RECLAMATION DISTRICT 341

SHERMAN ISLAND

FIVE YEAR PLAN

SH 08-3.0

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1. Executive Summary

The Five Year Plan (Plan) has been defined in the *Delta Levee Special Flood Control Projects Final Interim Guidelines for Providing Funding to Local Public Agencies* (Interim Guidelines) as a document that describes, in detail, a District’s integrated work plan to repair and improve flood protection infrastructure for the next five years. The requirements of the Plan are set forth in Attachment A of the Interim Guidelines (see Appendix A) and include:

- assessment of the status of existing levee systems and future goals,
- strategy to meet desired level of protection,
- identification of need for improvements to alleviate or minimize existing hazards,
- identification of the risks for current land use based on the existing assets,
- identification of opportunities for multi-objective project,
- habitat mitigation and enhancement and
- compliance with CEQA and obtaining required permits.

The contents of the Plan are based on both the requirements included in the *Interim Guidelines* and on direction received from Department of Water Resources staff. In accordance with staff direction, this Plan contains a detailed accounting of all technical information available. The information is presented and analyzed for the purpose of determining potential levee stability issues. Stability issues are reviewed with regard to the District’s five year level of protection goal, and projects to enhance stability or to gather additional technical information as required are proposed in order of priority.

The objective of the Five Year Plan is to identify improvement projects to the Sherman Island levee system that will protect public facilities and provide public benefits for a five year period. Improved levees minimize the threat of levee failure, protect Delta water quality and protect the reliability of the State Water Project, Contra Costa Canal, and Central Valley Project, and other local and non-local assets.

The Five Year Plan provides a strategic approach to rehabilitation of the levees and identifies habitat mitigation possibilities to facilitate implementation of the levee improvement projects. It is intended that with the Plan in place, feasible projects will be identified and ready to implement as funding becomes available.
2. A Brief History of Sherman Island

Geomorphic Evolution

The geomorphology of the Sacramento-San Joaquin Delta before the period of Euro-American colonization was dominated by intertidal landscapes shaped by sea-level rise and sedimentation. During the last glacial period, around 15,000 years ago, relative sea level was approximately 300 ft lower than today and the Pacific coast was at least 6 miles west of its present position. During this time the Delta formed part of the arid alluvial floodplain of the Central Valley and alluvial sand deposits together with aeolian sand deposits underlie most of the late Holocene Delta soils.

Between 10,000 and 5,000 years ago relative sea-level rise was rapid, approximately 6 mm/yr, then about 5,000 years ago the rate slowed to about 1-2mm/yr. At this time sea water encroached landward through the Carquinez Strait into the lowlands that became Suisun Bay and the Delta. It is likely that early in the formation of the Delta landscape (6,000 to 5,000 years ago), the rate of relative sea-level rise created more accommodation space than could be filled by the flood-borne sediment supply, and brackish sedimentary environments transgressed landward. This period of time saw the widespread deposition of organic silt and clay across the alluvial floodplain surface.

The Sacramento Delta to the north comprised about 30% of the total historic Delta area and extended as far as Sherman Island to the west. Its morphology was created by the interaction of rising sea level, alluvial river-flood deposition and tidal marsh peat formation. This created an inland ‘bird’s foot delta’ of distributary channels bordered by higher supratidal natural levees, and surrounded by marsh plains.

In the Delta, for the last 5,000 years to the 1850s, relative sea-level rise was balanced by vertical marsh growth through biomass accumulation and sediment deposition. A transition from deposition of organic silt-clay to peat formation in the Delta largely reflects the decline in inundation frequency and the maturation of the marsh plain towards mean higher high water elevations. The resulting freshwater tidal marshes developed because a relatively large freshwater inflow compared to the size of the tidal prism sustained a low salinity, which supported highly productive organic peat formation through tule growth. The large roots of the tule created an organic fabric that supported and aided rapid vertical growth. The living surface was maintained within the intertidal zone (natural habitat), and marsh organic accretion (injection of roots and rhizomes, and incorporation of surface litter) was able to sustain vertical growth at rates in excess of relative sea-level rise. The gradual accumulation of the organic and inorganic sediment must have also offset the loss and compaction of existing peat.

The development of today’s Delta began in late 1850 when the Swamp and Overflow Land Act conveyed ownership of tall swamp and overflow land, including Delta marshes from the federal government to the State of California. Reclamation of Sherman Island began shortly thereafter, and by 1859, local property owners had constructed small peat
levees of three to four feet in height, with a base width of about eight feet, along the banks of the Sacramento River and Mayberry Slough.

**Historical Flood Events**

The first significant flooding affecting Sherman Island agriculture occurred during the 1861/62 season and caused wide-spread damage throughout the delta’s river islands, and Sherman Island farmers lost most of their livestock as a result when the Sacramento River breached the low levees constructed along its banks. After completion of the levee system in 1869, Sherman Island suffered several floods. Sherman Island levees failed during the winters of 1871/72, 1874/75, 1876, and 1878. Several crevasses cut through the north and south levees west of Mayberry Slough in the 1874 levee failure, resulting in the loss of all but 100 acres of cropland in the western portion of the island. The subsequent levee reconstruction featured a 12-foot high peat levee with 120 feet widths at the base. Even so, the 1876 flood covered the western portion of the island again. The flood of 1878 devastated the entire island.

Subsequent levee breaks on the San Joaquin River submerged most of the land and Sherman Island’s 700 inhabitants fled to higher ground. The beleaguered reclamation districts were faced with underwriting thousands of dollars in assessments to replace most of the levee system. Landowners regrouped, and in March 1878, Reclamation District 252 formed out of a portion of RD 54. Sherman Island landowners reorganized again, and RD 54 and RD 252 combined to form Reclamation District No. 341 (RD 341) on June 17, 1879. Although reclamation efforts continued in RD 50 west of Mayberry Slough for several years after the 1879 floods, landowners eventually dropped reclamation efforts, and after the land flooded during the 1940s, ownership of the land reverted to the State for taxes.

By spring 1880, most of the new RD 341 was again under cultivation until high waters collapsed levee sections again in August later that year. Although an assessment of $13,141 was made for levee repair following the 1880 break, most of the land remained under water until 1894 when reclamation efforts were renewed.

