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ISLAND PONDS MITIGATION MONITORING AND REPORTING YEAR 1- 2006

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EXECUTIVE SUMMARY

The Santa Clara Valley Water District (District) and the U.S. Fish and Wildlife Service Don Edwards National Wildlife Refuge (Refuge) implemented the Island Ponds Restoration Project to fulfill two goals: 1) to initiate ecological restoration activities as described in the South Bay Salt Pond Initial Stewardship Plan (ISP), and 2) to satisfy the tidal marsh mitigation needs of both the Refuge for the ISP, and the District for the Stream Maintenance Program and the Lower Guadalupe River Project.

Breaching of the Island Ponds - Ponds A19, A20, and A21, occurred in March 2006. Five breaches were cut to allow tidal waters to inundate the ponds and begin the process of restoration. In the Restoration and Mitigation Monitoring Plan for the Island Pond Restoration Project (RMMP), the District and the Refuge agreed to conduct monitoring to track the progress of the restoration. This report presents the Year 1 (2006) monitoring results for both the District and the Refuge.

The following is a summary of the monitoring results:

The excavated breaches are providing tidal exchange to the ponds that is expected to be sufficient to support emergent vegetation colonization and marsh establishment in the ponds. Water levels in the three ponds correspond closely to the Coyote Creek water levels over approximately the upper two-thirds of the tide range, including the part of the tide range considered most important for vegetation colonization. Water levels and data availability vary by pond for the bottom third of the tide range.

Since breaching, sediment has deposited on the restored pond surface. Analysis of sedimentation pins shows that sediment accretion varies across each pond surface, and between ponds. Sediment accretion is greater towards the breaches (up to 0.5 feet recorded over eight months) diminishing towards the northern ends of each pond, where it is near zero. Accretion has been generally higher in Ponds A20 and A21 than in Pond A19. More than 70% of the ponds are accreting sediment at rates greater than the predicted rates.

Aerial photographs show that the excavated outboard tidal channels have widened since breaching. Levee breach widths have also widened, but there is marked variability in the amount of scour between individual breaches, with little widening of breaches A19 West and A21 East. No measurable scour has occurred along the fringe marsh in Coyote Creek and no signs of scour were detected at the levees or marshes opposite the breaches at Ponds A15, A17, and A18.

Limited scour was observed at the base of the railroad bridge piers. No new signs of erosion were noted along the levees near the Town of Drawbridge and no scour was detected along the rail levee adjacent to Ponds A20 and A21.

The total surface area of channels within the Island Ponds is 12.61 acres, accounting for approximately 2.6% of the total 475-acre complex.

As of August 2006, no new native vegetation or invasive species had established within the Island Ponds.

Since the breaching of the Island Ponds in March 2006, waterbird use of the ponds has increased for all species except eared grebes. The decline in numbers of eared grebes is likely due to a loss of foraging habitat as the ponds turned less saline. Dabbling ducks and small shorebirds have shown the highest increase in abundance, with over 14 times the number of birds counted post-breach versus pre-breach in some species.

No adverse water quality impacts were detected during breaching activities. All water quality parameters returned to normal levels within two weeks of breaching.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

In March 2006 the Santa Clara Valley Water District (District) and U.S. Fish and Wildlife Service (USFWS) Don Edwards National Wildlife Refuge (Refuge) restored tidal inundation to the 475-acre Island Pond Complex (the ponds). Five breaches were cut along the south side of the ponds by an amphibious excavator to allow tidal waters to inundate the ponds and begin the process of restoration. Two breaches (west and east) were cut in Pond A19 on March 7, 2006. A single breach was cut in Pond A20 on March 13, 2006. Two breaches (west and east) were cut in Pond A21, on March 21 and March 29, 2006, respectively. This restoration approach is a minimally engineered, passive design, which relies on natural sedimentation processes to restore the ponds to tidal marsh habitat to meet the project goals and objectives.

Restoration of the Island Ponds is a component of the Initial Stewardship Plan (ISP) for the larger South Bay Salt Pond Restoration Project (Life Science!, 2003). The District and the Refuge implemented the Island Ponds Restoration Project to fulfill two goals:

1. To initiate ecological restoration activities as described in the South Bay Salt Pond ISP
2. To satisfy the tidal marsh mitigation needs of both the Refuge for the ISP and the District for the Stream Maintenance Program (SMP) and Lower Guadalupe River Project (LGRP).

In the Restoration and Mitigation Monitoring Plan for the Island Pond Restoration Project (RMMP), the District and the Refuge agreed to conduct long-term monitoring to track the progress of the restoration and to evaluate whether there are adverse effects from the project (USFWS et al., 2006). Mitigation monitoring activities are anticipated to continue for 15 years. This report presents the Year 1 (2006) monitoring results.

1.2 PROJECTS WHICH REQUIRED MITIGATION

1.2.1 Initial Stewardship Plan

The ISP was created as an interim step to manage the ponds while a long-term plan is developed for the entire South Bay Salt Pond area. The main objectives of the ISP are to:

- cease commercial salt operations,
- introduce tidal hydrology to the ponds where feasible,
- maintain existing high quality open water and wetland wildlife habitat, including habitat for migratory and resident shorebirds and waterfowl,
- assure ponds are maintained in a restorable condition to facilitate future long-term restoration,
- minimize initial stewardship management costs,

- meet all regulatory requirements, especially discharge requirements to maintain water quality standards in the South Bay.

Taking into account the environmental effects of implementing the ISP based on the assessment in the EIR/EIS (Life Science!, 2004) and the associated permit requirements, the Refuge has agreed to restore unimpeded tidal inundation to approximately 475 acres at the Island Ponds and restore nine acres of tidal marsh specifically at Pond A21.

The permit file number for ISP activities which requires tidal wetland mitigation is San Francisco Bay Regional Water Quality Control Board - Order # R2-2004-0018.

1.2.2 Stream Maintenance Program

The SMP allows the District to implement routine stream and canal maintenance projects to meet the District's flood protection and water supply mandates in a feasible, cost-effective, and environmentally-sensitive manner. This program is also intended to assist the District in obtaining multi-year permits for these activities, which have currently been issued through 2012. The SMP applies to all of the District's routine stream maintenance, including three major types of activities: sediment removal, vegetation management, and bank protection. SMP activities commenced soon after the District received its final SMP permit in August 2002.

The SMP compensatory mitigation package includes mitigation for impacts to 30 acres of tidal wetlands; 29 acres from sediment removal activities and one acre from vegetation management activities. Taking into account the assessment in the EIR/EIS and the associated permit requirements, the District has agreed to restore 30 acres within the Island Ponds to tidal marsh habitat as mitigation for implementation of the SMP.

Permit file numbers for SMP activities which require tidal wetland mitigation are:

- San Francisco Bay Regional Water Quality Control Board - Order # R2-2002-0028
- U.S. Army Corp of Engineers - Permit # 22525S
- California Department of Fish and Game – 1601 Lake and Streambed Alteration Agreement # R3-2001-0119
- U.S. Fish and Wildlife Service – Biological Opinion 1-1-01-F-0314

1.2.3 Lower Guadalupe River Project

The LGRP was constructed to convey design flood flows in the lower Guadalupe River between Interstate 880 in downtown San Jose and the Union Pacific Railroad Bridge in Alviso. The project was designed to balance the needs for flood-control structures and channel maintenance with the goal of protecting and enhancing environmental conditions and public access. LGRP construction began in April 2003.

The LGRP compensatory mitigation package includes mitigation for both temporary and permanent impacts to wetland vegetation. Taking into account the assessment in the EIR/EIS and the associated permit requirements, the District has agreed to restore 35.54 acres to tidal marsh within the Island Ponds to mitigate for LGRP impacts.

Permit file numbers for LGRP activities which require tidal wetland mitigation are:

- San Francisco Bay Regional Water Quality Control Board - Order # R2-2002-0089
- U.S. Army Corp of Engineers - Permit # 24897S
- California Department of Fish and Game – 1601 Lake and Streambed Alteration Agreement # R3-2002-0732

1.3 ISLAND PONDS MITIGATION SITE

1.3.1 Site Description

The Island Ponds (Ponds A19, A20, and A21) are located at the extreme southern extent of the San Francisco Bay within Coyote Creek. The ponds are in Alameda County immediately north of the Santa Clara County line, in the City of Fremont (Figure 1). Prior to their 2006 breaching, these ponds were part of a larger 25-pond system known as the Alviso Complex. This complex contained 7,364 acres of pond habitat, 420 acres of saltmarsh outboard of the pond levees, 896 acres of brackish marsh in the adjacent sloughs and creeks, as well as associated upland (levee) and subtidal habitats (HTH et al., 2005).

Solar salt production began at the Alviso Complex in 1929 and continued until the ponds were purchased by State and Federal Agencies in 2003. The Island Ponds were middle stage salt evaporator ponds with intermediate salinity levels. In March 2006, the District and the Refuge cut five breaches on the south side of the ponds to permit full tidal inundation and allow the ponds to passively restore to tidal marsh habitat.

1.3.2 Mitigation Monitoring

The District and the Refuge agreed to conduct a long-term monitoring program to track the progress of the Island Ponds restoration. The RMMP details the monitoring activities, which are designed to track mitigation performance over a 15-year period (USFWS et al., 2006). The monitoring data will be compared from year to year to determine trends with respect to meeting performance criteria, permit requirements, and provide data for adaptive management actions, if necessary.

Table 1-1 describes the proposed monitoring schedule for the Island Ponds, including monitoring duration, frequency and timing. Table 1-1 also depicts the division of monitoring responsibilities between the District and the Refuge.

Table 1-1. Mitigation Monitoring Schedule for the Island Ponds – Responsible Party, Monitoring Duration, Frequency and Timing

Responsible Party	Monitoring Activity	Year(s) for Each Monitoring Activity [1]	Frequency	Seasonal Timing
On-Site Monitoring				
District	Inundation regime	Years 1, 2, 3, 5, 10, and 15 (or until two monitoring cycles indicate that full tidal exchange has been achieved)	Annual (*6 week duration*)	Spring Tides (Jun - Jul or Dec - Jan)
	Substrate development	a) Years 1 and 2	Semiannual	Apr, Oct
		b) Years 3 to 5	Annual	Oct
		c) Year 6 to 30 acres of vegetation	Biennial	Oct
	Levee breach and outboard marsh channel geometry[3]	Years 1, 2, 3, 5, 10, and 15	Annual	With aerial
	Aerial photo	a) Year 1 to 5, 10, and 15	Annual	Jul - Aug
		b) Year 7, 9, 11 … to end	Biennial	Jul - Aug
Refuge	Channel network evolution[3]	Years 1, 2, 3, 5, 10, and 15	Annual	With aerial
	Vegetation mapping[3]	Until mitigation achieved	Biennial	Jul - Aug[2]
	Ground-based quantitative vegetation sampling	Once 30 acres of vegetated area is established until 75 acres of 75% vegetation cover is achieved	Biennial	Jul - Aug[2]
	Invasive *Spartina* monitoring and control	Year 1 to 75% native vegetation cover	Annual	Sept - Nov
	Wildlife use (CLRA)	Begin when 30 acres native vegetation to detection	Annual	Jan - Apr 15
	Wildlife use (SMHM)	Begin at five acres contiguous suitable habitat, end at SMHM detected	Once every 5 years	Jun - Aug
	Wildlife use (shorebirds & waterfowl)	Years 1 to 5	Quarterly	Win, Spr, Sum, Fall

Responsible Party	Monitoring Activity	Year(s) for Each Monitoring Activity [1]	Frequency	Seasonal Timing
Off-Site Monitoring				
District	Rail bridge pier scour	a) Years 1 to 5	Quarterly	Win, Spr, Sum, Fall
		b) Years 1 to 5	Once per 10-yr storm event	
		c) Begin at implementation of corrective measures, end five years after	Quarterly	Win, Spr, Sum, Fall
	Fringing marsh scour in Coyote Creek[3]	a) Years 1 to 5, Final year	Annual	With aerial
	Scour of levees opposite breaches[3]	a) Years 1 to 3	Annual	With aerial
		b) If outboard marsh retreats to levees opposite breach, then three additional years from occurrence	Annual	Jul - Sep
	Rail line erosion	a) Years 1 to 5	Annual	Apr - Jun
		b) Years 1 to 5	Once per 10-yr storm event	
	Deterioration of Town of Drawbridge structures	a) Years 1 to 5	Annual	Apr - Jun
Refuge	Water Quality	a) Adjacent to breaches – Year 1	Weekly	March / April
		b) Upstream & downstream of ponds – Year 1	Monthly	May - Oct

[1]Projected time estimates to achieve performance criteria. Actual duration is dependent upon performance criteria and may vary.

[2]If CLRA are detected, on-site vegetation monitoring is only allowed from Sept 1 to Jan 31.

[3]Monitoring to use annual aerial photograph.

This report presents the monitoring results collected during the Year 1 (2006) monitoring period. The data are presented in detail and are compared to pre-breach results and Year 1 performance criteria identified in the RMMP (USFWS et al., 2006). Since the District and the Refuge divided the responsibility for the monitoring activities, the District's results and conclusions are presented in the main body of this report (and Appendices A to C), while the Refuge's results and conclusions are attached as Appendix D. Appendix E contains photographs of each breach during excavation and post-breach.

1.3.3 Performance Criteria

The performance criteria for the Island Ponds are specific to the mitigation needs of the Refuge and the District.

The performance criteria for the ISP mitigation are:

- Restore unimpeded tidal action to approximately 475 acres,

- Restore nine acres of vegetated tidal marsh located within a larger marsh area in Pond A21,
- Vegetation covers no less than 75% of the nine acres,
- Plant species composition consists of native tidal marsh species appropriate to the salinity regime,
- Targets achieved within 15 years following levee breach.

The performance criteria for the SMP mitigation are:

- Restore 30 acres of vegetated tidal marsh located within a larger marsh area on the three Island Ponds,
- Vegetation covers no less than 75% of the 30 acres,
- Plant species composition consists of native tidal marsh species appropriate to the salinity regime,
- Presence of California clapper rail at the Island Ponds as detected by a positive response to rail call counts using USFWS Endangered Species Office approved survey protocols. This performance criterion for the clapper rail mitigation requirement was established by the District through negotiations with the USFWS Endangered Species Office in December 2005,
- Targets achieved within 15 years following levee breach.

The performance criteria for the LGRP mitigation are:

- Restore 35.54 acres of vegetated tidal marsh located within a larger marsh area on the three Island Ponds,
- Vegetation covers no less than 75% of the 35.54 acres,
- Plant species composition consists of native tidal marsh species appropriate to the salinity regime,
- Targets achieved within 15 years following levee breach.

1.3.4 Other Independent Island Ponds Monitoring

The University of San Francisco (USF) is carrying out sedimentation pin monitoring in Pond A21. Details of the pre-breach and post-breach measurements are provided in Table 1-2 and the results presented in Section 3.1.3. The University of California, Berkeley (UCB) has deployed oceanographic instruments in Coyote Creek, just outside Pond A21 ('Creek Study') and along the axis of the west breach of Pond A21 ('Breach Study'). The data being collected includes water velocity, salinity, temperature, depth, and suspended sediment concentration (Table 1-2). There are no results presently available from the UCB study.

Table 1-2. Summary of University of San Francisco and University of California, Berkeley Monitoring at the Island Ponds, Year 1

Organization/Mitigation Monitoring Activity	Data Collected	Timing
University of San Francisco Substrate Development/Sedimentation	Ground and top elevations of USF & District pins in Pond A21	March 17 and 22, 2006.
	Ground and top elevations of USF & District pins in Pond A21	June 30, 2006
	Ground and top elevations of USF & District pins in Pond A21	November 1, 2006
University of California, Berkeley Hydrodynamics	Water velocity, salinity, temperature, depth, and suspended sediment concentration	March 8 to May 8, 2006
	Water velocity, salinity, temperature, depth, and suspended sediment concentration	October 10 to December 16, 2006

1.3.5 Contacts

The District contact is Lisa Porcella, Santa Clara Valley Water District, 5750 Almaden Expressway, San Jose, CA 95118-3686. Tel: (408) 265-2607 x2741.

The Refuge contact is Clyde Morris, Don Edwards San Francisco Bay National Wildlife Refuge, P.O. Box 524, Newark, CA 94560. Tel: (510) 792-0222.

2. MONITORING METHODS (DISTRICT ACTIVITIES)

This section describes the methods used to carry out the Year 1 monitoring activities for the District. The monitoring responsibilities of the Refuge are described in Appendix D and are not reported here.

2.1 ON-SITE MONITORING

2.1.1 Inundation Regime

Inundation regime monitoring was performed to evaluate the project objective of unimpeded tidal exchange, a fundamental precursor to achieving mitigation and restoration objectives. If tidal exchange is unimpeded, then the tide stage and tidal range will be nearly identical inside the ponds and outside the ponds in Coyote Creek.

Four water level sensors were installed at the recording stations shown in Figure 2 and Table 2-1. One sensor was located on an old drawbridge piling in the centre of Coyote Creek immediately east of the railroad bridge and three sensors were located in the pond's borrow ditches. The pond sensors were placed towards the northern side of each pond in order to maximize the distance from the breaches. The sensors were installed on November 8, 2006, for a six-week period, to capture the winter peak spring-tide conditions.

Table 2-1. Location of water level sensors in Coyote Creek and Ponds A19, A20, and A21

Type	Location	Northing	Easting
YSI sonde/Pressure Transducer	Coyote Creek	1993506	6133747
Pressure Transducer	North corner of Pond A19	1998632	6139544
Pressure Transducer	Northwest corner of Pond A20	1996013	6134053
Pressure Transducer	Northeast corner of Pond A21	1996338	6133620

The water level recording stations in each pond consisted of an Instrumentation Northwest (INW) stainless-steel submersible pressure transducer (model #PS9800) mounted inside a perforated stilling well. The stilling well was driven into the mud (and through the gypsum layer) until refusal and a lock box was bolted to the top of the well, above the highest water level. The pressure transducer was installed inside the stilling well above the level of the soft freshly deposited unconsolidated sediment and connected by cable to a data logger installed within the lock box. The data logger was programmed to record one measurement every ten minutes.

The initial water level recording station for Coyote Creek consisted of a YSI 6920 data collection sonde which utilizes a differential strain gauge transducer to measure pressure with one side of the transducer exposed to water. The sonde was mounted inside a perforated stilling well, in a similar way to the installation process used for the INW pressure transducers in each pond. The stilling well was attached to an existing in-channel wood piling. The sondes *in situ* data logging capacity allows for the downloading of data via a cable, which is located inside a protective enclosure, above the highest water level. The data logger was programmed to record one measurement every ten minutes.

