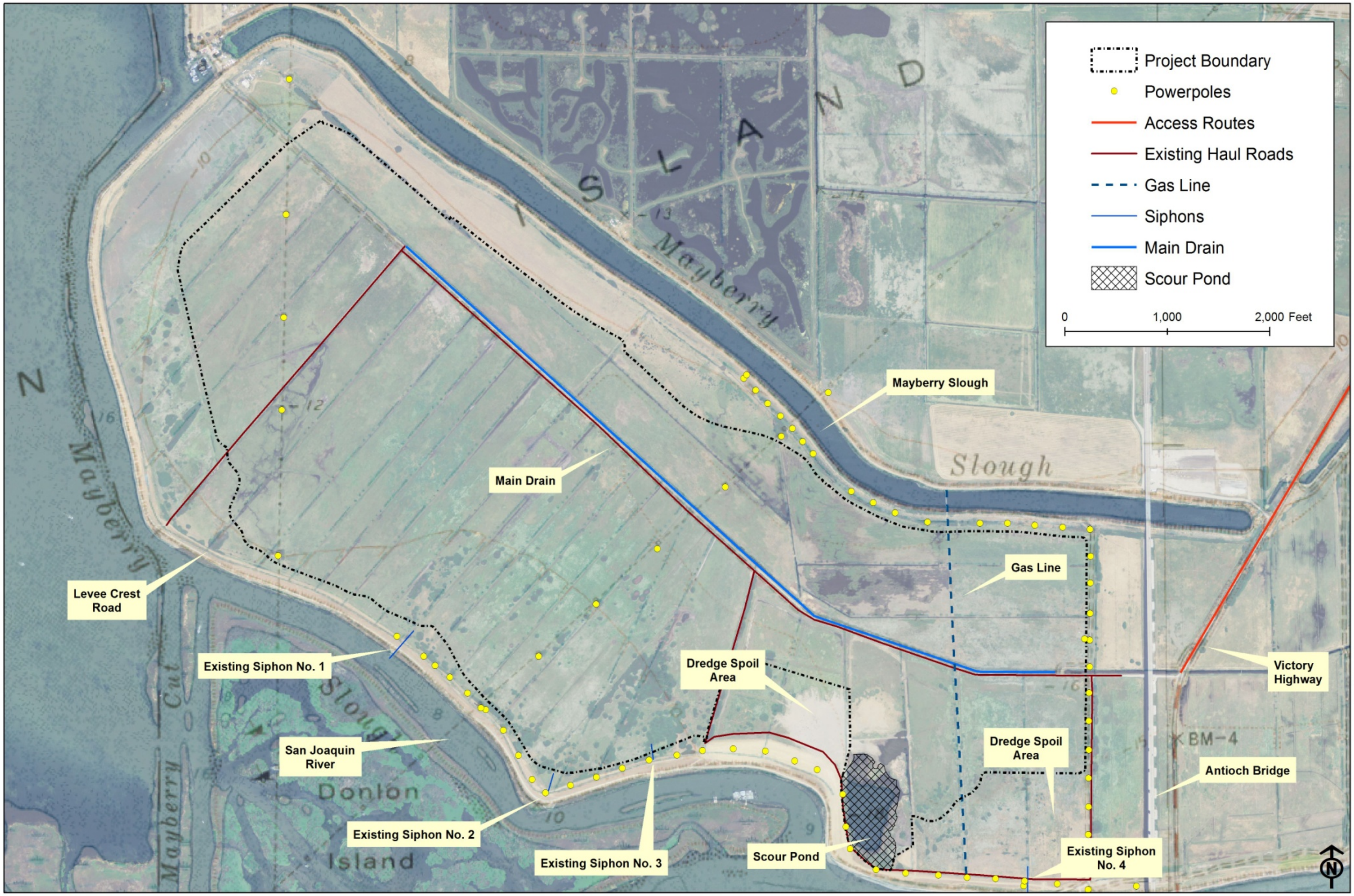

Figure 3. Restoration Plan Map

Prepared by: DUCKS UNLIMITED

Map Created by: Patrick Britton
Date of Map: August 20, 2013

Figure 4. Sherman Island Whale's Mouth Conceptual Design

Aerial photo: 2012 Color Orthophotography   Project location: Unsectioned, T2N, R2E, Sacramento County, CA

The project as proposed will result in creating approximately 600 acres of perrenial wetland marsh.

0 450 900 1,800 Feet

1 inch = 450 feet

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