In 1894, RD 341 encompassed 10,303.71 acres of land east of Mayberry Slough and the 3,000-foot cross-levee between Sacramento River and Mayberry Slough. The Sacramento and San Joaquin rivers are connected by Three Mile Slough, which forms the eastern and northern boundary of the Island. The district included 24.76 miles of levee, much of it at the time destroyed by previous floods. At the time, much of Sherman Island had been underwater for fifteen years. Although some stretches of levee were intact, much of the levee had sunk to the ground level of the island or below. The Horse Shoe Bend area of the Sacramento River had several breaks; one about 500 feet in width, with resulting scar holes measuring about 75 feet deep. The San Joaquin River levees on the south side of the island were essentially destroyed from Gallagher Slough, near the modern day location of Eddo’s Resort, to the mouth of Mayberry Slough.

During the first decade of the twentieth century, RD 341 conducted frequent levee upgrading and restoration projects on Sherman Island. RD 341 leased four dredges in
that worked in tandem around Sherman Island. Flooding occurred in some section of the Delta almost annually during the period from 1900 to 1910, and serious levee breaks and major flooding of RD 341 occurred during 1904 when a crevasse opened on Mayberry Slough, and in 1906 and 1909, when water again inundated the island. RD 341 trustees contracted with Franks Dredging Company for levee construction and repair work between 1908 and 1920.

The southern levee on the San Joaquin River side failed and flooded the Island on January 20, 1969 at approximate levee station 520+00. Upon finding the break, a large quantity of rock was placed on the upstream and downstream ends of the levee to protect against further erosion from high velocities into and out of the break due to tide. Without placement of the rock, the break which was approximately 275 feet wide and about 45 feet below mean sea level, would have been greatly enlarged. After the break, the water inside the island and in the San Joaquin River was at the same level. The flooding created a deep hole in the channel on the waterside and a deep lake on the landside toe of the levee at the site of the break. Pumps to dewater the Island were rented (District pumps were entirely submerged). Pumping with the rented equipment commenced February 28, 1969 and continued through August 9, 1969, at which point District pumps continued to remove the remaining water from the Island. All 93,000 feet of District drainage ditches were cleaned and/or excavated, primarily by drag line and ditcher operations before District ditches were operable. The Corps of Engineers spent approximately $600,000 in emergency funds to repair, reslope, and regrade the levee break area after the 1969 break. Seepage and settlement in the area of the break have been ongoing issues requiring constant levee improvements.

Photograph from July, 2008 of the Scour Pond created by the 1969 breach.
3. **An Inventory of Assets Protected By the Sherman Island Levee System**

**Sherman Island Today**

Today, Sherman Island (see Exhibit A) is protected by approximately 18-miles of levee which encompass approximately 9,937 acres of land, according to the 1995 Sacramento Delta San Joaquin Atlas. Approximately 9 miles of levee are project levee, constructed by the US Army Corps of Engineers, and approximately 9 miles of levee are non-project levee. The entire levee system is maintained by RD 341. RD 341 maintains and operates five modern pumping stations on Sherman Island: three on the San Joaquin River (south) side; one on the Sacramento River (north) side; and one on Sherman Island’s northwest corner. The pumps are part of a larger system of pumps, siphons irrigation ditches and canals used to circulate water and drain the Island. See Appendix L for details of the drainage system including location of the canals, siphons and pumps. Also included are pump capacities. Irrigation and canal ditch capacities are not available at this time.

According to the 2000 census, the Island has a population of 233 people, with 110 dwelling units. The District maintains an emergency response plan in the event a dangerous condition could significantly compromise the levee system (see Appendix H).

The Sacramento County General Plan designates approximately 500 acres of recreational land and about 10,000 acres of agricultural cropland/resource conservation area. Sherman Lake is designated as natural preserve. Crop acreage on Sherman Island as reported in the DRMS Risk Analysis Report dated July 16, 2008 is as follows:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>3,446</td>
</tr>
<tr>
<td>Field Crops</td>
<td>3,771</td>
</tr>
<tr>
<td>Grain</td>
<td>1,567</td>
</tr>
<tr>
<td>Truck</td>
<td>6</td>
</tr>
<tr>
<td>Vineyard</td>
<td>2</td>
</tr>
</tbody>
</table>

In addition to agricultural uses, several recreational vehicle parks and marinas for local and public use are located on Sherman Island including Rio Viento on the Sacramento River side, Eddos Harbor and RV park which includes a 70 berth marina on the San Joaquin River side (see aerial photograph on right), Sherman Lake Marina on Sherman Lake, and the Outrigger Marina located on the Island’s northeast corner. In total, the Island provides 368 marina berths, a boat launch maintained by Sacramento County and one fishing access site.
Local Assets

The DRMS July 16, 2008 Risk Analysis Report indicates that the Sherman Island levee system protects approximately $11,500,000 in local assets. The following table provides a breakdown of local assets for which the District can levy assessments:

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>6,132.83</td>
</tr>
<tr>
<td>Agricultural-Irrigated from District Facilities</td>
<td>4,003.44</td>
</tr>
<tr>
<td>Marina-Recreation</td>
<td>14.98</td>
</tr>
<tr>
<td>Urban</td>
<td>79.51</td>
</tr>
<tr>
<td>Commercial</td>
<td>7.52</td>
</tr>
<tr>
<td>Utilities</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>10,239.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Utility Easements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rossetta Resources Corporation</td>
<td>8.69</td>
</tr>
<tr>
<td>Pacific Gas and Electric Co.</td>
<td>414.23</td>
</tr>
<tr>
<td>Great Western Power Co.</td>
<td>46.39</td>
</tr>
<tr>
<td>Natural Gas Corporation of Calif.</td>
<td>4.70</td>
</tr>
<tr>
<td>Lodi Natural Gas and Storage</td>
<td>12.81</td>
</tr>
<tr>
<td>Western Area Power Administration (WAPA)</td>
<td>83.54</td>
</tr>
<tr>
<td></td>
<td>557.55</td>
</tr>
</tbody>
</table>

The local assets described above include recreational facilities, easements for infrastructure and local infrastructure. Sherman Island Levee Road, a ten to fifteen foot wide road both paved and gravelled, runs on the levee crown. The road provides access to the recreational vehicle parks and marinas for local and public use, fishing area and windsurfing area.