To ensure the logging equipment was functioning properly, all sensors were downloaded near the mid-point of the six-week sampling period. Data from the Coyote Creek and Pond A21 sensors were downloaded on November 28, 2006 (three weeks of data), and the Pond A19 and Pond A20 sensors were downloaded on December 6, 2006 (four weeks of data). The gap in the download dates was due to technical difficulties in the downloading process and limited access to the sites due to low tides. These technical issues caused a gap in the Pond A21 data collection from November 28 to December 6, 2006, as the data logger had to be removed from the field and then re-deployed. Data collection was also incomplete in Pond A19; the failure likely due to gunshot damage. Data for Pond A19 was only recorded between November 8 and 18, 2006. The Pond A19 sensor was reset on December 6 and appeared to be logging adequately, however it became evident upon removal and subsequent download of the sensor in late December that it had not recorded any reliable data since the gunshot damage occurred in mid-November.

The Coyote Creek sensor also experienced technical difficulties, evident by the unit's sporadic data collection during the first few weeks. The logger was reset and restarted several times in an attempt to fix the apparent software problem, however ultimately, the YSI sonde was replaced in week five (December 13, 2006) with an INW pressure transducer. The six-week sampling session ended and subsequent sensor removal occurred on December 22, 2006, providing approximately 2.5 weeks of overlapping data between the Ponds A20 and A21, and Coyote Creek, and one week between Pond A19 and Coyote Creek. The overlapping data are from two periods and cover both spring and neap-tide cycles:

- November 8 – 15, 2006 (Ponds A19, A20, A21, and Coyote Creek)
- December 13 – 22, 2006 (Ponds A20, A21, and Coyote Creek)

Although it would have been desirable to leave the sensors in place for an additional week (until December 30, 2006), tides during that week were not conducive to boat access to allow download and instrument removal. In addition, with a report deadline of early January 2007 and the tidal data to still be processed, it was determined that the data collected to date would suffice for the Year 1 sampling effort.

The record of data recovery is shown in Table 2-2.

Table 2-2. Water level data-recovery record in Coyote Creek and Ponds A19, A20, and A21

	Start	End	Gaps
Coyote Creek	November 8, 2006	December 22, 2006	November 16, 2006 to December 12, 2006
Pond A19	November 8, 2006	December 22, 2006	November 19, 2006 to December 22, 2006
Pond A20	November 8, 2006	December 22, 2006	
Pond A21	November 8, 2006	December 22, 2006	November 28, 2006 to December 6, 2006

At the time of each download, equipment functionality was assessed by a visual observation of the sensors to check for equipment degradation, an open air calibration reading, and a water surface elevation survey to check for instrument drift. The water level recording stations were all surveyed into the NAVD88 datum.

2.1.2 Substrate Development/Sedimentation

To meet the project objective of restoring tidal marsh, sedimentation must occur within the Island Ponds. Estuarine sediment deposition will form the substrate that is essential for plant colonization and growth, and will provide the environment required by benthic organisms.

A total of 30 sedimentation pins were installed by the District across all three ponds (15, 5, and 10 pins for Ponds A19, A20, and A21, respectively) (Figure 2). In addition, USF installed 27 additional pins in Pond A21 (Figure 2), as part of a separate study. Pin locations were distributed across the ponds to measure anticipated deposition gradients away from each of the levee breaches. The pins consist of Schedule 80 PVC, 2-inch internal diameter, and each District pin is tagged with a unique ID number. The tag number and pin coordinates are presented in Appendix A.

Three measurements were taken at each pin:

1. Sediment Accretion Based on Pin Measurements: The distance from the top of the pin cap to the ground surface was measured using a tape measure. Two measurements were taken for each pin; one on the east side and one on the west side (approximate). In cases where scour had taken place around the base of a pin, the elevation of the nearby sediment surface was projected to the base of the pin, so that a measurement was taken as though there were no scour. The typical measurement uncertainty with sedimentation pins is 0.07 to 0.1 feet (2-3 cm) (John Callaway, personal communication) and derives from limitations inherent in accurately establishing the representative local ground surface.
2. Check for Pin Movement by Surveying: The top of each pin was surveyed relative to NAVD88 using an RTK GPS to determine whether the pins themselves had shifted vertically since installation.
3. Sediment Accretion Based on Depth Probes: Three measurements of deposited sediment thickness were made at random from undisturbed locations within ten feet of each sedimentation pin. This was achieved by inserting a scale-rule through the sediment until the hard gypsum layer was encountered.

Measurements taken on November 27, 2006, for Ponds A21 and A20, and November 28, 2006, for Pond A19 were compared with pre-breach measurements (March 6 and 8, 2006) collected by the District, to establish accretion rates across each pond.

Previous analyses by USF of the pins in Pond A21 consisted of the same methodologies as the District except USF took eight random sediment thickness measurements adjacent to each pin and only had limited use of surveying to check for pin movement. The USF pins were measured on March 17 and 22, 2006 (baseline), June 30, 2006 (after approximately three months), and November 1, 2006 (after approximately seven months).

2.1.3 Levee Breach And Outboard Channel Geometry

The levee breaches and channels through the outboard marsh are expected to erode in response to tidal scour, until equilibrium conditions are achieved. The breach monitoring documents the response of breach width to either tidal scour or sedimentation to aid management decisions regarding breach maintenance.

The width of erosion at each of the five levee breaches and the total area of the outboard tidal channels were measured in ArcView GIS using the 2006 aerial photographs. Section 2.1.4 below provides details about the aerial photographs. The width of each levee breach was measured from east bank to west bank at the centerline of each levee. The area of each outboard tidal channel was delineated along the marsh edge, and the construction/breach impact areas were outlined. Using these delineations, outboard marsh scour was calculated by subtracting the area of marsh affected by construction impacts from the total area of each tidal channel.

Both sides of the outboard tidal channel at Pond A20 were visually inspected on site for the presence of perennial pepperweed and any remnant side-cast materials.

2.1.4 Aerial Photography

Aerial photographs were obtained for use in several of the Year 1 monitoring activities at the Island Ponds. Photographs were taken by an airplane-mounted and calibrated camera to achieve a scale of six inch resolution. Images were captured during the mid-day hours, at low tide on August 12, 2006 to capture peak vegetation production, minimize shadows and glare from sunlight, and maximize visibility of vegetation and tidal channels. Photographs were orthorectified and geo-referenced to ensure spatial comparability from year to year. The spatial extent of the images included all three Island Ponds plus both sides of Coyote Creek. Images were taken in both color and infrared.

2.2 OFF-SITE MONITORING

2.2.1 Railroad Bridge Scour

The EIR/EIS (Life Science!, 2003) identified scour at the railroad bridge crossing of Coyote Creek as a possible impact of the Island Ponds restoration. Previous modeling of the breaches at the Island Ponds (Gross, 2003) predicted erosion of approximately two to three feet in depth at the piers.

On July 13, 2006, the District took four photographs of the railroad bridge piers from control points adjacent to the bridge to evaluate for signs of scour at the piers. The bridge piers were re-photographed at these same stations on November 29, 2006, at which time an additional eight close-up photographs were taken to provide more detail of the mudflats around the pier bases. All visual inspections were conducted above the water surface (i.e. not a diver inspection). The photographs from July and November 2006 are in Appendix B.

2.2.2 Fringe Marsh Scour In Coyote Creek/Scour Of Levees Opposite The Breaches

In the RMMP, it was predicted that the larger tidal prism and associated increased velocities created by the breaches at the Island Ponds could result in scour of the fringing marsh along the margins of Coyote Creek and cause erosion of the levees adjacent to the creek. This monitoring task investigated the spatial changes in fringing marsh area and changes in the position of the fringing marsh-mudflat boundary, as well as the integrity of the levees at ponds A15, A17, and A18.

The extent of scour of the outboard fringing marsh along Coyote Creek was investigated by comparing pre-breach (June 13, 2005) and post-breach (August 12, 2006) aerial imagery. The City of San Jose provided pre-breach 2005 IKONOS satellite images at one-meter resolution. The District provided 2006 post-breach images at six-inch resolution. The analysis covered the reach of Coyote Creek from the eastern end of Pond A19 to the western end of Pond A21 and included marsh on both sides of the creek and approximately 200 feet of marsh upstream in Artesian Slough and the Coyote Creek Bypass Channel. ArcView GIS was utilized to delineate the marsh edges along Coyote Creek for both years. The 2006 delineation was superimposed over the 2005 delineation to highlight any discrepancies in post-breach marsh boundaries. In addition, the creek-side levees opposite the breaches were evaluated by visual inspection and by comparing the 2005 and 2006 aerial images to evaluate the extent of any change.

Due to slight projection differences, the 2005 images were shifted for the rectification process to allow for more accurate comparisons with the 2006 imagery. In addition, the 2006 images were higher resolution than the 2005 images, and therefore, more detailed mapping of the marsh edge was possible with the 2006 imagery. Due to the manual rectification and differences in the imagery resolution, there are likely to be some inherent differences in the marsh edge between 2005 and 2006.

2.2.3 Rail Levee Erosion

On July 13, 2006, the District inspected the rail levee and took a series of photographs along the railroad track alignment, along the Pond A20 western levee and along the Pond A21 eastern levee. These Year 1 post-breach photographs will serve as the baseline to evaluate whether breaching of the Island Ponds causes scour of the existing pond levees or the rail levee. The July 2006 photographs are shown in Appendix B.

2.2.4 Accelerated Deterioration Of The Town Of Drawbridge

The RMMP states that Deterioration of the Town of Drawbridge will be assessed visually and that any evidence of accelerated erosion will be reported. The monitoring activities undertaken for this requirement consisted of monitoring the deterioration of the pond levees adjacent to the Town of Drawbridge structures. The western levee of Pond A20 and the eastern levee of Pond A21 were monitored to detect any signs of levee erosion which could potentially lead to an undermining of the historical structures.

On August 8, 2006, a Civil Engineer from the District walked the Pond A20 and Pond A21 levees adjacent to the Town of Drawbridge, inspecting them for signs of erosion. Photographs were taken of any area with visible erosion. These photographs along with an aerial photograph of the Town of Drawbridge are included in Appendix B. These photographs will serve as the baseline condition for this monitoring activity.

3. MONITORING RESULTS (DISTRICT ACTIVITIES)

This section describes the results of the District's monitoring activities. The results of the Refuge's monitoring activities are described in Appendix D and are not reported here.

3.1 ON-SITE MONITORING

3.1.1 Inundation Regime

Figures 3 through 5 present time-series comparisons of the recorded tidal elevations in Coyote Creek against those from Ponds A19, A20, and A21. Practical constraints (the need for a high tide to gain boat access to the ponds, and the conflicting need for a low tide to install the equipment at the lowest point in the borrow ditches) in installation resulted in sensor positions above the lowest tides in Ponds A20, A21, and Coyote Creek, meaning that data for the lowest tides are not available for these locations.

Water level data were available for all three ponds and Coyote Creek above 2.5 feet NAVD88, or for approximately the upper two-thirds of the tide range. Water levels in the three ponds track the Coyote Creek water levels fairly closely over this range. High tide water levels in the ponds are within 0.2 feet of the high tide water levels in Coyote Creek.

Water levels varied by pond for the bottom third of the tide range. Ebb low tide drainage is impeded in Pond A19, with the lowest tides in Pond A19 draining to approximately one foot NAVD88, compared to –1 to zero feet NAVD88 in Coyote Creek (Figure 3). Water levels for Pond A19 show a noticeable lag in ebb tide drainage compared to Coyote Creek below about two feet NAVD88. Low tides for Pond A20 were not available below 1.6 feet NAVD88 (Figure 4) and low tides for Pond A21 were not available below 2.2-2.5 feet NAVD88[1] (Figure 5). However, for the part of the tide range for which data are available, there are signs that ebb tide drainage for Ponds A20 and A21 lags behind that of Coyote Creek. At the lowest elevation for which complete data are available (2.2 feet NAVD88), Pond A19 shows the greatest constraints on ebb tide drainage of the three ponds.

Restricted low tide drainage in Pond A19, and any restricted low tide drainage that may be present in Ponds A20 and A21, is below the anticipated root zone and is therefore unlikely to impede emergent vegetation colonization and marsh establishment in the ponds. HTH and PWA (2005) estimated the lowest colonization elevation of emergent marsh vegetation at approximately mean tide level (four feet NAVD88) with a root zone depth of approximately one foot. Using these data, the bottom of the root zone would be approximately three feet NAVD88. This is above the elevation of the impeded low tide drainage in Pond A19 and the potentially impeded drainage in Ponds A20 and A21.

[1] Pond A21 water surface elevations were truncated at 2.2 feet from November 8 to 29, 2006. The sensor was reinstalled and water surface elevations were truncated at 2.5 feet from December 6 to 22, 2006.

3.1.2 Substrate Development/Sedimentation District Results

Baseline/pre-breach sedimentation pin measurements were conducted by the District in early March 2006. These results are compared to the November 28/29, 2006, results to estimate sediment accretion over the eight-month period across each pond (Appendix A). The sediment accretion data are presented in several ways:

1. Sediment accretion based on pin measurements plotted against the distance of the pin from the nearest breach (Figures 6 to 8)
2. Sediment accretion based on depth probes (calculated from the average of three random measurements within ten feet of each pin) plotted against the distance of the pin from the nearest breach (Figures 6 to 8)
3. An isopleth[2] map of sediment accretion based on pin measurements (Figure 9)
4. An isopleth map of sediment accretion based on depth probes (Figure 10)

Pond A19 pin measurement data. The largest amount of accretion (0.42 feet) has taken place close to the east breach, decreasing to the north and east. The northern tip of Pond A19 records approximately 0.01 feet of accretion. Pin A1912, close to the west breach (Figure 2), recorded no sediment, with an eroded gypsum layer at the base of the pin. The erosion is probably a function of its position as the pin is close to the west breach, the south borrow ditch, and the confluence of one of the remnant channels. The data from this pin is anomalous compared to surrounding accretion rates and was not included in the isopleth interpretation of the results (Figure 9). In addition, pins A1910 and A1911 along the western side of the Pond A19 record negative values, although sediment accretion was observed at the base of each pin. Several reasons may account for these anomalies:

- Baseline measurements of base to top pin distance are low,
- November 2006 measurements of base to top pin distance are high,
- Baseline and November 2006 measurements were not taken at exactly the same point at the pin base,
- Dissolution of gypsum may have taken place prior to and/or during sediment accretion resulting in a lower ground surface elevation compared to the original gypsum surface even though sediment accretion has taken place.

Pond A19 depth probe data. Sediment accretion increases from approximately 0.01 feet at the northern extreme of the pond to up to 0.25-0.30 feet towards the breaches and northwest corner. Accretion decreases to approximately 0.09 feet into the extreme southwest of the pond.

Pond A20 pin measurement data. Sediment accretion reaches a maximum of approximately 0.72 feet along the west-central portion of the pond. From here, accretion decreases to approximately 0.49 feet towards the breach and to 0.07 feet in the northwest corner of the pond.

[2] A line connecting points of equal thickness

Pond A20 depth probe data. Sediment accretion reaches a maximum of approximately 0.53 feet along the west-central portion of the pond. From here accretion decreases to approximately 0.37 feet towards the breach and to 0.12 feet in the northwest corner of the pond.

Pond A21 pin measurement data. The highest values of sediment accretion (0.70 feet) occur in the southeast corner of the pond. To the north and west, accretion rates reduce to 0.38 feet in the center of the pond, 0.20 feet near the west breach, and 0.01 feet in the northeast corner of the pond. Pin A2110 in the southeast corner recorded 1.37 feet of accretion. However, it is likely that this pin was placed in a low area (remnant channel), which is not characteristic of the surrounding terrain. The sediment may therefore be anomalously deep at this point and not representative of the sediment accretion rates across the southern part of the pond.

Pond A21 depth probe data. The highest rates of accretion (0.50 feet) are in the southeast corner of the pond and immediately north of the east breach (0.45 feet). From these two points accretion decreases to the north and west (in the latter case towards the western breach where accretion is 0.18 feet). In the extreme northeast of the pond, accretion is approximately 0.03 feet.

In summary, the District sedimentation results show that although absolute sediment accretion over the eight-month period between March and November 2006 varies across each pond, there is a general tendency for higher accretion rates nearer to the breaches with decreasing rates with distance from the breaches. The highest rates of accretion have taken place in Ponds A20 and A21, with lower rates in Pond A19. An accretion rate of 0.2 feet per year (0.13 feet over eight months) was predicted by HTH and PWA (2005). Approximately 90% of Pond A20, 70% of Pond A21, and 70% of Pond A19 are exceeding this predicted accretion rate (based on the depth probe data). In some of the southern portions of Ponds A20 and A21, the accretion rate is over five times the predicted rate, less so (three-times) in Pond A19. These results indicate that the project is exceeding the performance criteria for accretion and is currently on track to meet the mitigation requirements.

In general, sediment accretion based on pin measurement is greater than sediment accretion based on depth probe (Figures 9 and 10). Many of the sedimentation pins were placed in slight depressions where the gypsum layer is softer and hence was more penetrable during their installation. This would encourage greater accretion rates than higher elevation areas away from the pins, where the depth probe measurements were taken.

Apart from pin A2003, the survey data from the top of each pin show apparent differences between zero and 0.30 feet between the initial pin height and the pin height at Year 1 (Appendix A). These differences are likely to be within the uncertainty of measurement, which we estimate to be approximately 0.25-0.30 feet, and relate to:

- errors in accurately resting the GPS on the ground surface in soft mud,
- errors in positioning the instrument in Year 1 at the same location as the Year 0 measurements,
- errors associated with finding a representative ground surface due to scour around the pin,

- errors inherent in the instrument itself.

This level of uncertainty is supported by comparing the ground elevations in Year 0 and Year 1 at pins A1901, A1902, and A1903 where the lowest amount of accretion has taken place across all the ponds. Here, measured ground elevations pre-breach were 5.75, 5.20, and 5.38 feet NAVD88. At Year 1 the comparative measured elevations were 5.93, 5.57, and 5.69 feet NAVD88. Accounting for accretion of up to 0.04 feet (based on depth probes), these measurements equate to differences of approximately 0.14, 0.33, and 0.27 feet, respectively.

3.1.3 Substrate Development/Sedimentation USF Results

Baseline measurements in Pond A21 were conducted by USF in March 2006, and these results are compared to measurements carried out after three months (end-June 2006) and seven months (start-November 2006). The sediment accretion data are summarized as plots of sediment accretion based on pin measurements (Figure 11) and sediment accretion based on depth probes (calculated from the average of eight random measurements within ten feet of each pin) (Figure 12) plotted against the distance of the pin from the nearest breach.

A similar accretion pattern to that recorded by the District pins in Pond A21 is described for the three-month and seven-month results of the USF study, supporting the results and conclusions of the District's monitoring.