Although the assets listed above are local assets against which the District can levee assessment for flood protection, the levees also protect non-local assets which provide a public benefit.
Non-local Assets and Public Benefit

The Sherman Island levee system protects non-local assets which provide a public benefit, including infrastructure, utilities, water quality and water supply reliability. Below is a list of the non-local assets protected by the levee system:

**Non-local Assets Protected by the Sherman Island Levee System**

**Water Delivery System**
- State Water Project
  - South Bay Aqueduct
  - North Bay Aqueduct

**Federal Central Valley Water Project**
- Delta Mendota Canal
- California Aqueduct
- Contra Costa Canal

**Miscellaneous Diversions Directly from the Delta**
- Western Delta Industry
- 1800+ Agricultural Diverters
- City of Vallejo diversion

**Infrastructure**
- State Route 160
- Highway 160 Drawbridge
- Dam (forms Mayberry Canal)

**Utilities**
- Major 500kV Transmission Lines
  - WAPA California Oregon Transmission Project
  - PG&E Table Mountain-Tesla line
  - PG&E Vaca Dixon-Tesla line

**Natural Gas Resources**
- Natural gas pipeline from Canada
- Natural gas storage area

**Telecommunication and fiber optic lines**

*Note:
See following diagram of Water Development Facilities*
4. Consequences of Levee Failure or Breach

Consequences of Sherman Island levee failure or breach for local and non-local assets described in the previous chapter are described briefly below. For a more comprehensive discussion of risk and possible consequences of asset loss, see The Risk Analysis Report dated July 16, 2008 completed as part of the Delta Risk Management Strategy (DRMS). The DRMS report provides detailed descriptions of types of failures possible and economic consequences of such failures.

In addition to the costs incurred to repair or replace the assets destroyed by Sherman Island levee failure, an immediate cost would be pumping out the Island. To estimate the cost of restoring Sherman Island, we considered the 2004 failure of the Upper Jones Tract, an Island of 6,259 acres which cost approximately $120 million to restore. This equates to about $19,100 per acre, and assuming inflation of 4% a year, would be about $22,200 in 2009. Accordingly it would cost approximately $221 million to pump out and restore Sherman Island (9,937 acres X $22,200 per/acre = $221 million). This estimate is conservative in that it does not account for the elevations on the interior of Sherman Island, which are up to 20 feet below sea level. Sherman will likely impound a greater volume of water per acre than Upper Jones Tract, and per acre restoration costs will therefore be greater.

Transmission Lines

Three major electric transmission lines (greater than 500kV) cross Sherman Island: the California Oregon Transmission Project, operated by the Western Area Power Administration, the Pacific Gas and Electric Company (PG&E) Table Mountain-Tesla line, and the PG&E Vaca-Dixon-Tesla line. These lines work mainly to interconnect California loads and generation with loads and generation in the Pacific Northwest. The three lines through the Delta are operated as a coordinated grouping, with maximum imports or exports limited to provide some joint redundancy to help ensure reliability.

The combined load on these three lines is typically around 4,000 MW, though under some circumstances it can be as high as 4,800 MW (Mirzadeh 2006). This is approximately ten percent of statewide summer loads, which is less than the required planning reserve margin of 15 percent. However, other outages may occur at the same time as this disruption, so under some circumstances the loss of all three lines due to the failure of the Sherman Island levee system could cause operating problems.

PG&E also operates two other lines with less than 500kV capacity to provide local service to Sherman Island and nearby Delta Islands. Failure of the Sherman Island levee system would impact the ability of PG&E to serve the local delta community.

The DRMS report estimates the cost of a two month outage of two 500 kV lines to be $42,000,000. For additional information, please refer to the DRMS report.
The photograph to the right shows the major and local transmission lines described above.

Natural Gas Resources
Sherman Island has 60 natural gas and oil wells, and approximately 1,082 acres of gas and oil production fields. In addition, the levees protect 145,514 feet of a natural gas pipeline which originates in Canada and crosses Sherman Island. Failure of the Sherman Island levee system would interrupt gas service through the pipeline and gas production and storage occurring on Sherman Island.

IMPACTS TO WATER QUALITY

Sherman Island levees provide a public benefit by maintaining water quality and water supply reliability for cities and farms in the San Francisco Bay area, San Joaquin Valley, and Southern California. Sherman Island is situated where fresh river water and salty bay water meet and mix. Under typical summer salinity conditions in the lower Sacramento River, salinity rises sharply in the area of Sherman Island. Consequently, the island’s levees are critical to controlling salinity intrusion to the interior Delta. A levee break would increase the rate and area of mixing and would allow the saline bay water to move further upstream, jeopardizing the fresh water supply taken from the Delta for the Central Valley Project water supply, the State Water Project and the Contra Costa intake (see previous Water Development Facilities diagram).

An artificial balance is maintained in the water exchanged between the Delta and the San Francisco Bay. Freshwater inflows regulated by upstream dams and diversions supply water to the Delta ecosystems and to farms and cities in central and southern California. Failure of Sherman Island levees would tip the water exchange balance in favor of more saltwater intrusion, which can ruin the water for agriculture and domestic uses supplied by the State Water Project and the Central Valley Water Project. Any reductions in the supply of imported Delta water could force water purveyors in many parts of the State to meet water demand with ground-water supplies. This, in turn, could renew land subsidence in the Santa Clara and San Joaquin Valleys and exacerbate subsidence in Antelope Valley and other areas that currently are reliant on imported Delta water supplies and prone to aquifer-system compaction.

The presence of the western Delta islands, Sherman Island in particular, is believed to effectively inhibit the inland migration of the salinity interface between the Bay and Delta. If Sherman Island were to become permanently inundated with saline water, the
water available to the massive pumping facilities near the Clifton Court Forebay might become too saline to use. The timing of levee breaks and flooding is critical in this regard. Fortunately, most flooding occurs in winter and spring, when major saltwater intrusion is less likely. However, there are occasional levee failures under low-flow conditions. These failures can cause major short-term water-quality problems, even if the flooded areas are later reclaimed. During one such incident, which occurred in summer of 1972, the Andrus Island levee failed, flooding an area slightly larger than Sherman Island. Salt concentrations in the central and western Delta quickly showed an increase up to sixfold. It took a large volume of extra reservoir releases to flush the salty water from the west Delta. The Andrus Island levee break may also have been a contributing factor in high mortality of juvenile bass that year. Similar impact could occur if one of Sherman Island’s levees were to fail under low flow conditions.

The Department of Water Resources modeled salinity impacts of levee breaches in the Delta with the DWR Delta Simulation Model 1 (DWRSIM1). In particular, DWR modeled the long-term impacts of un-repaired levees. DWRSIM1 accounted for Delta bathymetry, tidal fluctuations, facility configurations, water exports, breach size, and location. The model predicted altered salinity levels and compared them to historical salinity levels over four years at eight locations in the Delta (DWR, 1999). DWR concluded that un-repaired levee breaches on Sherman Island would nearly double salinity near the Contra Costa Water District intakes.

Reducing increased salinity levels hinges on repairing the levee breaks, flushing the Delta with upstream reservoir releases, and pumping out salt water in the south Delta (DWR, 1982). Failure to repair the levees in a timely manner not only perpetuates elevated salinity levels in the Delta but also increases the damage to remaining portions of the levee systems. While the islands are inundated, the interior face of the levee is subject to wind generated wave erosion. The combination of several large levee breaches and waves rapidly eroding the levees from the interior increases the amount of time and material necessary to repair the levees, and subsequently, the amount of time to reduce salinity levels to acceptable levels. If emergency response teams are unable to repair all the levee breaches and pump water off the islands, it is conceivable that salinity levels will remain elevated and terminate an entire year or more of water exports. If a levee were to break and not be repaired, the situation would continue, resulting in long-term degradation of Delta water quality that would adversely affect several beneficial uses, including fish and wildlife, municipal and industrial, and agricultural uses. The situation would be especially severe on Sherman Island because of the Island’s size (9,900 acres) and interior elevation, which is in excess of 20 feet below sea level.

The quality of water supplies derived from the Delta depends to a great extent on the path the water takes through the Delta to the export facilities. Water diverted from the Sacramento River upstream of Sherman Island and transported through the Delta waterway to the Delta export facilities maintains good water quality because mixing with saline water from the ocean is minimal or non-existent. Water that takes a reverse flow path around the western end of Sherman Island is of poorer quality because it is forced to blend with ocean-derived water high in chlorides. Increased chloride levels affect the
ability of water project operators to meet Delta water quality standards. Permanent flooding of Sherman Island would worsen this situation resulting in even higher chloride concentrations. This would require modifications in project operations involving releases of upstream storage to help offset the chloride levels.

The water supply relied upon by the Central Valley Water Project, State Water Project and miscellaneous diversions directly from the Delta, and the regions they serve would be negatively impacted should water quality fall below acceptable standards due to a salinity increase caused by failure of Sherman Island levees. Projections of increased salinity resulting from a levee breach are included in Appendix J.

The DRMS report provides an estimate of the cost to urban water uses which would result from a water shortage, such as that which could be caused by a decrease in water quality due to failure of the Sherman Island levee system. The estimate ranges from $23,000,000 million per month assuming a 5% shortage in water deliveries to $81,938,000,000 per month, assuming a 100% disruption in water supply. For additional information, please refer to the DRMS report.

STATE INFRASTRUCTURE

Sherman Island levees also protect State Highway 160 and the drawbridge at Three Mile Slough. State Route 160 connects Sherman Island to the mainland Sacramento County on the northeast corner via Threemile Slough Bridge (Bridge 24-0121), and to Contra Costa County on the island’s west side, via the Antioch Bridge (Bridge 28-0009). Failure of the Sherman Island levee system and resulting loss of State Route 160 and access to the Antioch Bridge would severely impact truck and vehicular traffic relying on this roadway. To determine the reduction in public benefit which would be realized should the levees fail, we reviewed Annual Average Daily Traffic (AADT) counts and Annual Average Daily Truck counts available from Caltrans. AADT is the total volume of traffic from October 1st through September 30th divided by 365 days. The results are shown on the table below:

<table>
<thead>
<tr>
<th>State Route 160 Traffic Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SR 160 Count Location</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Antioch, Junction Rte. 4 east</td>
</tr>
<tr>
<td>Wilbur Avenue</td>
</tr>
<tr>
<td>Contra Costa/Sac Co. line</td>
</tr>
<tr>
<td>Junction Route 12</td>
</tr>
</tbody>
</table>

* Back AADT represents traffic South of the count location. Ahead AADT represents traffic North of the count location.
The above table clearly shows that in addition to the inconvenience to the general public caused by the loss of a major state highway, truck traffic along State Route 160 is significant, and loss of the roadway would disrupt intrastate commerce.

The DRMS report estimates that closure of State Highway 160 would cost approximately $70,000 per day.
5. **Future Goals for the Sherman Island Levee System**

The District expects to achieve the goals described below to reduce the risk of levee failure and loss of assets and public benefit provided by the levee system.

The District proposes the following five year goals:

**Goal 1:** *Improve District levees to reduce risk of levee failure and impacts to water quality, water supply reliability, other non-local assets and local assets*

- **Goal 1a:** Improve all non-project levees to meet minimum PL 84-99 height and width standards.
- **Goal 1b:** Improve the stability of the levee system by draining areas with seepage and repairing cracks.
- **Goal 1c:** Reduce the potential for wind and wave erosion.
- **Goal 1d:** Reduce the risk of overtopping by maintaining existing splash cap protection or installing additional splash cap protection as required.
- **Goal 1e:** Move standing water away from the levee toe.
- **Goal 1f:** Gather additional information as required to determine extent of levee repair work necessary.

**Goal 2:** *Ecosystem restoration and habitat enhancement*

- **Goal 2a:** Identify programmatic mitigation opportunities
- **Goal 2b:** Increase habitat value by restoring larger, contiguous areas rather than several small areas that cannot support large populations and have less resiliency to outside forces.

**Goal 3:** *Reverse land subsidence*

- **Goal 3a:** Increase island surface elevation through managed peat accumulation
- **Goal 3b:** Maintain flooded conditions to reduce oxidation.

The strategy to meet the desired level of protection, including phasing of the work, estimated cost of the work and schedule of the work is described in Exhibit B. The District anticipates that the projects will be funded through the Special Projects program, since assessments are insufficient for the District to cost share the levee rehabilitation projects.