3.1.4 Levee Breach and Outboard Channel Geometry

The breaches in the levee and the outboard marsh were designed to have the same top width (40 feet), bottom width (6 feet), and depth dimensions (2.7 feet NAVD88), but have variable side slopes due to height differences between the top of the levee and the marsh and different lengths for the trapezoidal channel connecting the pond to Coyote Creek (SCVWD, 2006a, b). For the purposes of the levee breach monitoring, the 2006 aerial photographs were reviewed and erosion at each breach was compared with the constructed channel widths by measuring the existing top width of visible erosion. The outboard marsh channels were similarly monitored by delineating the area of each unvegetated channel in the 2006 photographs. The results are shown in Figures 13 and 14, and in Appendix C (Figures C-1 to C-4). In addition, to photographically illustrate how the breaches have performed over time, Appendix E provides a sequence of photos showing each breach location soon after construction and several months after breaching activities.

<u>Pond A19 East - Breached on March 7, 2006.</u> The width of the erosion within the former levee footprint at the Pond A19 East breach on August 12, 2006, was 110 feet; therefore, approximately 70 feet of levee scour has occurred in five months. The outboard marsh loss due to breaching activities was 0.02 acres with subsequent scour of the outboard tidal channel resulting in an additional 0.03 acres, equating to a total of 0.05 acres (Figure 13, Appendix C).

<u>Pond A19 West - Breached on March 7, 2006.</u> The width of the erosion within the former levee footprint at the Pond A19 West breach on August 12, 2006 was 22 feet. Unlike the large amount of erosion

recorded at the Pond A19 East breach, the levee at the western breach is not eroding at the same rate. It is possible that the levee material at this location is more compacted than the Pond A19 East location. Based on previous site visits by the District, there is evidence that the top width of the breach within the former levee was constructed as planned. Future monitoring efforts will continue to document the rate of erosion at this breach. Field visits by District staff have revealed that a large scour hole has developed within the old marsh area. It is anticipated that the scour hole will eventually undermine and weaken the levee material which should help open up this breach. The outboard marsh loss due to breaching activities was 0.03 acres with subsequent scour of the outboard tidal channel resulting in an additional 0.02 acres, equating to a total of 0.05 acres (Figure 13, Appendix C).

Pond A20 - Breached on March 13, 2006. The width of the erosion within the former levee footprint at the Pond A20 breach on August 12, 2006, was 76 feet; therefore, approximately 36 feet of levee scour has taken place in five months. Construction activities at this breach included depositing excavated material on the marsh area adjacent the breach channel, for the purposes of:

- reducing construction costs by avoiding the need for multiple handling of the excavated material
- documenting whether or not the excess weight on the adjacent marsh would help the breach channel widen
- introducing potential habitat complexity on the marsh surface.

During construction of the breach channel, excavated material was piled two-feet high on the east side of the breach channel and three-feet high on the west side (i.e. side-cast berms). The total width of the area impacted by the construction efforts (excavated breach plus the width of the deposited material) was approximately 100 feet. Using these construction footprint estimates, the marsh area impacted by breaching efforts was 0.72 acres. The 2006 aerial photographs indicate that a majority of this footprint has now been scoured, and the side-cast materials have been actively redistributed (Figures 13 and 14). Very little excavated material remains on the marsh surface and the side-cast berms are no longer visible during a mid to high tide. No additional channel scour has been observed beyond the original width of the construction area including the side-cast materials. No evidence of perennial peppergrass was observed adjacent to the Pond A20 tidal channel during field visits or on the 2006 aerial photographs. At this time, it appears that the material will continue to erode and the establishment of perennial peppergrass will not be a concern.

Pond A21 East - Breached on March 29, 2006. The width of the erosion within the former levee footprint at the Pond A21 East breach on August 12, 2006, was 32 feet. Similar to the Pond A19 West breach, the original levee has not eroded beyond the initial construction width. However, the marsh breach channel has increased in width to approximately 45 feet. The 2006 breach width of Pond A21 East will be used as the baseline for future year comparisons. The outboard marsh loss due to breaching activities was 0.28 acres with subsequent scour of the outboard tidal channel resulting in an additional 0.05 acres, equating to a total of 0.33 acres (Figure 13, Appendix C).

Pond A21 West - Breached on March 21, 2006. The width of the erosion within the former levee footprint at the Pond A21 West breach on August 12, 2006, was 76 feet; therefore, approximately 36 feet of levee scour occurred in five months. The outboard marsh loss due to breaching activities was 0.11

acres with subsequent scour of the outboard tidal channel resulting in an additional 0.14 acres, equating to a total of 0.25 acres (Figure 13, Appendix C).

Marsh loss due to breaching activities and/or subsequent scour from the five breaches totaled 1.40 acres. Scouring at the five levee breaches was highly variable, and associated outboard channel scour was evident through both aerial photographs and field observations.

3.2 OFF-SITE MONITORING

3.2.1 Railroad Bridge Scour

The November 29, 2006, photographs were compared to the July 13, 2006, photographs to document changes at each of the control point locations. The photographs are provided in Appendix B.

In the absence of any pre-breach photographs, the July 13, 2006, photographs were used as the baseline. The perspective of these photographs makes it difficult to identify whether any scour has taken place around the pier bases (Appendix B). To provide better documentation of scour, additional close-up photographs were taken on November 29, 2006. In addition, measurements of scour were made at all accessible piers. At the time of photography, the bases of three piers located in the intertidal zone on each side of the bridge were visible.

The November 29, 2006, photographs show that scour has taken place along the creek-side bases of all the piers. The scour is more pronounced on the piers on the north side of the bridge where the intertidal substrate is soft mud than on the south side where the substrate is firmer (a mix of mud, sand, and gravel). The scour holes on the south side are between 2.0 and 2.5 feet long, a half to one foot wide, and up to approximately 0.7 feet deep in comparison to the surrounding mudflat surface. The scour holes on the north side of the bridge were not directly accessible, but visual observation from a distance suggests they are approximately 2-3 feet long, 1-2 feet wide, and less than one foot deep. The observations indicate that the size of the scour holes is similar at the downstream and upstream piers (i.e. in an east-west direction) on both the north and south sides of the bridge. From a structural perspective, the amount of scour at the base of the piers is minimal and not a cause for concern with regard to structural failure.

Although scour was documented at the bridge piers in November 2006, it is unclear whether this scour was induced by the Island Ponds Restoration or whether the scour occurred prior to the breaching. Since there are no pre-breach baseline photographs or measurements of conditions at the base of the piers, we suggest continued annual monitoring to see if the scour continues to advance over time.

3.2.2 Fringe Marsh Scour In Coyote Creek/Scour Of Levees Opposite The Breaches

There was no evidence of fringe marsh scour or scour of the levees opposite the breaches at ponds A15, A17, and A18 (Figure 13). Despite the differences in the resolution of the 2005 and 2006 imagery we are confident that little if any scour of the existing outboard marshes has occurred. This conclusion is corroborated by our (H.T. Harvey) extensive field presence in 2005, and subsequent field verification in

2006. We therefore recommend utilizing the 2006 imagery (due to its higher resolution) as the base imagery for future GIS fringe marsh analysis in future years of the monitoring program.

3.2.3 Rail Levee Erosion

There was no evidence of rail levee erosion, or erosion of the adjacent levees in Ponds A20 or A21. Appendix B provides photographs of the rail levee and adjacent marsh taken approximately 300 feet north of the northern abutment of the Coyote Creek bridge. These photographs show the current condition and relationship of the marsh area adjacent to the rail levee in an area where the Pond A20 and A21 levees are closest to the rail levee (approximately 45 feet from the Pond 21 levee). These photographs will serve as a baseline for future inspections.

3.2.4 Accelerated Deterioration Of The Town Of Drawbridge

While inspecting the Pond A20 and A21 levees adjacent to the Town of Drawbridge, one particular area of erosion was found. The eroded levee is located near the southeast corner of Pond A21, approximately 100 feet from two existing Drawbridge structures and approximately 70 feet from the remnants of a previously collapsed structure. The erosion is occurring on the pond side of the levee with a large portion of the levee being affected. This erosion however is not a direct result from the breaching activities, as this same erosion scar is visible on the 2005 aerial photos. Based on measurements using ArcView GIS, there is no difference in the size of this scour pre-breach versus post-breach. Therefore, it appears that this erosion is not rapidly advancing. A photograph of the eroded levee and an aerial photograph of the general area are included in Appendix B. These photographs and the 2006 measurement of the scour will serve as the baseline information for this particular monitoring effort.

4. DISCUSSION (DISTRICT ACTIVITIES)

4.1 LESSONS LEARNED

4.1.1 Activities On Target

The tidal regime in all the ponds has developed such that full tidal incursion is taking place on all high tides, however, all the ponds appear to have impeded drainage at low spring tides. A second monitoring cycle is required in the RMMP, and will be performed in the June/July timeframe for the year 2 (2007) monitoring effort.

HTH and PWA (2005) predicted an accretion rate of 0.2 feet per year for all the ponds. A large portion of the ponds are accreting sediment at greater rates indicating that currently the ponds are exceeding their performance criteria for sedimentation.

Aerial photographs show that all of the outboard tidal channels have widened since breaching. Levee breach widths have also widened, but there is marked variability in the amount of scour between individual breaches, with little widening of breaches A19 West and A21 East. Similarly at both Pond A19 and Pond A21, two breaches were constructed, however one breach has widened significantly while the other breach has not. With such a large dissimilarity in the current breach sizes, it is unknown whether there will be enough water exchange through the smaller breaches to continue to widen them. Future monitoring will reveal how the different breaches respond.

Although the breaching of the ponds may have increased the tidal prism in Coyote Creek, currently, there is no evidence of fringe marsh scour or scour of the levees opposite the breaches (at Ponds A15, A17, and A18). In addition, no scour has been detected along the rail levee adjacent to Pond A21 and no new signs of erosion were noted along the levees near the Town of Drawbridge.

4.1.2 Problems Encountered

The pond water level sensors were placed in the borrow ditches between the pond levees and the pond surface. Damage to the Pond A19 sensor was sustained, and approximately five weeks of data lost, presumably by individuals firing gunshots (probably at multiple times) at it from the levee (approximately 30 feet). Although encased in a metal top-box, it is likely the impact caused the sensor recorder to malfunction. In the future, we plan to provide additional protection to the recorders by using more robust casing, and/or utilizing the alternate season (June/July) for monitoring as specified in the RMMP in an attempt to avoid vandalism during the hunting season.

There were no problems encountered with the field logistics of the sedimentation pin measurements in Year 1. However, future problems may arise when the depth of sediment deposition (particularly at the pins nearer to the breaches) becomes a safety hazard for foot traffic maneuvering the pond surface. Given the high accretion rates to date, safely walking within the deposited sediment is likely going to be a challenge in the near-term, and measurements of pin height would need to be carried out from a boat at high tide. This would reduce the accuracy of the results as the sediment surface would be hidden by water. Also, sediment thickness values would be more difficult to record beneath water, reducing accuracy.

A site visit on December 20, 2006, showed that pin A1903 has snapped approximately one foot above the sediment surface. The reason for the break is unknown. Future measurements of pin height cannot now be made, and the pin is difficult to locate at distance. We recommend discontinuing the use of this pin for surveying activities, but suggest the continued collection of sediment thickness using a depth probe adjacent to this pin location.

The gypsum at the base of pin A1912 has eroded, producing a local anomaly in a highly accretional part of the system. We recommend continued collection of sediment thickness using a depth probe adjacent to this pin, as well as continued observations of the pin itself to investigate the erosion phenomenon.

Limited scour was observed at the base of the railroad bridge piers. However, it is unknown whether this scour occurred pre-breach or post-breach, as there are no photographs or measurements to verify the pre-breach conditions of the piers. It would have been useful to have pre-breach baseline information to better explain and track this phenomenon. We recommend continued annual monitoring to see if the scour continues to advance over time, using the 2006 data as baseline.

For future monitoring years we recognize that there are limitations to using aerial photographs for measuring the widths of the levee breaches (not the marsh breach areas). Given that these photographs are one-dimensional, it is difficult to pinpoint where the existing levee top ends and the upper slopes of the levee excavation begins, and therefore difficult to measure the actual width of each levee breach. We recommend the continued use of the photographs to measure erosion of the tidal channels, marsh breaches and levee breaches, supplemented with field verification of the widths of each breach.

4.2 ADAPTIVE MANAGEMENT RECOMENDATIONS

The following are recommendations for future monitoring activities at the Island Ponds:

- Although the Year 1 monitoring duration for the tidal inundation task was not a full six weeks as anticipated, the available data indicates that full tidal exchange is occurring during high tides. The District anticipates that a third season of monitoring will not be necessary for this task, since the RMMP states that monitoring can cease once two monitoring cycles show full tidal exchange. The District will continue to monitor tidal inundation in Year 2, during the months of June and July to avoid the duck hunting season in the hopes of avoiding further damage to the sampling equipment.
- The practice of taking three sediment thickness measurements adjacent to each sedimentation pin location will continue during the Year 2 monitoring cycle. However, we recommend discontinuing the surveying activities and measurements of the pins themselves because of the

errors inherent in these activities. The District and the USF Year 1 monitoring data suggests that the pin data collection effort is redundant and the random depth probe measurements are more indicative of actual sediment accretion rates in each pond (Section 3.1.2). The pin measurements are less accurate due to measurement inconsistencies (i.e. different measurement locations on the pins, uneven ground surfaces from which to survey the pins), the specific level of accuracy for the survey equipment, and the pins themselves being installed in biased locations (i.e. locations where the ground was either depressed or softer). Taking three sediment thickness measurements adjacent to each pin and plotting the average thickness appears to provide a more accurate picture of accretion than taking a single measurement at each pin (Figures 6 through 8). In addition to taking sediment depth using the depth probe, we propose the use of photogrammetry in conjunction with the 2007 aerial photographs. This data will provide ground elevations for each pond accurate to approximately two-tenths of a foot (District surveyors estimate). In the 2007 monitoring report we will construct a sediment thickness map by comparing the topography derived from the 2007 photogrammetry exercise with LIDAR data collected pre-breach in 2004. This thickness (isopleth) map will be compared to the data collected in the field with the depth probe to assess the accuracy of the aerial technique. Given that sediment is accreting at a faster rate than anticipated and it is becoming difficult to walk across the ponds surface, if the photogrammetry data collection method proves useful it will replace the field measurements for the 2008 sampling year.

- The 2006 aerial photographs should be used as the baseline for all subsequent marsh edge, levee breach, and tidal channel comparative analysis. In addition, levee breach and tidal channel measurements will be supplemented with field verification.
- Monitoring the railroad bridge piers with the use of close-up photography should continue with supporting field measurements when possible. In the absence of pre-breach scour measurements, the 2006 data will be used as the baseline for future monitoring.

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SCVWD (Santa Clara Valley Water District). 2006b. Tidal Wetland Mitigation/ Restoration (Island Ponds) Cross Sections Pond A21 Design Plans. February 8, 2006.

USFWS (U.S. Fish & Wildlife Service), Don Edwards National Wildlife Refuge, and Santa Clara Valley Water District. 2006. Restoration and Mitigation Monitoring Plan for the Island Ponds Restoration Project.

6. LIST OF PREPARERS

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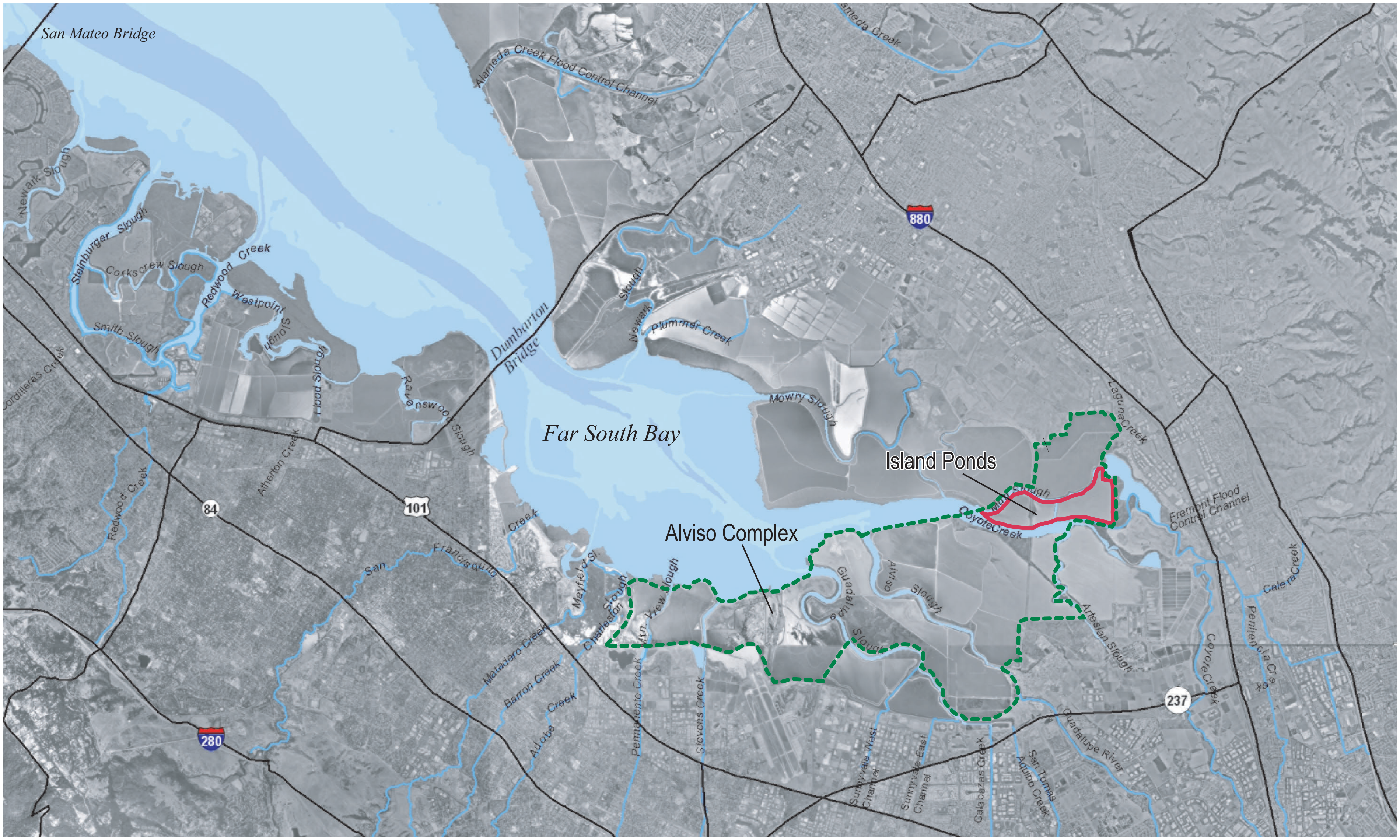
7. FIGURES



Source: NASA image

0 10,000 20,000 feet

figure 1

Island Ponds Mitigation Monitoring

Location of the Island Ponds Restoration Site

#1864

PWA

Image Source: SCVWD (August 12, 2006 11:00 am)

N

0 500 1,000 2,000 3,000 Feet

LEGEND

○ District Sedimentation Pin

△ USF Sedimentation Pin

⬠ Water Level Sensor

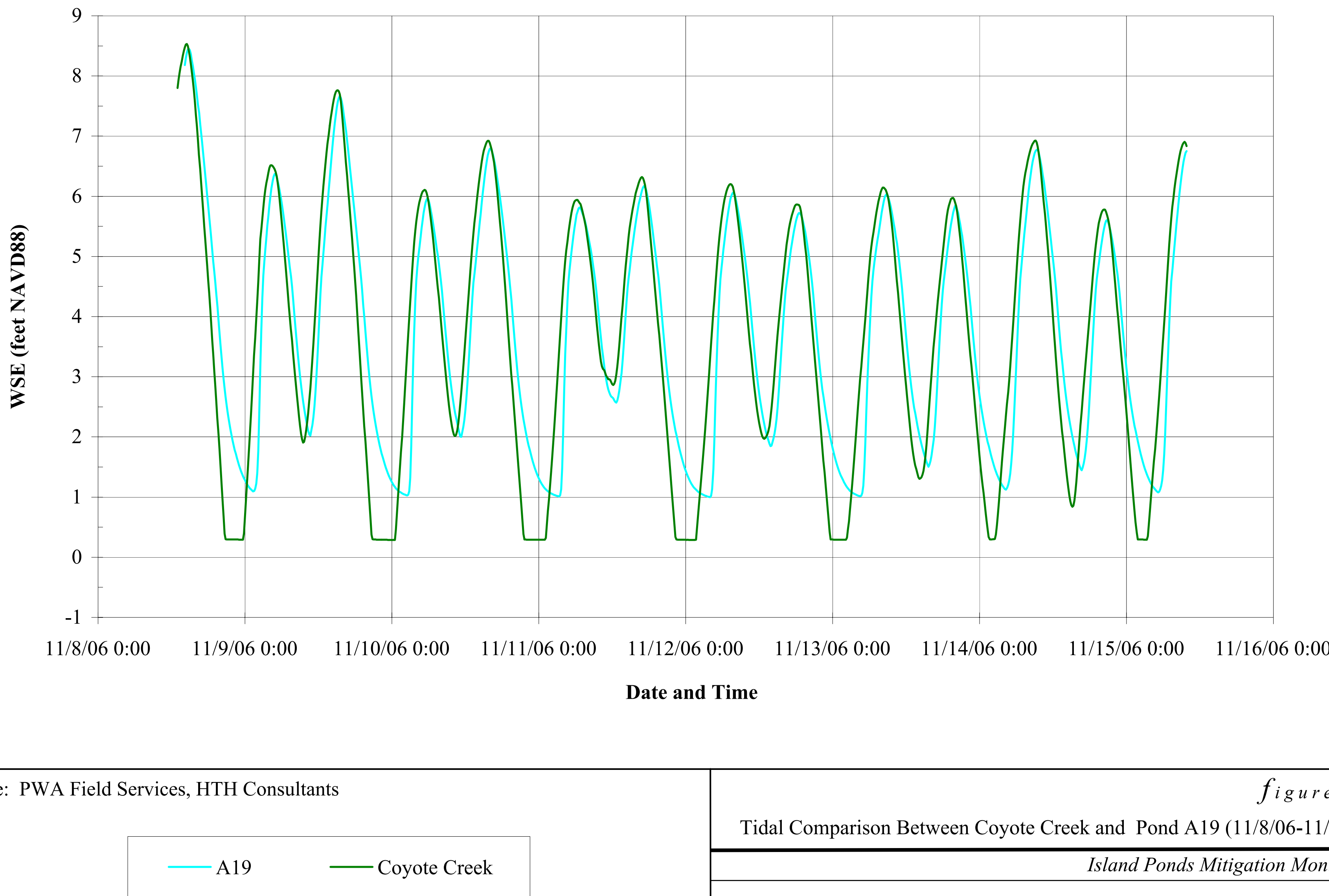
figure 2

Island Ponds Mitigation Monitoring

Location of Water Level Sensors and Sedimentation Pins

#1864

PWA



Source: PWA Field Services, HTH Consultants

figure 3

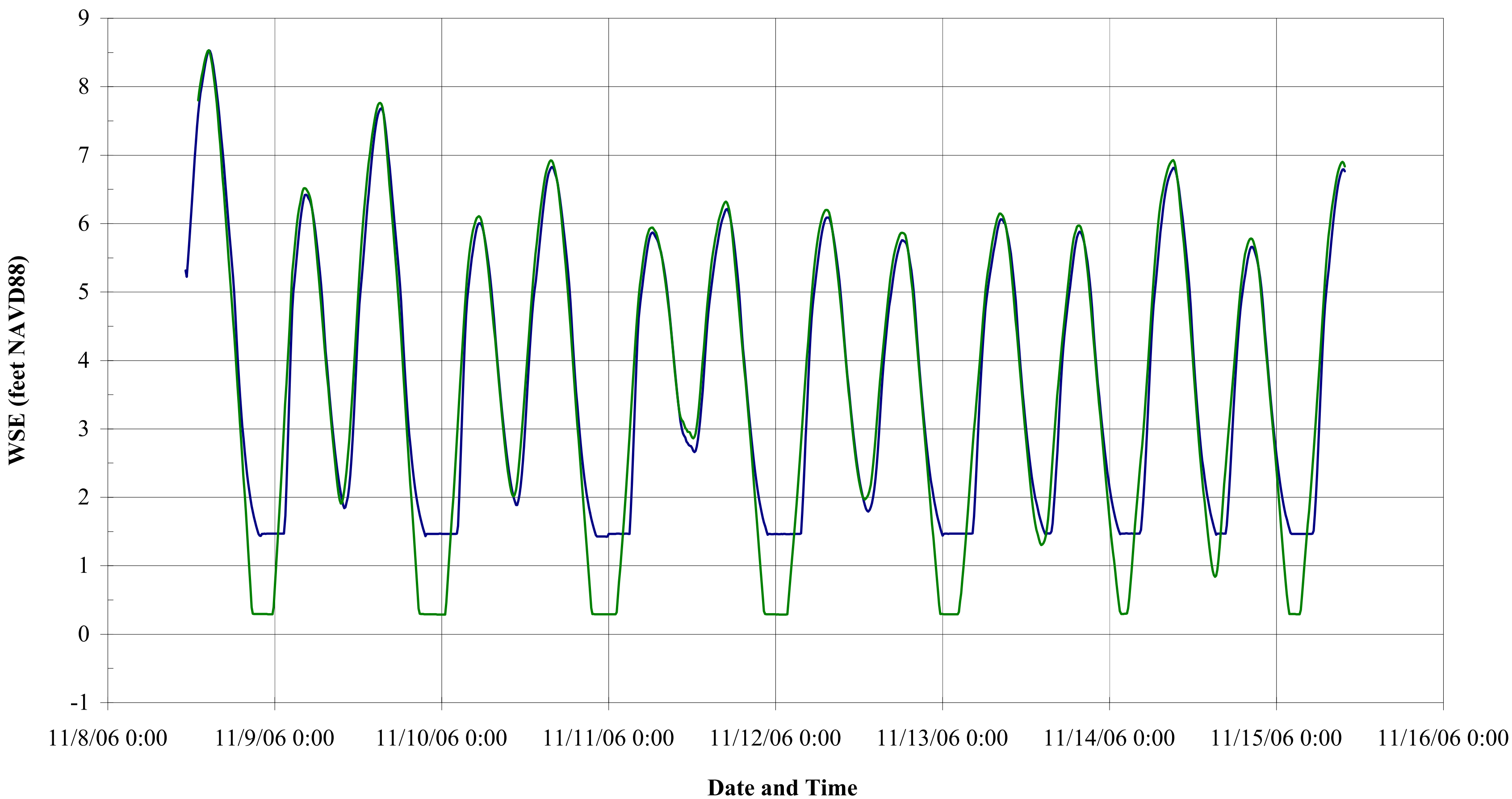
Tidal Comparison Between Coyote Creek and Pond A19 (11/8/06-11/15/06)

Island Ponds Mitigation Monitoring

PWA Ref# 1864.00

PWA

Island_Ponds_Water_Levels_Calibrated_v2.xls / FIG3



Source: PWA Field Services, HTH Consultants

figure 4a

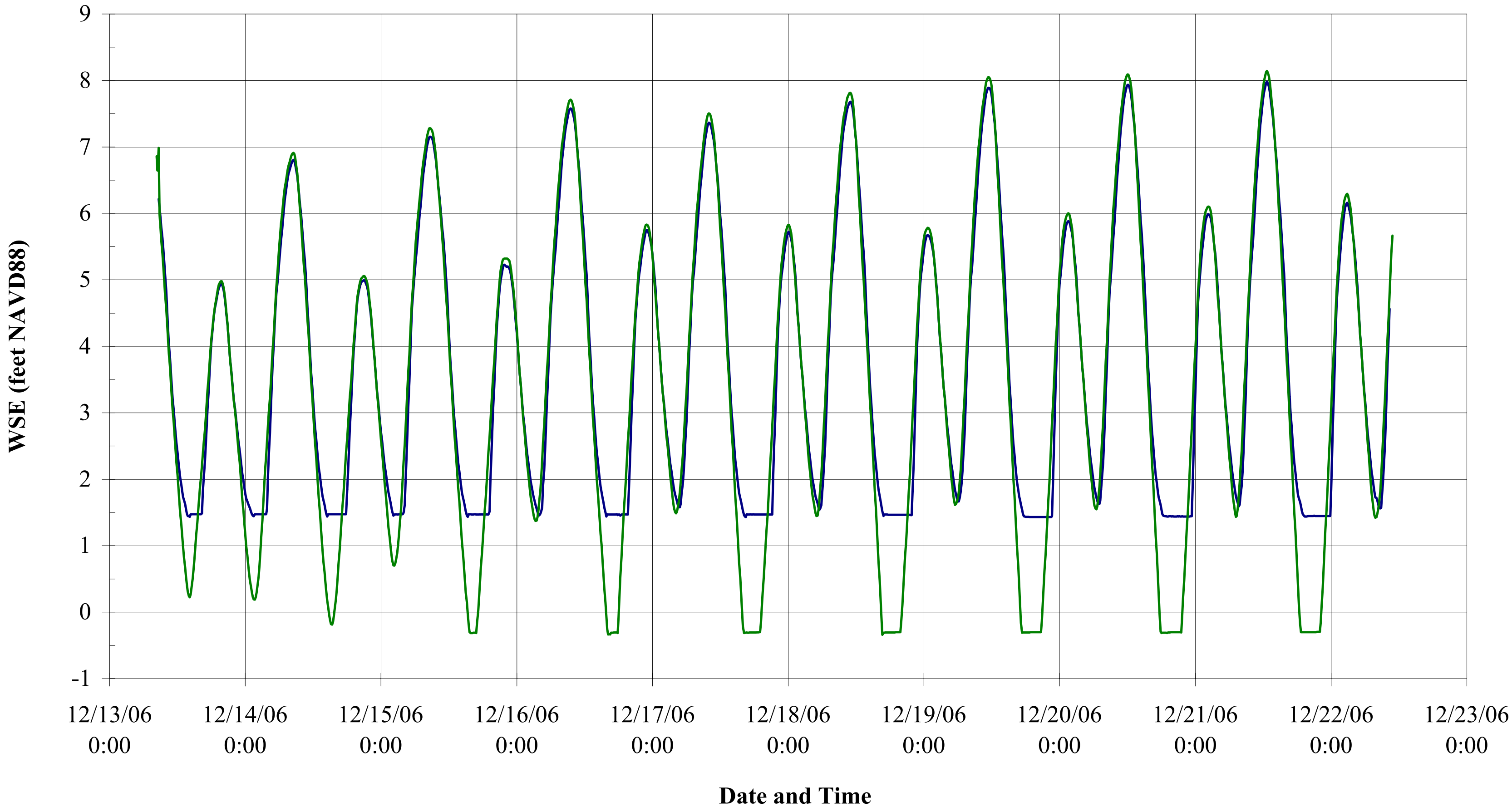
Tidal Comparison Between Coyote Creek and Pond A20 (11/8/06-11/15/06)

Island Ponds Mitigation Monitoring

PWA Ref# 1864.00

PWA

Island_Ponds_Water_Levels_Calibrated_v2.xls / FIG4a



Source: PWA Field Services, HTH Consultants

A20 — Coyote Creek

figure 4b

Tidal Comparison Between Coyote Creek and Pond A20 (12/13/06-12/22/06)

Island Ponds Mitigation Monitoring

PWA Ref# 1864.00

PWA

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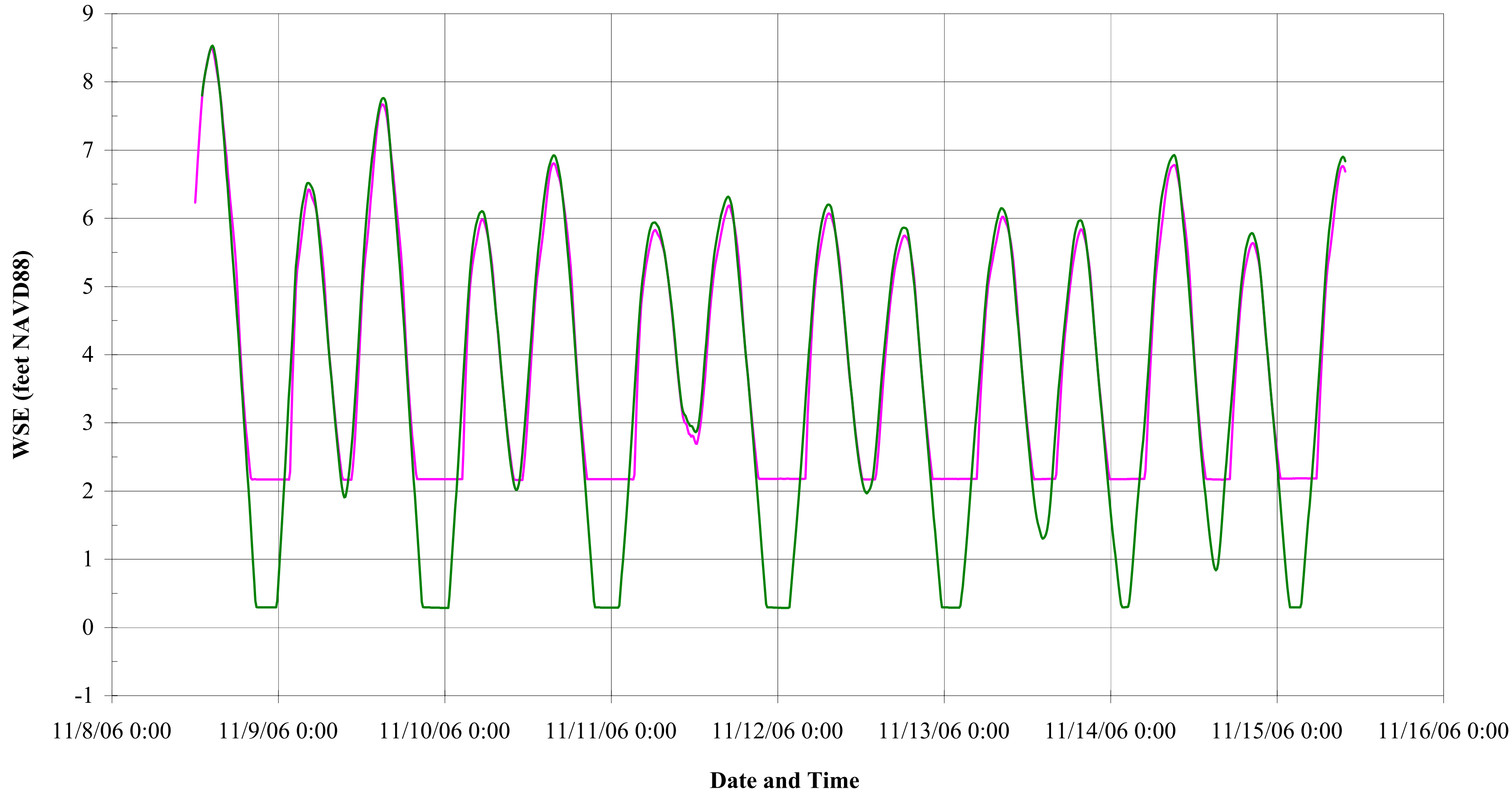


Source: PWA Field Services, HTH Consultants

figure 5a

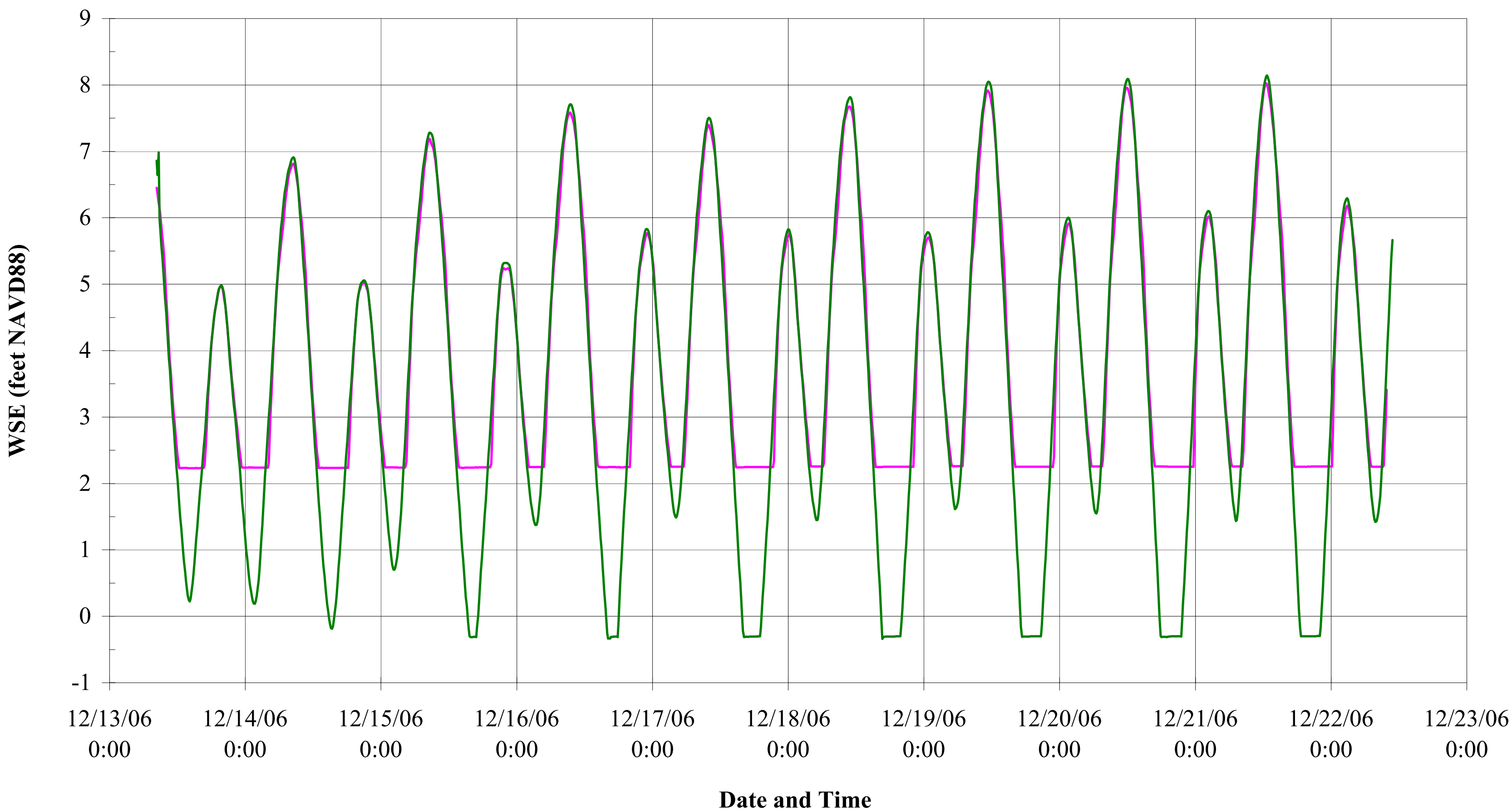
Tidal Comparison Between Coyote Creek and Pond A21 (11/8/06-11/15/06)