The following section assesses the current state of the Sherman Island levee system based on existing data and identifies existing deficiencies in the system.
6. **Assessment of the Existing Sherman Island Levee System - Vulnerability to Failure**

Due to the public benefit provided by Sherman Island levees and the valuable local and non-local assets they protect, District employees conduct visual inspections of the Sherman Island levee system every day of the year. In addition, the superintendent, Board president and District engineer survey the levee a minimum of twice a month and participate in an annual inspection of the levee from the waterside. These inspections are invaluable for identifying issues such as seepage, cracking, erosion and lack of splash cap and riprap.

Through discussion of the visual inspections, the District Board members, District superintendent and District engineer have determined that Sherman Island levees are most vulnerable to failure cause by flooding or earthquake damage. Failure from flooding could be caused by any one of the following:

- Overtopping
- Erosion
- Slope instability
- Burrowing animals

Areas of the existing levee system most susceptible to overtopping are those which do not meet the PL 84-99 height standard. Appendix C provides an inventory of levee height around the Island. Analysis of this inventory shows that the levee along the San Joaquin River from about levee station 330+00 to 510+00 contains stretches which are below the HMP height standard (1 foot above 1:100 year flood event) and therefore are susceptible to overtopping.

Areas of the existing levee system most susceptible to failure due to flooding resulting from erosion are those areas with inadequate riprap protection. Appendix F provides an inventory of existing riprap protection around the Island. The District has observed that the levees along the Sacramento River have minimal riprap protection. The large expanse of waterway of the Sacramento River adjacent to Sherman Island provides the necessary distance, or fetch, when accompanied by high winds can produce large waves. The existing rip rap protection lacks the required coverage of the waterside slope to protect the levee from wind generated waves. The existing large breakwater quarry stones and limited amount of rip rap are below the high tide level of the Sacramento River exposing the unprotected levee embankment material to wind generated erosion damage. High winds originating from the north during periods of high tide and/or high storm runoff will seriously erode the unprotected levee slope. Accordingly, the District feels that the lack of riprap slope protection is a critical issue which could affect the stability of the levee, should erosion damage occur.

Finally, failure of the Sherman Island levees due to flooding could be triggered by slope instability. Areas prone to instability often crack as the levee shifts. Such cracks have been observed by District personnel at the Cross Levee and Scour Lake area. The
existence of the Scour Lake created from the 1969 levee failure contributes to slope instability, as standing water should be at least 400 feet from the levee toe. Seepage can also contribute to slope instability, and District personnel have observed active seepage between approximate levee stations 880+00 - 935+00 and 715+00 – 735+00. See Appendix F for a detailed breakdown of locations which have cracks and active seepage.

Repair of crack along landside levee toe from approximate station 529+00 – 540+00, near the location of the 1969 levee failure. The area has ongoing subsidence and instability issues.

In addition to levee failure caused by overtopping, erosion or slope instability, levee failure caused by an earthquake event is a serious concern to the District. The Sherman Island levees are susceptible to earthquake-induced breaching from dynamic slope failure, inertially-driven cracking, levee liquefaction, and bearing capacity failure in liquefied native soils. Soils susceptible to liquefaction are present both beneath and within many levees. Liquefaction of sands down to about 50 feet can cause significant surface effects. Thus, the distribution of liquefiable sands buried beneath the peat is a critical objective of any subsurface mapping investigation. In the Delta, Atwater (1982) has shown that alluvial fans, sand dunes, abandoned distributary river channels, and floodplains are the primary geologic environments responsible for buried sand layers in the Delta. Appendix K contains a map showing the faults across Sherman Island. Also included in appendix J is a map showing the organic content of the Sherman Island soils, which determines the behavior of the levees during a seismic event. Boring logs are available at the locations noted in Appendix B and can be used in a subsurface mapping investigation.
7. **Data Collection and Monitoring**

Due to the public benefit provided by Sherman Island levees and the valuable assets they protect, the District and the Department gather a variety of technical information for analysis and use in assessing the status of the levee system. Information available includes the following:

**Data Available for Analysis**
- Levee crown and cross section surveys,
- visual inspections (see chapter 6 for a detailed description of visual survey results)
- groundwater quality monitoring,
- inclinometer monitoring,
- settlement plate monitoring, piezometer monitoring and
- boring logs.

A summary of data available at various levee stations including location maps are provided in Appendix B. Following is a discussion of the types of data available.

**Surveys available**
- levee surveys,
- a LIDAR survey,
- a bathymetric survey and
- an electromagnetic anomaly survey.

The District surveys the levee crest elevation and levee cross section every five years; the most recently completed survey dates from July, 2005. This survey was used to determine the levee crest elevations shown in Appendix C, Exhibit 1.

Additional survey data was provided by the Department from LIDAR flights (Appendix C, Table 1) of the Sacramento-San Joaquin Delta conducted during late January and February of 2007. The work was conducted under contract issued by California Department of Water Resources to URS Corporation and had a vertical accuracy of 95% at 0.6’ and 90% at 0.5’ and a horizontal accuracy of 1.0 foot. Comparison of the 2005 ground survey and subsequent surveys undertaken at the completion of construction projects around the Island with the LIDAR data revealed discrepancies in levee crest elevations. For example, the LIDAR data does not include improvements made to the Mayberry Slough levee in 2008. Accordingly, we have based our assessment of levee height primarily on the 2005 ground survey, subject to additional investigation as required.

Based on the information included in Appendix C, the District has identified deficiencies in the levee system. The perimeter levees were divided into five hundred foot sections and classified according to the elevation of the lowest point of the section. Portions of the existing levee system fall below the elevation specified by the HMP and PL 84-99 elevation standards as follows:
o Approximately 4,000 feet of levee is below the elevation specified by the HMP standard, which equates to about 4% of the Island’s levee system,

o Approximately 15,500 feet of levee meets or exceeds the HMP elevation standard, which equates to about 15% of the Island’s levee system.

o Approximately 20,500 feet of levee meets or exceeds the PL 84-99 elevation standard, which equates to about 20% of the Island’s levee system,

o The remaining 62,627 feet of levee meets or exceeds elevation specified by the USACE standard.

In total, the Island consists of 62,627 feet of project levee and 40,000 feet of non-project levee. This levee elevation information reported herein will be verified pending the 2010 ground survey results.

In accordance with their five year goal, the District intends to improve all non-project levee to meet levee crown elevation and levee geometry specified by PL 84-99 standards (see Exhibit B for phasing of proposed improvement work).