Island Ponds Mitigation Monitoring

PWA Ref# 1864.00

PWA

Island_Ponds_Water_Levels_Calibrated_v2.xls / FIG5a



Source: PWA Field Services, HTH Consultants

figure 5b

Tidal Comparison Between Coyote Creek and Pond A21 (12/13/06-12/22/06)

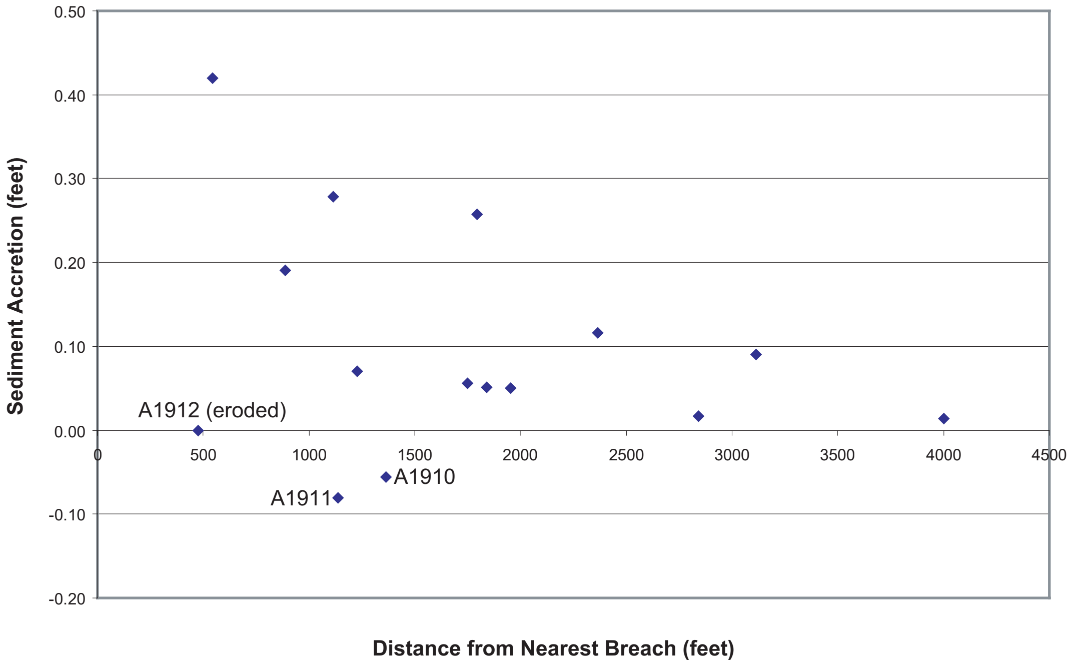
Island Ponds Mitigation Monitoring

PWA Ref# 1864.00

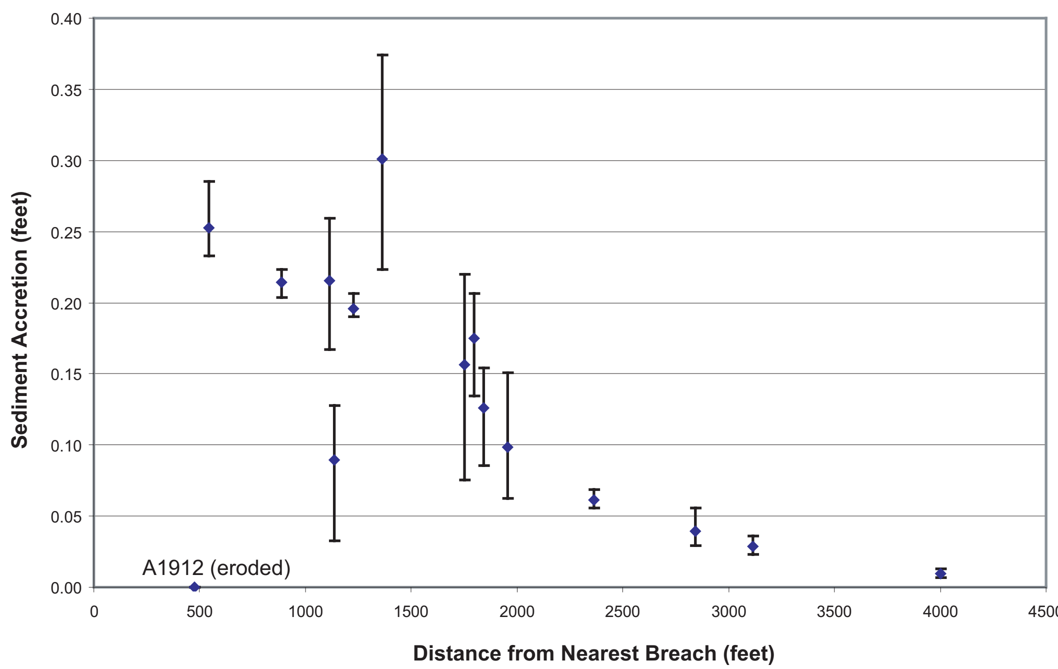
PWA

Island_Ponds_Water_Levels_Calibrated_v2.xls / FIG5b

6a. Pond A19 Sediment Accretion Based on Pin Measurements



6b. Pond A19 Sediment Accretion Based on Depth Probes



Note:
Data points in Figure 6a are average of two measurements (east and west).
Data points in Figure 6b are average of three depth probes.
Error bars in Figure 6b represent maximum and minimum values.
Sediment accretion measured November 2006, eight months after breaching.

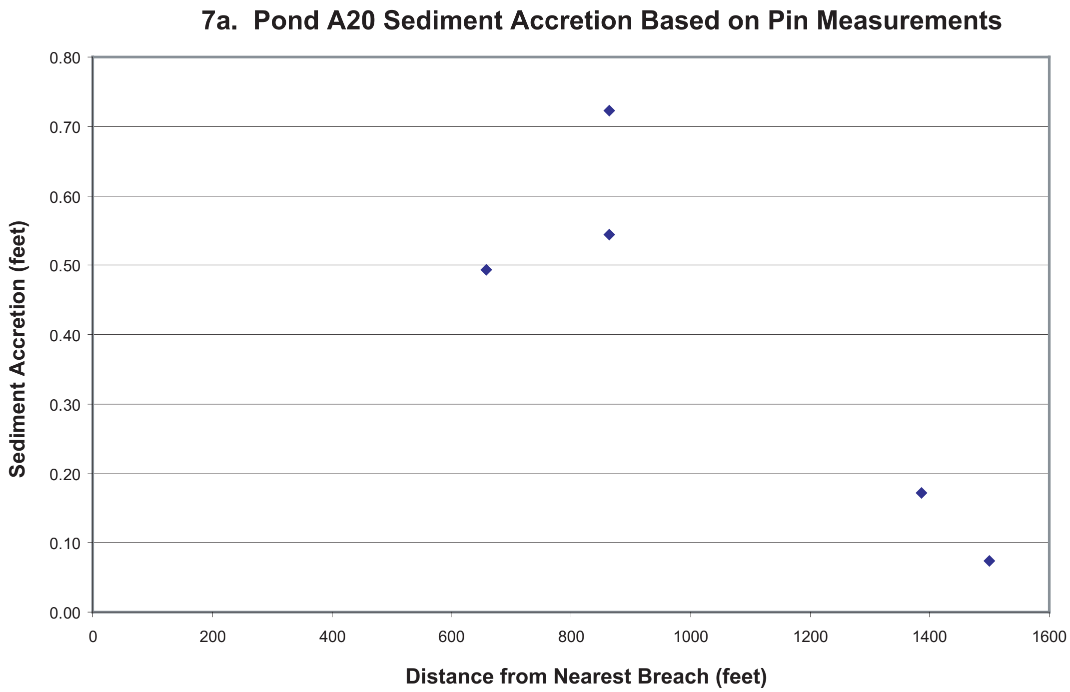
figure 6

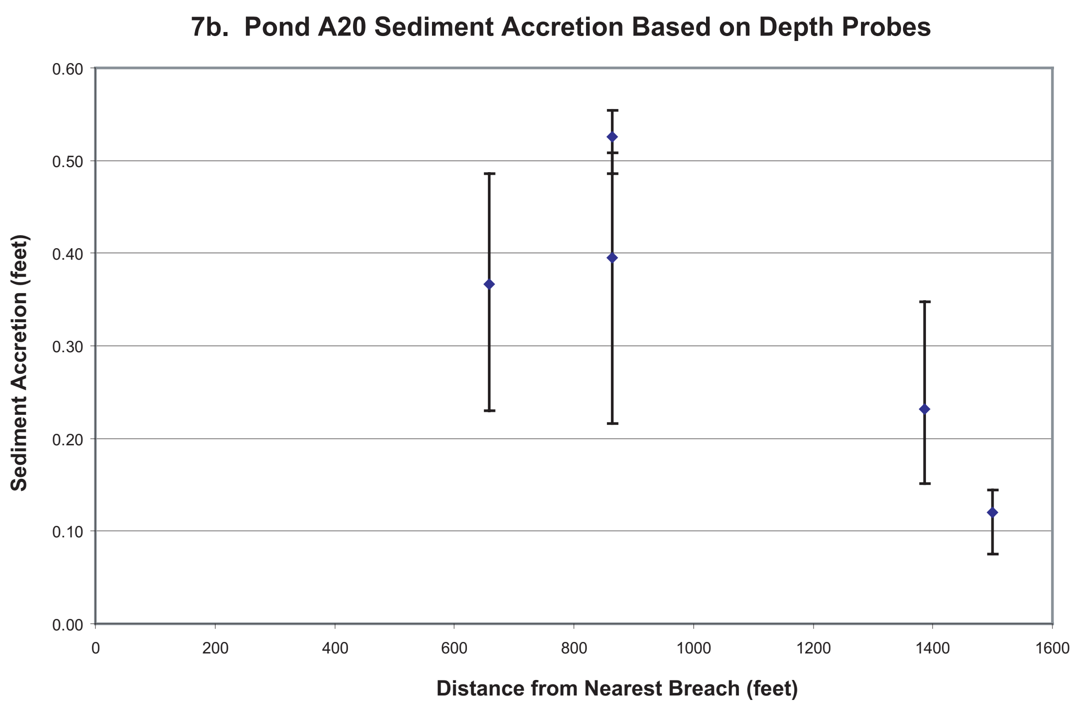
Island Ponds Mitigation Monitoring

Pond A19 District Sedimentation Results

#1864

PWA





Note:
Data points in Figure 6a are average of two measurements (east and west).
Data points in Figure 6b are average of three depth probes.
Error bars in Figure 6b represent maximum and minimum values.
Sediment accretion measured November 2006, eight months after breaching.

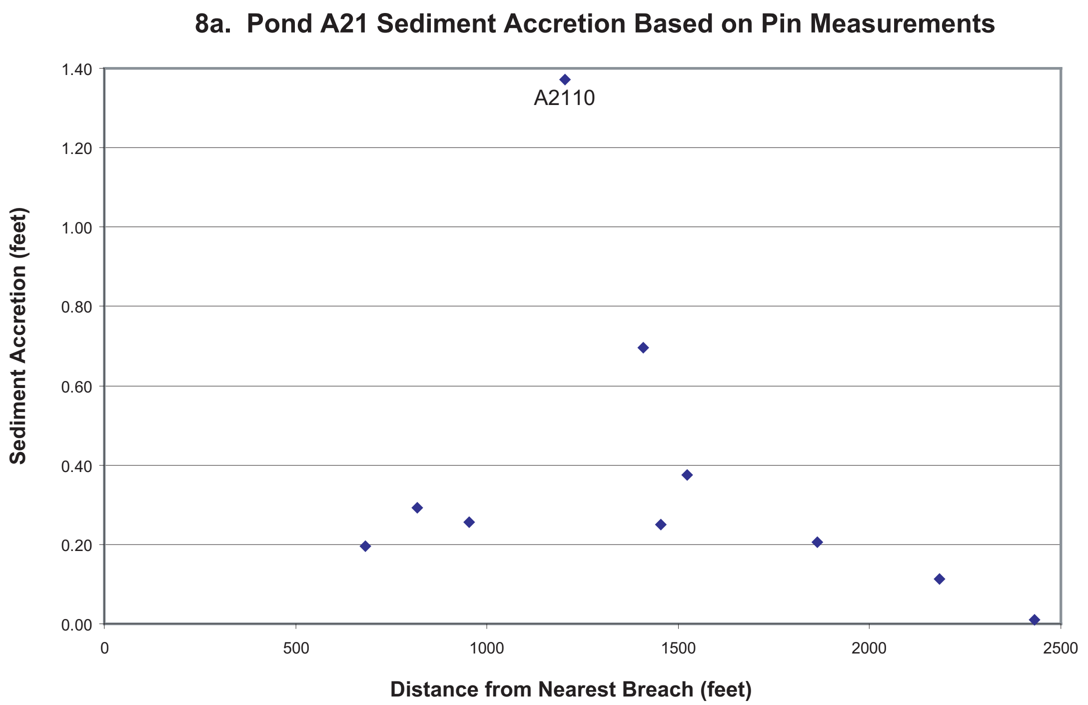
figure 7

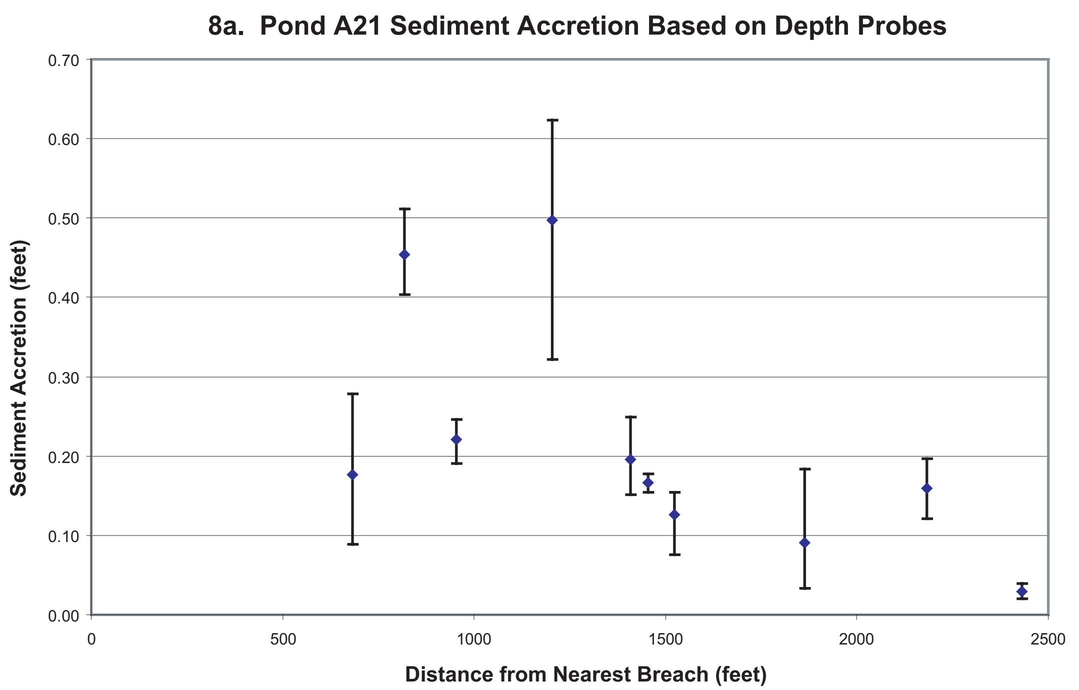
Island Ponds Mitigation Monitoring

Pond A20 District Sedimentation Results

#1864

PWA





Note:
Data points in Figure 6a are average of two measurements (east and west).
Data points in Figure 6b are average of three depth probes.
Error bars in Figure 6b represent maximum and minimum values.
Sediment accretion measured November 2006, eight months after breaching.

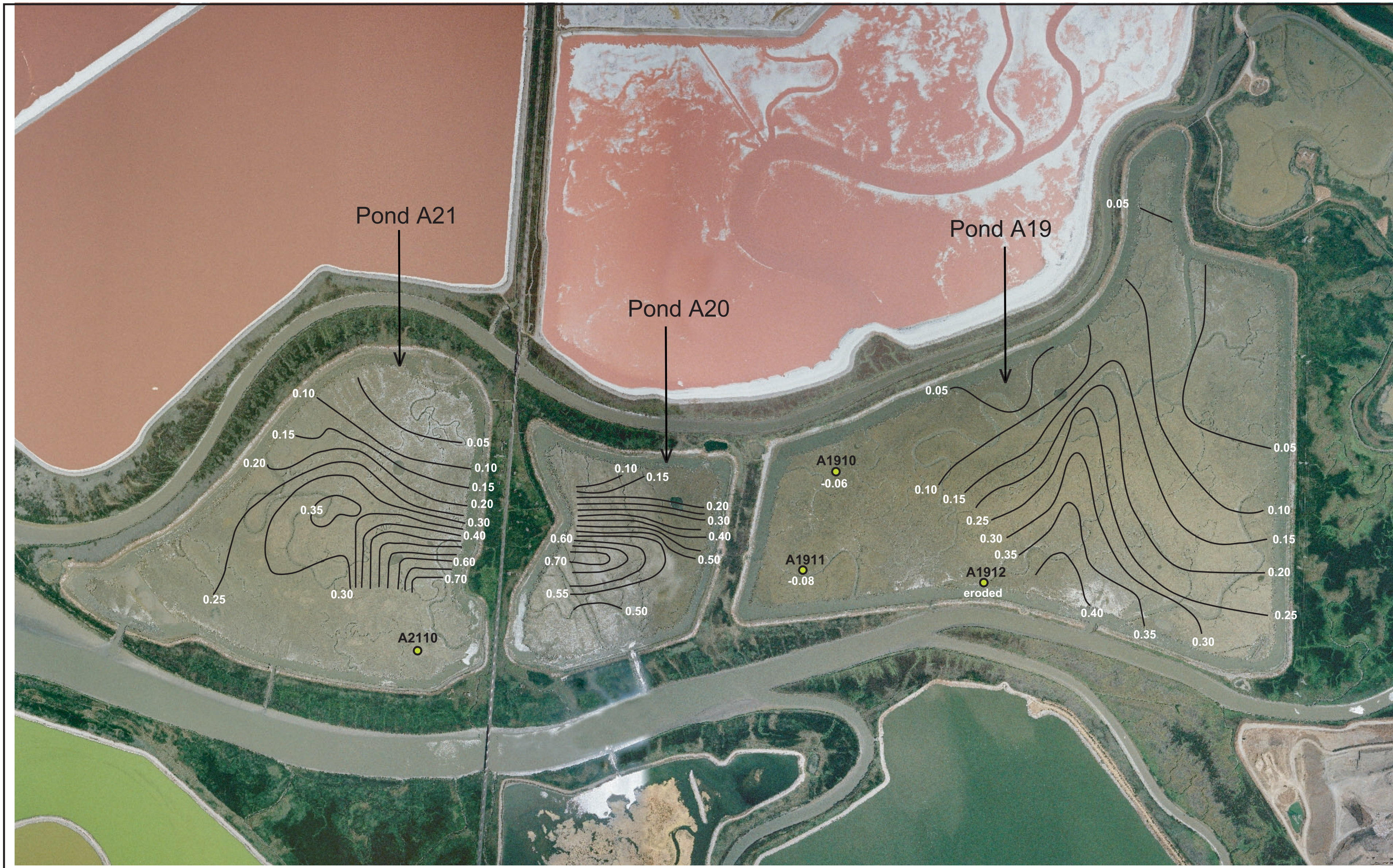
figure 8

Island Ponds Mitigation Monitoring

Pond A21 District Sedimentation Results

#1864

PWA



A2110 = sedimentation pin

contour units in feet

Note:
Sediment accretion measured November 2006, approximately eight months after breaching

0 500 1,000 feet

Image Source: SCVWD (August 12, 2006 11:00 am)

figure 9

Island Ponds Mitigation Monitoring

Isopleth Map of Sediment Accretion Based on Pin Measurements

#1864

PWA

contour units in feet

Note:
Sediment accretion measured November 2006, approximately eight months after breaching

0 500 1,000 feet

f i g u r e 10

Island Ponds Mitigation Monitoring

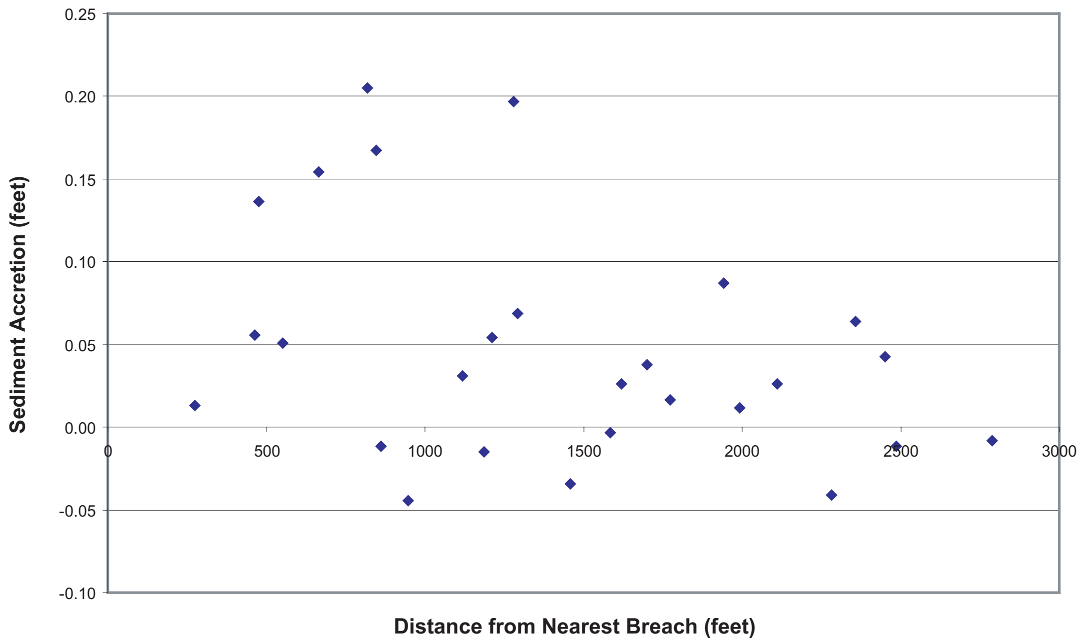
Isopleth Map of Sediment Accretion Based on Depth Probes

#1864

PWA

Image Source: SCVWD (August 12, 2006 11:00 am)

11a. Pond A21 Sediment Accretion Based on Pin Measurements Three Months after Breaching



11b. Pond A21 Sediment Accretion Based on Pin Measurements Seven Months after Breaching

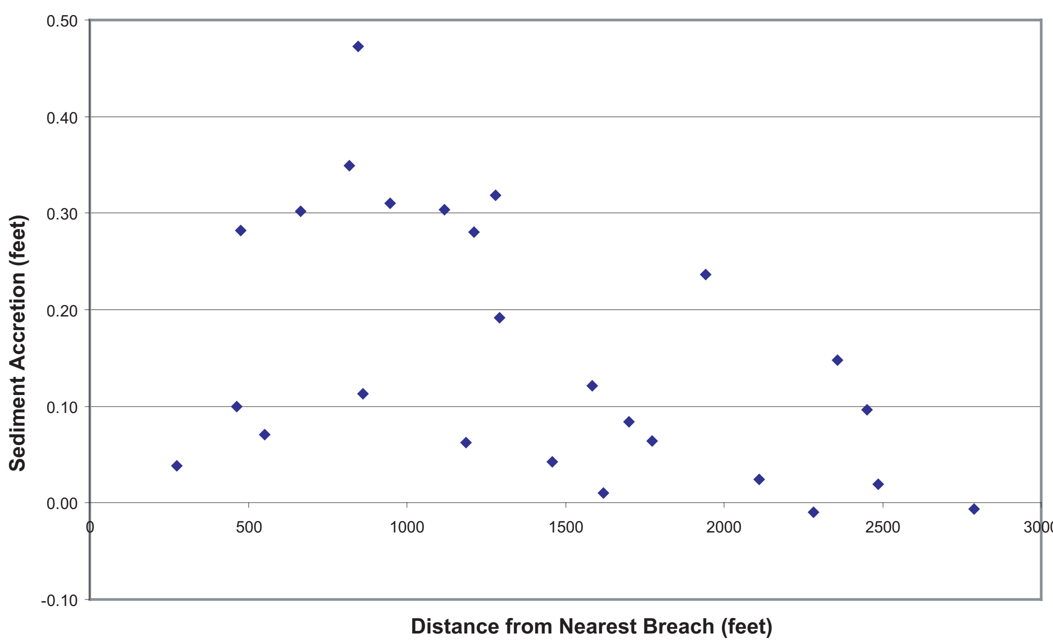


figure 11

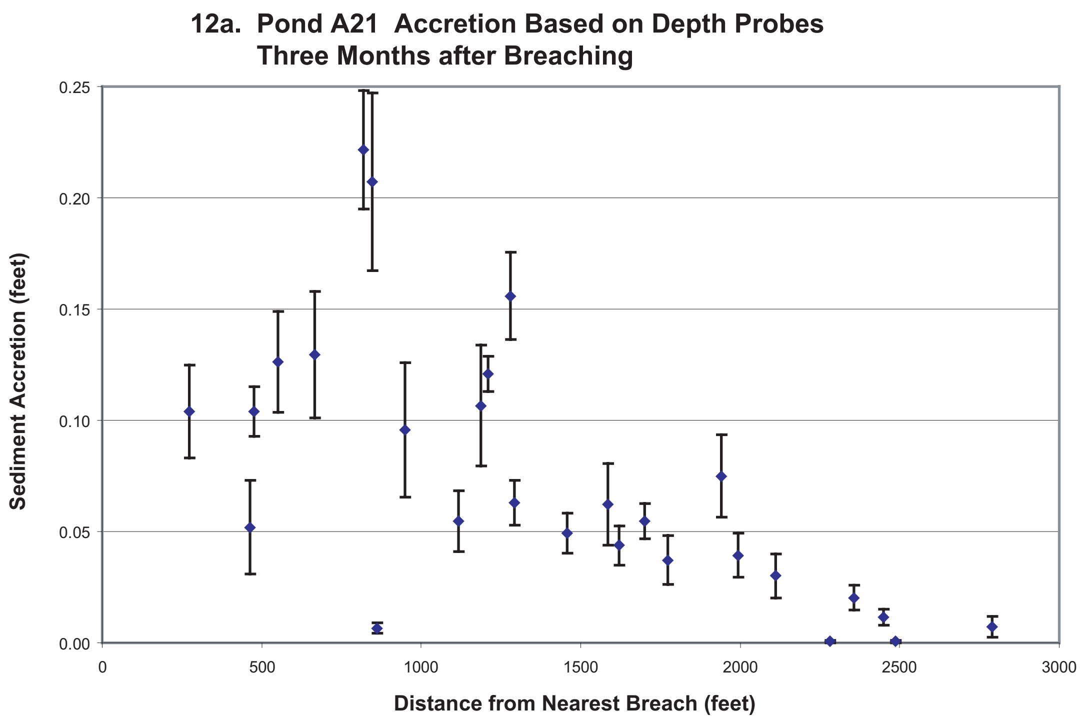
Island Ponds Mitigation Monitoring

Pond A21 USF Pin Measurement Results

#1864

PWA

Note:
Data points in Figure 11a and 11b are average of two measurements (east and west).



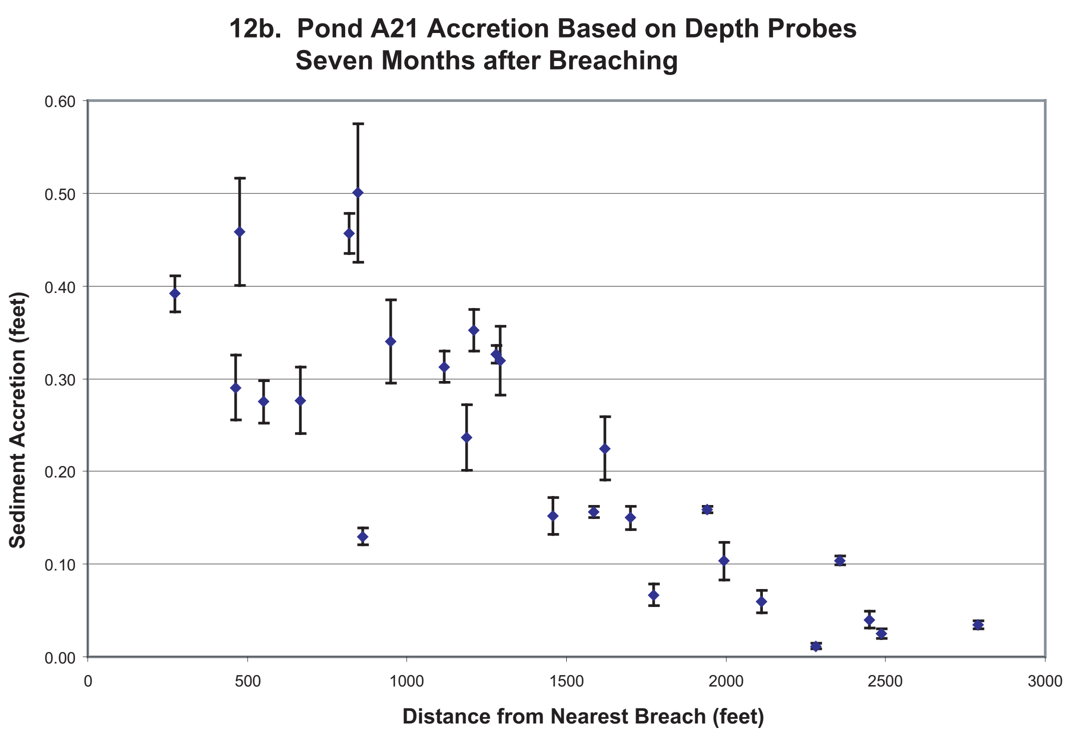


figure 12

Island Ponds Mitigation Monitoring

Pond A21 USF Depth Probe Results

Note:
Data points in Figure 12a and 12b are average of eight measurements.

#1864

PWA

Legend

- 2005 Marsh Edge
- 2006 Marsh Edge
- Breach Widths
- Marsh Loss Area
- Construction Impacts

Breach Name	Breach Widths	Construction Impacts	Marsh Loss from Scour
A21W	76 ft	0.11 ac	0.14 ac
A21E	32 ft	0.28 ac	0.05 ac
A20	76 ft	0.72 ac	0.00 ac
A19W	22 ft	0.03 ac	0.02 ac
A19E	110 ft	0.02 ac	0.03 ac

N

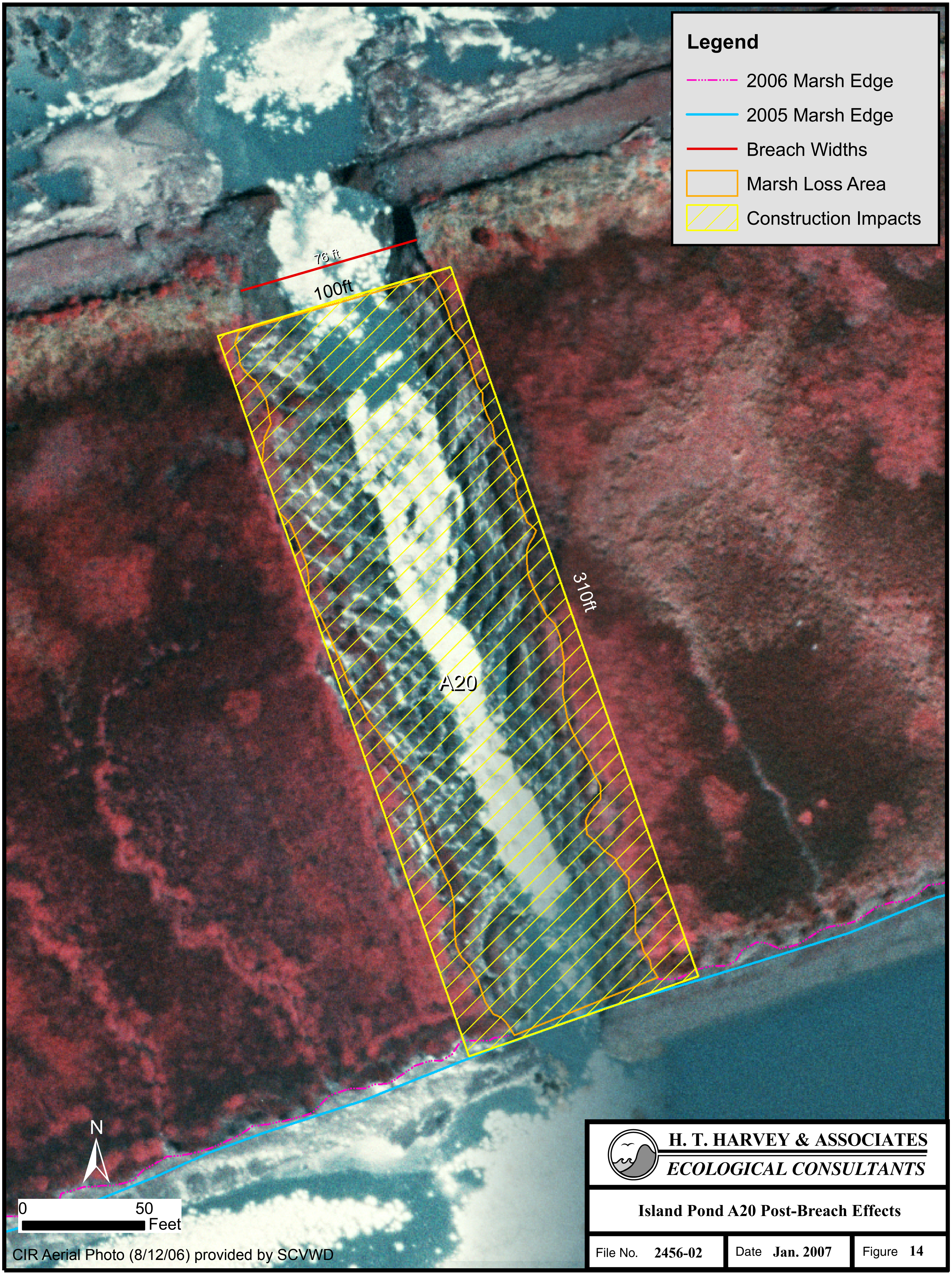
0 750 1,500 Feet

CIR Aerial Photo (8/12/06) provided by SCVWD

H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

Island Pond Post-Breach Effects

File No. 2456-02 | Date Jan. 2007 | Figure 13



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Island Pond A20 Post-Breach Effects

File No. 2456-02	Date Jan. 2007	Figure 14

APPENDIX A
SEDIMENTATION PIN DATA

Pond	ID	Northing	Easting	Pin Movement[1] (feet)	Pin Accretion[2] (feet)	Depth Probe Accretion[3] (feet)	Distance from Nearest Breach (feet)
A19	A1901	1998378	6139462	0.17	0.01	0.01	4000
A19	A1902	1997533	6139359	0.28	0.09	0.03	3114
A19	A1903	1997004	6140052	0.29	0.02	0.04	2841
A19	A1904	1996794	6139043	0.09	0.12	0.06	2364
A19	A1905	1996246	6139614	0.01	0.05	0.10	1955
A19	A1906	1996260	6138748	-0.02	0.26	0.17	1795
A19	A1907	1996306	6138209	0.11	0.05	0.13	1841
A19	A1908	1995661	6140093	0.00	0.06	0.16	1750
A19	A1909	1995850	6137503	-0.02	0.07	0.20	1227
A19	A1910	1995754	6136634	-0.22	-0.06	0.30	1364
A19	A1911	1994902	6136328	0.07	-0.08	0.09	1136
A19	A1912	1994802	6137896	Eroded	Eroded	0.00	477
A19	A1913	1994943	6138503	0.08	0.42	0.25	545
A19	A1914	1994981	6139508	0.21	0.19	0.21	886
A19	A1915	1994441	6139937	-0.01	0.28	0.22	1114
A20	A2001	1995675	6134580	0.09	0.07	0.12	1500
A20	A2002	1995551	6135296	0.16	0.17	0.23	1386
A20	A2003	1995020	6135241	0.51	0.54	0.39	864
A20	A2004	1995023	6134585	0.03	0.72	0.53	864
A20	A2005	1994548	6134334	0.18	0.49	0.37	659
A21	A2101	1996190	6133043	-0.07	0.01	0.03	2432
A21	A2102	1996203	6132359	0.00	0.11	0.16	2182
A21	A2103	1995533	6133027	0.06	0.21	0.09	1864
A21	A2104	1995507	6132381	N/A	0.38	0.13	1523
A21	A2105	1995539	6131707	0.11	0.25	0.17	1455
A21	A2106	1994858	6133026	0.19	0.70	0.20	1409
A21	A2107	1994877	6132369	0.20	0.26	0.22	955
A21	A2108	1994879	6131709	0.30	0.29	0.45	818
A21	A2109	1994879	6131048	-0.01	0.20	0.18	682
A21	A2110	1994221	6133040	0.21	1.37	0.50	1205