Bathymetric Data Available
The Department has also completed a bathymetric survey of the Sherman Island levees. The data identifying areas of potential concern on the waterside levee slopes is included in Appendix D. Based on the information included in Appendix D, the District has identified deficiencies in the levee system. One of the District’s five year goals is to improve levee stability, and the bathymetric survey identified waterside levee areas which are potentially unstable. The District intends to further investigate the areas highlighted on Exhibit 1 Appendix D to determine if repair work is required (see Exhibit B for phasing of proposed additional study).

Electromagnetic Anomalies Data Available
Appendix E provides location of anomalies identified by Argus Technologies during their electromagnetic anomaly survey of the Sherman Island levees in 2008. The survey is intended to supply the baseline electromagnetic data for locating and identifying potential deficiencies in levee integrity on Sherman Island. Obtaining results depends on the presence of contrasting physical properties between subsurface features and their surroundings. With sufficient contrast, features described as anomalies manifest as discrete variations from the typical background signal on a qualitative basis. The actual cause of an anomaly is determined by conducting some level of invasive exploration (proving, drilling or excavation) which also allows for data to be calibrated with known ground conditions and geology. Electromagnetic anomalies identified were correlated with classes of specific levee features or objects, identifying their locations and approximate depths.

The electromagnetic survey data was subjected to a first and second order analysis to identify potential anomalies within the levee. The first order analysis is a broad scale, one-dimensional analysis used to locate high contrast anomalies. It provides an overview of trends in the physical properties of subsurface material laterally and with depth. These anomalies are likely located within the top five feet of levee. The second order analysis
targets a particular area and is used to identify smaller-scale and subtle anomalies of lower contrast. Second order analysis is undertaken when additional resolution is required for a particular location. The District has determined that to meet their five year goal of levee stability, the large scale, small scale and second order anomalies found during the electromagnetic anomaly survey should be investigated (see Exhibit B for a schedule of the proposed work).

**Groundwater Monitoring Wells**

Appendix B, Figure 6 provides the location of groundwater monitoring wells around the Island. Groundwater quality monitoring is undertaken at the Scour Pond in accordance with the terms and conditions of the Central Regional Water Quality Control Board General Order Waste Discharge Requirements to monitor changes in groundwater quality as a result of placement of dredge material. A series of deep and shallow wells were installed, and water samples taken from the wells and treated prior to, during and after placement of dredge material. Results of the monitoring program are available from the District or the Department upon request.

**Vibrating Wire Piezometers**

Piezometer locations and data samples are also provided in Appendix B. Vibrating wire pressure piezometers help determine the most appropriate rate of fill placement during construction by monitoring the pressure readings. Piezometers measure the pore-water pressure of the soil matrix by converting water pressure to a frequency signal via a diaphragm, a tension steel wire and an electromagnetic coil. At steady-state conditions, the pore-water pressure is equivalent to the hydrostatic water pressure at that depth. As fill material is placed on the ground surface over and adjacent to the piezometer, the pore-water pressures increase. In a well drained soil matrix, the increase in pressure dissipates relatively quickly as the excess water is “pushed out” to the adjacent lower-pressure areas as the soil material consolidates. “Lifts” of material can be placed at a rate and depth such that the pressures do not increase beyond a specified level and/or pressures return to or near the pre-project level (or other specified level) prior to placement of additional material. Piezometers data is primarily used during construction; however information obtained subsequent to construction provides an insight to sub-surface activity, which is a useful tool for identifying long-term solutions to levee instability. A sample of piezometer data used during construction is included as Figure 3 of Appendix B.

**Inclinometers**

Inclinometers are used to measure the horizontal deflections of the levee embankment. An inclinometer is physically two separate components. One component is a PVC pipe with engineered grooves on the pipe interior which is installed in the ground via a borehole. The base of the pipe is located in a stiff, relatively stable material which will not move as a result of construction work or general levee movement. In order to locate this stiff, stable material, the pipe must extend down from the levee surface typically 60 to 100 feet. Only when the pipe is located in the stable material is the inclinometer useful for engineering evaluation purposes. The second component of an inclinometer is the inclinometer probe. The inclinometer probe is a stainless steel rod with wheels located at the top and bottom of the rod which run along the engineered grooves of the PVC pipe.
Located inside the stainless steel probe are sensitive tiltmeters. During an inclinometer reading, the inclinometer probe is inserted into the PVC pipe and the inclination of the probe is measured and recorded at two-foot interval stations from the bottom of the inclinometer pipe to the ground surface. The inclinometer software uses the probe tiltmeter measurements to determine the position of the inclinometer pipe at the time of reading and by comparing the pipe positions between a prior or baseline reading to the current reading, the deflection/movement of the pipe is determined.

Historical monitoring of the inclinometers on Sherman Island has shown that the levees are constantly undergoing some deflection/movement during normal conditions, and during construction activities the deflection/movement is significantly greater.

Inclinometers were extensively used during construction of the landside setback levee in 2008. Generally, and as anticipated, the Scour Lake area of the project area (~sta. 520+00 to 542+00) experienced the greatest amount of deflection/movement. The inclinometers on the levee crest showed only minimal movements, generally less than 1/4 inch of total movement throughout the project period, whereas the inclinometers near the landside toe showed upwards of 11 inches of total movement. The differential deflection/movement between the levee crest and levee toe primarily explains the development of longitudinal cracks which appeared along the levee slope following the completion of construction. These cracks are presumed to be the result of differential settlement caused by the extension and enlargement of the stabilization berm and construction of the benches.

Based on the inclinometer data, the District has determined that existing levee deficiencies exist in the area of the Scour Pond (approximate station 520+00 – 535+00) and at the cross levee (approximate station 660+00 – 690+00). Figure 4 of Appendix B shows inclinometer movement at station 532+50, and offers clear evidence of levee instability. Before the District can meet their goal of raising the non-project levee to meet PL 84-99, this area must be stabilized. Accordingly, the District is proposing stabilization and widening projects in this area (see Exhibit B for a proposed schedule of projects).

Settlement Plates
Settlement plate locations and data samples are provided in Appendix B. The settlement plates provide an additional component to the levee stability monitoring, and these were used extensively during construction of the landside setback levee in 2008. The contractor installed settlements plates within the footprint of the setback levee at about 400 foot intervals prior to placing fill material. On a weekly basis, a surveyor under the direction of the Engineer measured the elevations of each of the settlement plates. The results of the settlement plate monitoring are shown in Appendix B, Figure 6. The settlement plates located at the toe of the levee generally experienced about 6 inches of settlement during the course of the project, however settlement plate 537+00 in the Scour Lake area settled almost 2.5 feet. This settlement plate was located near an area composed primarily of peat soils which previously had not supported additional weight. As import material was placed on the peat soil to construct the berm, the levee foundation
began to consolidate. Although the magnitude of settlement was high, extensive consolidation was expected due to the nature of the soil and the amount of import fill placed.

**Boring Logs**
Locations with boring logs available are provided in Appendix B. The logs provide an indication of the subsurface conditions at the boring location. These can be used for determining areas likely to liquefy during a seismic event, or to identify areas which can be used as borrow site for future levee repairs. For an overview of soil types on Sherman Island, see Appendix J which contains a map showing the percent organic content of soils on the Island.

**Additional Information Available**
In addition to evaluation of the data included in Appendices B through F, the District and Department have produced a variety of reports, primarily geotechnical analyses, for use in evaluating the stability of the levee system. See Appendix G for a list of the technical analyses available.

Also available are a variety of reports produced by other entities such as CALFED and the Delta Blue Ribbon Task Force which focus on Delta-wide issues such as subsidence reversal and the repercussions of a seismic event. Included herewith in Appendix J is a sample of information available from such reports. The Subsided Island Restoration Plan produced by CALFED address subsidence on Sherman Island. While the Delta-wide reports are not extensively discussed herein, such information is an important resource available to decision makers as many of the reports address Sherman Island specifically, due to the public benefit provided by the Island.
8. **Identification of Opportunities for Multi Objective Projects**

In accordance with the Requirements for the Five Year Plan (see Appendix A) the District has identified projects which have a levee improvement component in addition to a habitat enhancement or subsidence reversal component (multi-objective projects). AB 360 mandates that all habitat impacts associated with levee improvements be mitigated and requires that DWR’s actions result in long-term net habitat improvement. Mitigation for levee improvement impacts frequently requires the creation of terrestrial, tidal or freshwater habitats. Fulfilling the mitigation and enhancement component of the AB 360 program in advance of the levee improvements is a programmatic approach to habitat restoration which accomplishes objectives related to habitat enhancement and ecosystem restoration while increasing public safety. Accordingly, the District has identified the following as opportunities to adopt a programmatic approach to levee improvement/habitat restoration projects. These multi objective projects are listed below, together with a brief project description.

**Project 1:** **SH 06-1.0 (planning), SH 08-1.0 (construction) Mayberry Farms**  
**Project Description:** Convert existing Duck Club into permanent wetland  
**Goals:** Reduce subsidence, carbon sequestration, improve wetland habitat  
**Required CEQA:** Initial Study, Mitigated Negative Declaration  
**Permits:** USACE 404 permit (qualifies under Nationwide 27), RWQCB 401 permit. (in progress)  
**Mitigation:** Project is self mitigating, provides net habitat benefit

**Project 2:** **Mayberry Slough Levee Setback and Habitat Enhancement**  
**Project Description:** Complete setback levee along Mayberry Slough to stabilize, widen levee, install waterside habitat bench with vegetation to reduce risk of erosion.  
**Goals:** Improves levee to PL 84-99 height standard, reduce potential for erosion through vegetation, enhance shaded riverine aquatic habitat.  
**Required CEQA:** Initial Study, Mitigated Negative Declaration (existing)  
**Permits:** USACE 404 permit (qualifies under Nationwide 27), RWQCB 401 permit. (existing)  
**Mitigation:** Project is self mitigating, provides net habitat benefit

**Project 3:** **Scour Pond Habitat Enhancement Project**  
**Project Description:** Shift the Scour Pond a minimum of 400 feet away from the landside levee toe while expanding the northern border of the Pond to balance and/or increase the wetland habitat footprint. In order to ensure the no-net habitat loss criteria of the program the Scour Pond’s northern and eastern pond edge will be excavated in order to expand and improve the wetland habitat surrounding the pond.
Goals: Satisfies goals 1e, 2 and 3 (moves water away from levee toe, enhances habitat, and reduces subsidence.
Required CEQA: Initial Study, Mitigated Negative Declaration
Permits: USACE 404 permit (should qualify under Nationwide 27), RWQCB 401 permit.
Mitigation: Project is self mitigating, provides net habitat benefit

Project 4: San Joaquin River Levee Improvement and Waterside Habitat Project
Project Description: Improve levee from approximate station 200+00 to 500+00 to meet PL 94-99 elevation and width standards. Create waterside habitat bench from approximate station 200+00 to 290+00. Install channel island at approximate station 355+00 - 365+00.
Goals: Improves levee to meet PL 84-99 elevation and width standards, reduces potential for erosion, and provides contiguous stretch of waterside habitat along the San Joaquin River.
Required CEQA: Initial Study, Mitigated Negative Declaration
Permits: USACE 404 permit (should qualify under Nationwide 27), RWQCB 401 permit, DFG 1603 permit
Mitigation: Project is self mitigating, provides net habitat benefit

Project 5: Horseshoe Bend Waterside Rock Reinforcement and Sherman Lake Habitat Island
Project Description: Install riprap along waterside of Horseshoe Bend (approximate levee sta. 850+00 – 1027+00) and reclaim shallow area in Sherman Lake to provide wave protection and waterside habitat to mitigate for loss of habitat along Horseshoe Bend.
Goals: Reduces the potential for wind/wave erosion along Horseshoe Bend and Sherman Lake. Reclaiming a habitat island on Sherman Lake offers a programmatic approach to mitigation for the rockwork along Horseshoe bend by providing habitat in Sherman Lake contiguous to Mayberry Slough waterside habitat bench and providing wind and wave erosion protection along the levee bordering Sherman Lake.
Required CEQA: Initial Study, Mitigated Negative Declaration
Permits: USACE 404 permit, RWQCB 401 permit, DFG 1603 permit
Mitigation: Project is self mitigating, provides net habitat benefit

The District has identified the projects described above as opportunities to combine levee improvement work with habitat restoration or subsidence reversal within the next five years. The District is considering the Subsided Island Restoration Plan in the Sacramento San Joaquin Delta (Plan) (See Appendix J) as a long range planning tool for guidance in determining critical upcoming projects beyond the timeframe of this report.
9. Proposed Work to Reduce Island’s Vulnerability to Levee Failure

In addition to the multi objective projects described in chapter 8, the District is also planning a number of projects focused primarily on addressing levee vulnerability issues as identified through visual inspections and analysis of data. The District has identified the projects listed below as improvements necessary to ensure that the levee system continues to provide the public benefit realized by continued water quality and water supply reliability for a large portion of the state.