[1]Calculated by subtracting the pin-top elevation at Year 0 from the pin-top elevation at Year 1

[2]Average of two measurements (east and west)

[3]Average of three depth probe measurements within ten feet of pin

APPENDIX B
PHOTOGRAPHS

Appendix B-1

Railroad Bridge Scour Photograph Comparisons

East Side of Bridge Looking South – July 13th, 2006

East Side of Bridge Looking South – November 29th, 2006

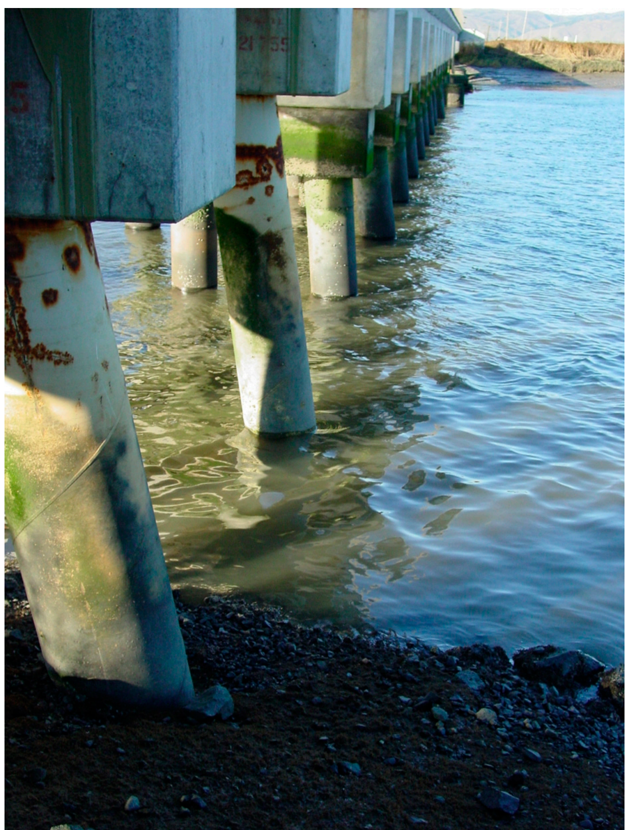
West Side of Bridge Looking South – July 13th, 2006

West Side of Bridge Looking South – November 29th, 2006

West Side of Bridge Looking North – July 13th, 2006

West Side of Bridge Looking North – November 29th, 2006

East Side of Bridge Looking North – July 13th, 2006



East Side of Bridge Looking North – November 29th, 2006

Close-up of West Side Pier on South Bank Looking West

Close-up of all Piers on South Bank Looking West

Close-up of West Side Pier on North Bank Looking West

Close-up of Central Pier on North Bank Looking East

Close-up of Central Pier on North Bank Looking West

Close-up of East Side Pier on North Bank Looking West

Appendix B-2

Rail Levee Photographs

Pond A21 Levee West Side of Railroad (07/13/2006)

Pond A21 Levee Looking North

Pond A21 Levee Looking South

Pond A21 Levee West Side of Railroad (07/13/2006)

West Side of Railroad Looking South

West Side of Railroad Looking North

Pond A20 Levee East Side of Railroad (07/13/2006)

Pond A20 Levee Looking North

Pond A20 Levee Looking South

Pond A20 Levee East Side of Railroad (07/13/2006)

East Side of Railroad Looking North

East Side of Railroad Looking South

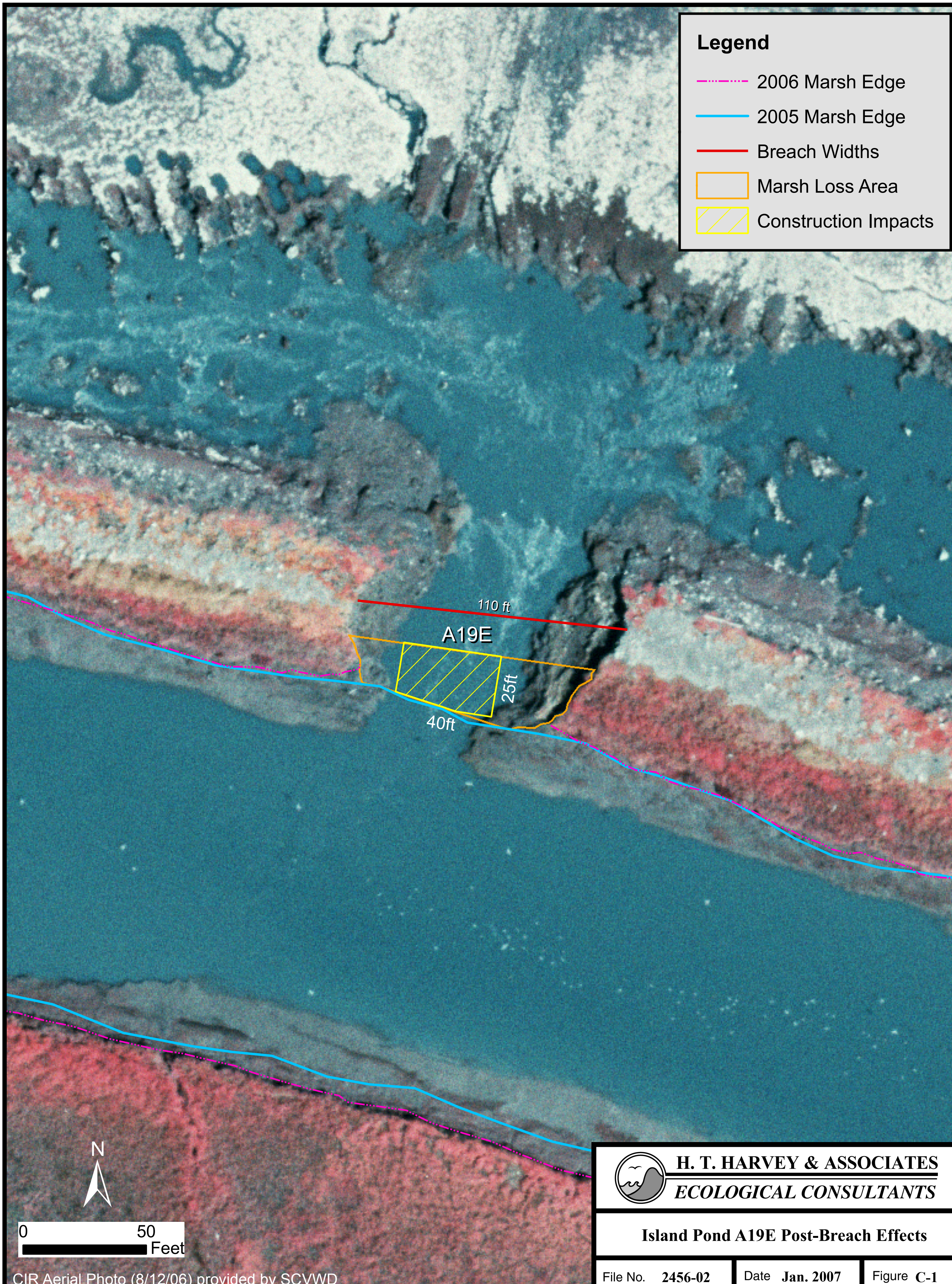
Appendix B-3

Town Of Drawbridge Photographs

Aerial view of the railroad and the Town of Drawbridge.
The red circle in the southeast corner of Pond A21 depicts the area of concern.

Close up of eroded levee in the southeast corner of Pond A21

APPENDIX C
AERIAL PHOTOGRAPHS OF POST-BREACH EFFECTS – PONDS A19 AND A21



H. T. HARVEY & ASSOCIATES
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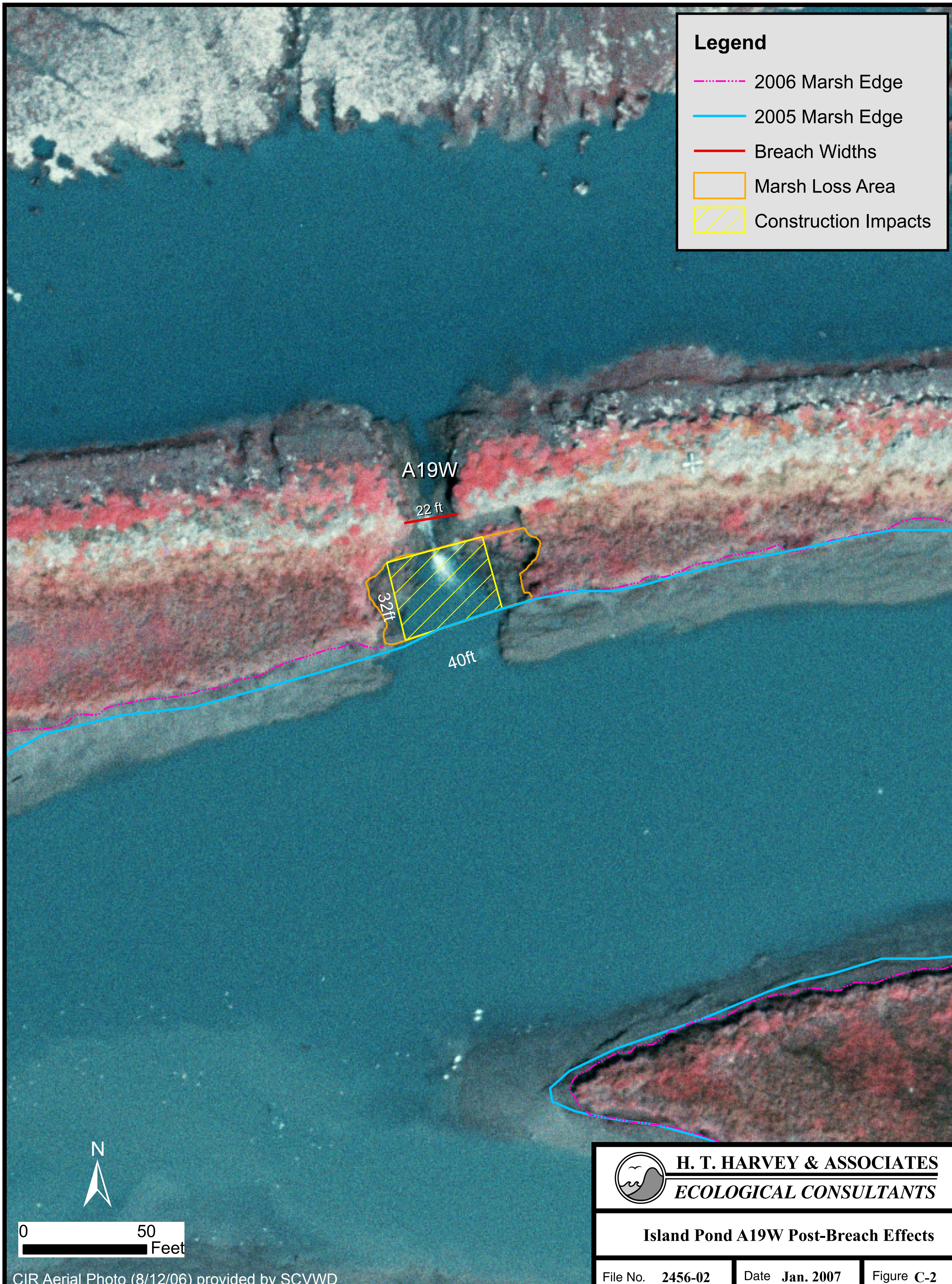
Island Pond A19E Post-Breach Effects

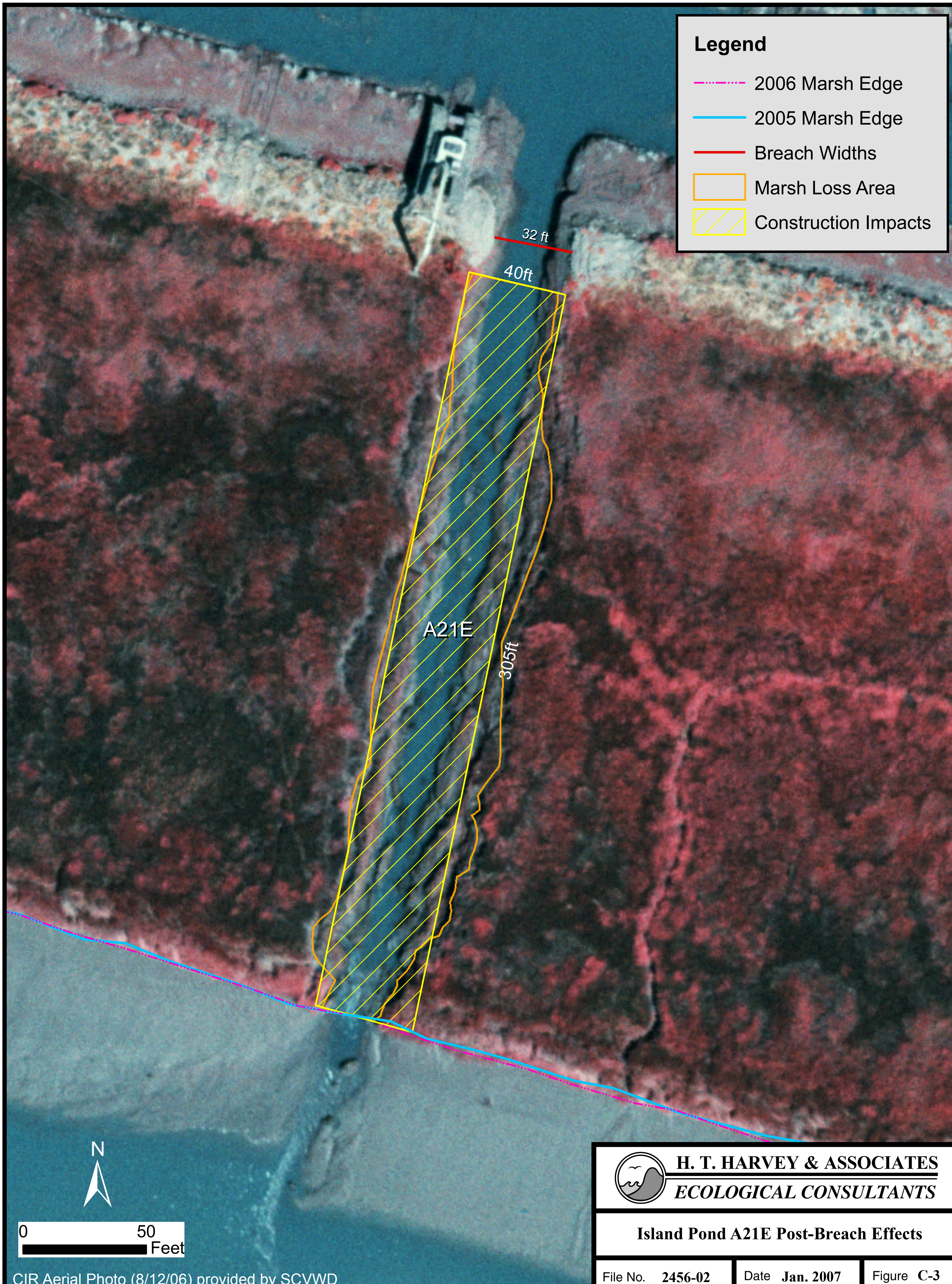
File No. 2456-02	Date Jan. 2007	Figure C-1



H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

Island Pond A19W Post-Breach Effects

File No. 2456-02	Date Jan. 2007	Figure C-2



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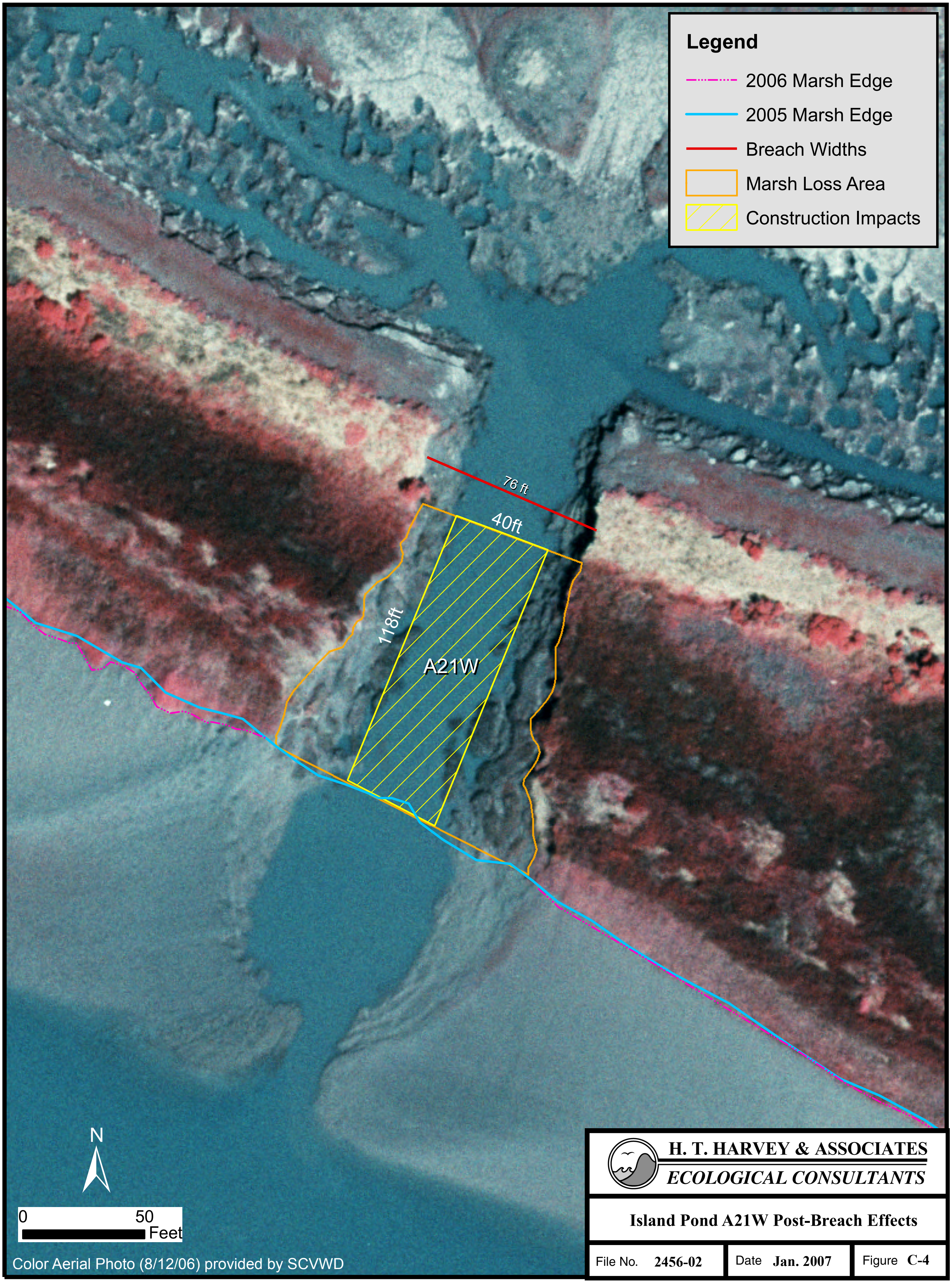
Island Pond A21E Post-Breach Effects

File No. **2456-02** | Date **Jan. 2007** | Figure **C-3**


Legend
2006 Marsh Edge
2005 Marsh Edge
Breach Widths
Marsh Loss Area
Construction Impacts
76 ft
40ft
118ft
A21W
N
0
50
Feet
Color Aerial Photo (8/12/06) provided by SCVWD
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
Island Pond A21W Post-Breach Effects
File No. 2456-02
Date Jan. 2007
Figure C-4

APPENDIX D
REFUGE MONITORING (METHODS/RESULTS/DISCUSSION)

APPENDIX D

SAN FRANCISCO BAY NWR MONITORING REQUIREMENTS FOR ISLAND PONDS TIDAL WETLAND RESTORATION

San Francisco Bay NWR Monitoring Requirements for Island Ponds Tidal Wetland Restoration

Summary of Tasks

During Year One (Y1) of the Island Ponds Tidal Wetland Restoration program, Tasks 5.2.3, 5.2.4, 5.2.6, 5.2.7, and 5.3.6 were conducted. The following provides a brief description of these tasks and their Y1 results.