**Project: Highway 160 Landside Slope Repair**

*Project Description:* Clear landside levee slope to determine extent of seepage. Undertake additional geotechnical investigation as necessary. Repair seepage as necessary.

*Goals:* Goals 1b, 1f (repair seepage, gather additional info)

*CEQA:* Exempt

*Permits:* None required

*Mitigation:* Expand Parcel 11 by 6.5 acres (per Andy Rockriver, DFG)

**Project: Beneficial Reuse project**

*Project Description:* Receive dredge material for use in levee improvement projects

*Goals:* Goal 1a, b, e (material can be used to improve levee, repair crack, move water away from levee toe)

*CEQA:* Initial Study, Mitigated Negative Declaration (existing)

*Permits:* USACE 404 permit, RWQCB 401 permit (existing)

*Mitigation:* None required

**Project: Landside Setback**

*Project Description:* Continues work along landside of Mayberry Slough from approximate station 520+00 to 545+00 to repair crack and stabilize levee to allow eventual improvement to PL 84-99 standard.

*Goal:* Goal 1a, b (improve levee, repair crack)

*CEQA:* Initial Study, Mitigated Negative Declaration (existing)

*Permits:* None

*Mitigation:* None required (previously mitigated)

**Project: Waterside Rock Reinforcement**

*Project Description:* Maintain or improve existing riprap along Sacramento River from approximate levee station 700+00 - 850+00, install new riprap as necessary.

*Goals:* Goal 1, c (improve levee to reduce risk of levee failure due to wind and wave erosion)

*CEQA:* Initial Study, Mitigated Negative Declaration
Permits: USACE 404 permit, RWQCB 401 permit, DFG 1603
Mitigation: Expand Parcel 11 as required (to be determined by Andy Rockriver, DFG)

**Project:** Seepage Repair Program
Project Description: Repair seepage as areas are identified
Goals: Goal 1 b (improve levee stability by repairing seepage)
CEQA: exempt
Permits: None required
Mitigation: None required

**Project:** Levee Stability Monitoring Program
Project Description: Proactively gather additional information on levee stability through use of inclinometers, piezometers and settlement plates
Goals: Goal 1f (gather data as necessary)
CEQA: exempt
Permits: None required
Mitigation: None required

**Project:** Investigation of Levee anomalies
Project Description: Investigate electromagnetic anomalies identified in the levee.
Goals: Goal 1 f (gather additional information as necessary)
CEQA: exempt
Permits: None required
Mitigation: None required

**Project:** Borrow Material Purchase Fund
Project Description: Purchase borrow material for levee improvement purposes as it becomes available
Goals: Goal 1a (improve levee to PL 84-99 standard)
CEQA: exempt
Permits: None required
Mitigation: None required

**Project:** Install Cross Levee Toe Berm
Project Description: Install toe berm along cross levee to stabilize area – inclinometer readings indicate movement in area.
Goals: Goal 1 – improve levee stability
CEQA: Initial Study, Mitigated Negative Declaration
Permits: None
Mitigation: To be determined through CEQA process, likely none required
Project: Expand Parcel 11
Project Description: Increase Parcel 11 habitat mitigation site by 12 acres
Goals: Goal 2 (ecosystem restoration and habitat enhancement)
CEQA: Initial Study, Mitigated Negative Declaration
Permits: None
Mitigation: none required, project provides net habitat benefit

See Exhibit B for a proposed phasing of projects. Potential mitigation for the above projects will be assessed based on the levee log provided by DFG. The existing Levee Log (Appendix I) dates from 2001. The District has accomplished various mitigation projects since this time, and requested an updated Levee Log from DFG in April 2008. Upon receipt of the updated Log, the District will determine acreage of scrub-shrub, wetland and riparian forest habitats and determine mitigation required for projected included in the five year plan accordingly.

Constraints most likely to affect the District in their pursuit of projects include endangered species and associated permitting issues, lack of feasible on-Island mitigations sites and unreliable funding.

Endangered species most likely to be impacted by the projects proposed include, but are not necessarily limited to, giant garter snake, delta smelt, green sturgeon and Chinook salmon. Potential impacts will be determined on an individual project basis through the environmental review process and may result in consultation with Agencies as required under Section 7 of the Endangered Species Act. On past projects, the District has reduced impacts to listed species through a variety of avoidance and minimization measures including timing of construction and employing environmental monitors during construction. The District will likely use similar methods on future projects to ensure a smooth permitting process.

A more difficult issue to overcome is the apparent lack of suitable waterside mitigation sites. Extensive waterside mitigation will be required to mitigate for impacts associated with rocking the waterside of the levee in the Horseshoe Bend area. Waterside habitat enhancement along other portions of the Sherman Island levee system is difficult if not impossible for various reasons. Feasibility issues include high water velocities, deep channels and steep banks, surrounding property ownership etc.

The final constraint likely to face the District in their pursuit of the projects described herein is funding. The District is assuming that the work described will be undertaken as a series of Special Projects funded through Project Funding Agreements between the District and the Delta Suisun Marsh office. The short-term and intermediate projects described in Exhibit B are not likely to be underfunded, as those projects are relatively inexpensive and do not require an extended financial commitment. The projects more likely to be affected by lack of funding are the long-term projects. These projects will incur extensive planning, environmental review and permitting costs in addition to actual construction costs and may require five years or more of financial commitment.
Historically, long-term projects have suffered due to changing priorities and lack of consensus as to the most efficacious allocation of funds.

The District anticipates that all projects proposed in Exhibit B will require environmental review and permits. Upon identification of projects to be funded, the District will undertake the required environmental review and acquire the permits. The District is also aware of the no net loss of habitat requirements of Water Code Sections 12314. The Baseline conditions on the Island were established in Habitat Assessments of project and non-project levee completed in 1993 and 1994 (see Appendix G).