Task 5.2.3: Since the breaching of the Island Ponds, channel networking monitoring will yield critical data to show suitable habitat for the California Clapper Rail and many other species.

Task 5.2.4: During year one for the monitoring of native vegetation development of the Island Ponds, no new vegetation was observed

Task 5.2.6: No invasive plant species were found to be in the Island Ponds for year one, except for two previously identified patches of invasive Spartina on the outer fringe of Pond A21 which were treated in 2005.

Task 5.2.7: With the anticipation of long term ecological benefits for the California Clapper Rail and the Salt Marsh Harvest Mouse, the short term monitoring of wildlife on the Island Ponds has proven positive results.

Task 5.3.6: Monitoring of the Island Ponds for water quality show that the parameters of salinity, dissolved oxygen, pH, turbidity, and temperature in Coyote Creek were all back to normal levels within two weeks of each breach.

Task 5.2.3 – Channel Network Evolution Monitoring

The Channel Network Evolution Monitoring Task (Task 5.2.3) for the Island Ponds is described in the Mitigation and Monitoring Plan (MMP) as follows: "Monitoring will consist of extracting channel planform morphology from the aerial photographs collected periodically and rectified to ensure spatial comparability from photo to photo (see Aerial Photography, Section 5.2.8). Evolution of channel networks will be measured over time. Parameters to be measured include total surface area of channels and areas of expansion and loss. Monitoring results will be incorporated into a table showing, for each pond, the total pond acreage, total channel coverage, and percent of pond as channel. Maps will show the channel network in each year, the change from prior year that an aerial image was taken, and the change from the baseline."

Table D-0 will provide a baseline to show channel networking in the Island Ponds.

Table D-0: Channel Networking in Island Ponds During 2006

Pond	Pond Acreage	Total Channel Acreage	Percent Pond as Channel
A19	265	8.74	3.30
A20	63	0.85	1.35
A21	147	3.02	2.05

Figures 1-3 show the channel networking evolution for Y1 monitoring in the Island Ponds.

Figure 1: Channel Networking in Pond A19 during 2006.

Figure 2: Channel Networking in Pond A20 during 2006

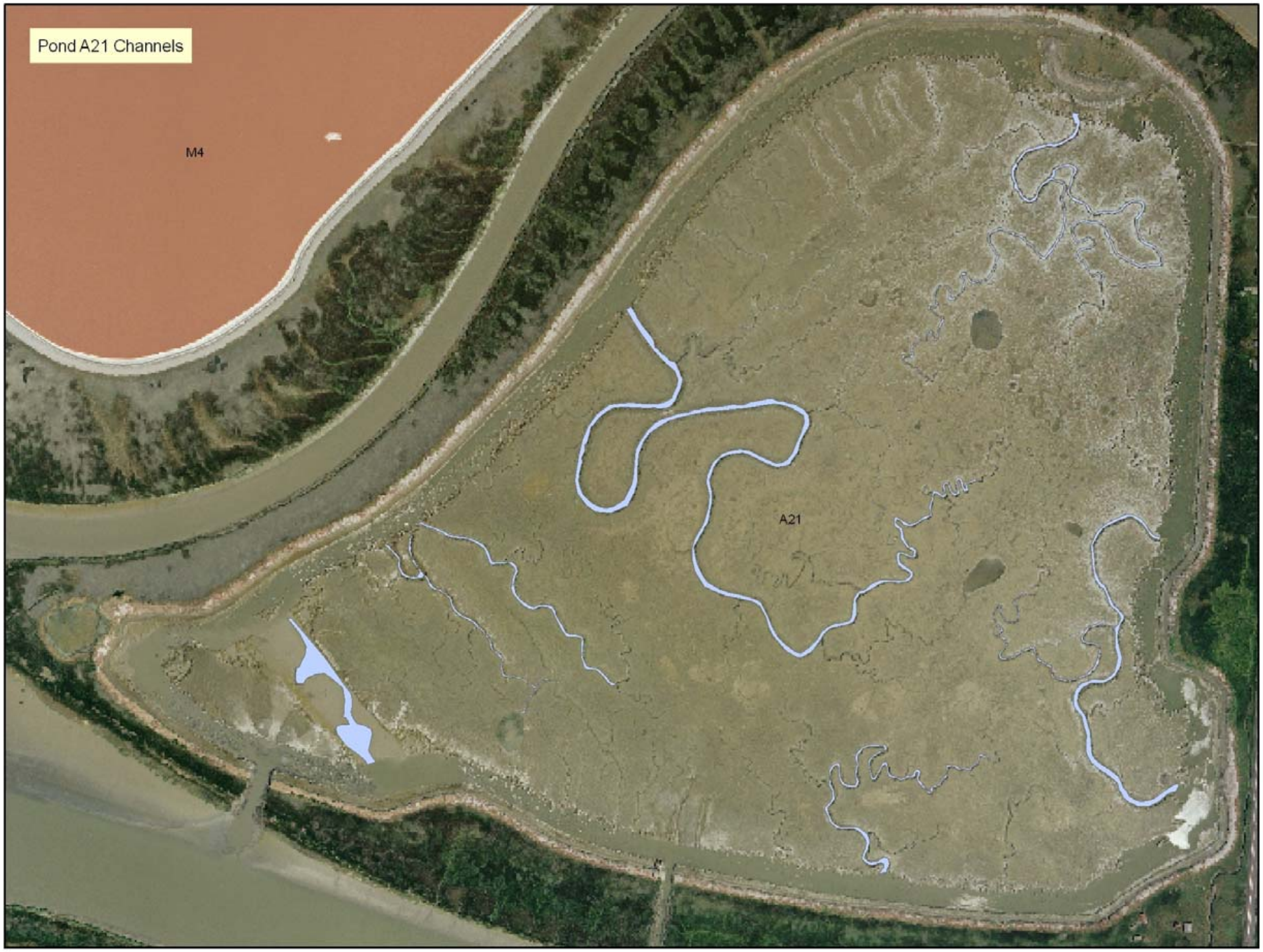


Figure 3: Channel Networking in Pond A21 during 2006

Task 5.2.4 – Native Vegetation Development

The Native Vegetation Development Task (Task 5.2.4) for the Island Ponds is described in the MMP as an evaluation of the "progress in achieving the success criteria for tidal marsh restoration." To do so, vegetation establishment is monitored using aerial photographs and field sampling.

Before the breaching in 2006, the Island Ponds had no established vegetation due to 99% of the total area being covered with a hard salt crust gypsum layer (H.T. Harvey & Associates 2004). The Island Pond Complex has also become subsided since diking, so plant colonization will not occur until sedimentation reaches appropriate marsh plain elevation. During Y1of native vegetation development monitoring in the Island Ponds, no new vegetation was observed inside the Ponds.

Task 5.2.6 – Invasive Plant Species Establishment

The Invasive Plant Species Establishment Task (Task 5.2.6) is described in the MMP as follows: "Colonization of the Island Ponds restoration site by non-native invasive species would jeopardize the success of the island ponds mitigation and restoration. Many of the important ecological benefits of restored tidal marsh vegetation will not be provided by invasive species. In particular, invasive non-native plant species may prevent establishment of native tidal marsh vegetation. Annual monitoring for invasive smooth cordgrass and its hybrids will occur for the duration of the mitigation project (i.e., until vegetation covers 75% of 75 acres). This effort will provide early detection and trigger prompt control efforts, before invasive cordgrass can dominate any portion of the Island Ponds. Other non-native plant species that may occur with increasing frequency in high marsh zones include Perennial Peppergrass, Russian thistle (*Salsola soda*), and New Zealand spinach (*Tetragonia tetragonioides*). Observations of these and other non-native species will be recorded during the aerial photo monitoring and field-truthing, conducted under the native vegetation development section (see Section 5.2.4)."

The Santa Clara Valley Water District (SCVWD) surveyed the perimeter of the Island Ponds on October 17, 2006 for invasive Spartina and did not locate any new stands of the species. Two patches were previously identified and treated in 2005 along the fringe of Pond A21. These patches appeared to be very well controlled (>90% kill) in 2006 and the Scirpus and native Spartina appeared to be overcoming it. The SCVWD did however spray what was left of the two invasive Spartina patches (Lisa Porcella, SCVWD, *personal quote*). No other invasive species were found during the 2006 SCVWD survey of the Island Ponds during Y1.

During Y1, photo points were set at the most southwest section of each of the three Island Ponds to document any invasive plant establishment. Each photo point will be a series of three pictures covering the entire pond area. The points will be taken yearly at low tide to show any invasive species growth.

Figures 4-6 were taken at these photo points during 2006.

Task 5.2.7 – Wildlife Monitoring

The Wildlife Monitoring Task (Task 5.2.7) for the Island Ponds is described in the MMP as follows: "The ISP (Initial Stewardship Project) anticipates that restoration of the Island Ponds to tidal marsh will provide long-term ecological benefits to native birds (particularly California clapper rail) and mammal species (particularly SMHM) [Salt Marsh Harvest Mouse]. In addition, the District [SCVWD] has chosen presence of California clapper rail as a performance criterion to measure success of their SMP mitigation requirements. Although there are no performance criteria or success criteria associated with the presence of other wildlife species, the project partners agreed it was prudent to incorporate a wildlife component into this monitoring program. Monitoring for bird and mammal species will reveal whether restoration of tidal exchange at the Island Ponds produce the anticipated benefits to native wildlife species.

"A) California Clapper Rail Monitoring – The Refuge will monitor for California clapper rail with in the Island Ponds as soon as suitable habitat develop. During year one, there is no suitable habitat available for the California clapper rail.

“B) SMHM Monitoring – The Refuge will monitor for SMHM in the Island Ponds as soon as five acres of contiguous suitable habitat develop. During year one, there is no suitable habitat available for the SMHM.

“**C) Waterfowl and shorebird species –** USGS has been counting waterbirds at the Island Ponds since 2002. They will continue to monitor non-threatened and endangered bird species for five years after the first breach.”

The U.S. Geological Society (USGS) has counted waterbirds at Island Ponds A19-A21 monthly between October 2002 and November 2006, with the exception of September 2005. Before the ponds were breached, USGS’ standard protocol was to conduct counts within three hours of high tide when bird numbers in ponds would be at their peak (Takekawa et al. 2005, 2006). After the Island Ponds were breached in March 2006, USGS conducted low tide surveys between April 2006 and November 2006 in addition to the high tide surveys to document changes in bird-use coincident with changing water levels and habitat evolution (Takekawa et al. 2006). Birds were identified to species with the exception of some similar species that cannot be readily distinguished in the field. For example, long-billed and short-billed dowitchers were recorded together as “dowitchers,” and greater and lesser scaup together as “scaup”.

To facilitate analysis of bird species with similar habitat requirements, USGS assigned species to foraging guilds (Takekawa et al. 2005, 2006). These included: 1) dabbling ducks – e.g. northern shovelers (*Anas clypeata*); 2) diving ducks – e.g. ruddy ducks (*Oxyura jaimaicensis*); 3) eared grebes (*Podiceps nigricollis*); 4) fish eaters – e.g. double-crested cormorants (*Phalacrocorax auritis*); 5) gulls – e.g. ring-billed gulls (*Larus delawarensis*); 6) herons – e.g. great egrets (*Ardea alba*); 7) medium shorebirds – e.g. marbled godwits (*Limosa fedoa*); 8) phalaropes – e.g. Wilson’s phalaropes (*Phalaropus tricolor*); and 9) small shorebirds – e.g. western sandpipers (*Calidris mauri*).

During Y1, it was found that since the breach of the Island Ponds in March 2006, waterbird use has increased in almost all species except for eared grebes. The decline of eared grebe use can be contributed to a loss of foraging potential when the Island Ponds were changed from salt making ponds to tidal action.

Tables D-1 through D-7 document the yearly and monthly totals of waterbird use at the Island Ponds.

Monitoring for waterfowl and shorebird use on the Island Ponds will continue to be an important indicator to show how the Island Ponds progress from former salt making ponds, with minimal waterbird habit, to tidal action where the foraging potential for many waterbirds is abundant. During the years prior to breaching of the Island Ponds, the area provided foraging habitat for a few specialized high-saline tolerant species, such as Eared Grebes. Once the Ponds became tidal, many different species and abundance of species are now seen on the Island Ponds. For the years before the breaches (2002 – 2005) the highest number of Western sandpipers recorded was 1,215 and the highest number of Northern Shovelers was 173. In 2006, waterfowl dabbling ducks and small shorebirds showed the highest increase of Island Pond use with a total of 2,632 and 17,279 sightings, respectively. Of the 2,632 dabbling ducks that were observed during high tide, 2,327 were Northern Shovelers. During the low tide count 16,722 of the small shorebirds were identified as Western sandpipers of the total 17,279.

The numbers of Gulls observed on the Island Ponds has remained consistently high during the pre- and post-breach monitoring. The Ponds are most likely being utilized by the Gulls as resting areas, since they are in close proximity to landfills. As the Island Ponds begin to become vegetated, it will be interesting to see if the Gulls continue to use these ponds or move to a more open-water area.

Figure 4: Photo Point taken of Pond A19 during ebb tide – December 1, 2006

Figure 5: Photo Point taken of Pond A20 during ebb tide – December 1, 2006

Figure 6: Photo Point taken of Pond A21 during ebb tide – December 1, 2006

Task 5.3.6 – Water Quality Monitoring

The Water Quality Monitoring Task (Task 5.3.6) for the Island Ponds is described in the MMP as follows: "In coordination with water quality monitoring performed by USGS, the Refuge will perform grab samples within one-foot of the surface and within one-foot of the bottom upstream and downstream of the first breach site (but not for the second breach on A21 and A19) for each of the three ponds. Therefore, testing would be done for three breaches, the first breach on each island. The samples will be tested for salinity, DO [dissolved oxygen], pH, turbidity and temperature. The sampling would occur the day after breaching, 7-days after and then weekly as necessary until the salinity levels return to normal.

In addition, grab samples within one-foot of the surface and within one-foot of the bottom will be taken between the Pond A14 receiving water sample site and the downstream breach on Pond A21; and the Pond A18 intake structure and the up stream breach of Pond A19. Samples will be tested for salinity, DO, pH, turbidity and temperature.

The sampling would occur once a month from May to October in the year of breaching. Based on the results of the first year's water quality sampling, the RWQCB [Regional Water Quality Control Board] may require sampling in future years."

USGS accessed slough sampling sites via boat from San Francisco Bay and used a Geographic Position System to navigate to sampling locations. When the boat was approximately 25-50 meters from the designated sampling site, the engine would be cut or reduced to allow for drifting caused by current and wind to the site location. Every effort was made to ensure that the sample was collected from the center of the slough. A recently calibrated Hydrolab Minisonde from the Hydrolab-Hach Company in Loveland, Colorado was used to measure salinity, pH, turbidity, temperature, and DO at each location. Samples were collected from the near-bottom of the water column in addition to the near-surface at each sampling location. Depth readings of samples were collected at the completion of each Minisonde measurement to account for drift during the reading equilibration period. The specific gravity of each site was additionally measured with a hydrometer from Ertco of West Paterson, New Jersey. The hydrometer was scaled for the appropriate range. This sample was collected concurrently with the near-surface Minisonde measurement. The majority of the samples were collected on the rising or high tide in order to gain access to the sampling sites, which were not accessible at tides less than 3.5 feet mean low-low water.

Standard observations were collected at each site and included:

A. Observance of floating and suspended materials of waste origin;

B. Description of water condition including discoloration and turbidity;

C. Odor (presence or absence, characterization, source and wind direction);

D. Evidence of beneficial use, presence of wildlife, fisherpeople, or other recreational activities;

E. Hydrographic conditions (time and height of tides, depth of water column, and sampling depths); and

F. Weather conditions (air temp, wind direction and velocity, and precipitation).

Observations A, B, C, D and E were recorded at each sampling location. Observation F was recorded at the beginning and ending of each traverse of the slough.

Water quality samples were collected during 2006 at the Island Ponds at five days pre-breach, one day post-breach, and generally once a week for each pond until salinity levels were considered to be back to normal levels by the RWQCB. Pond A19 was first breached on March 7th, 2006, Pond A20 on March 12th, 2006, and Pond A21 on March 29th, 2006. Figure 7 shows the location of these ponds within the Island Ponds system as well as the location of water quality sampling points.

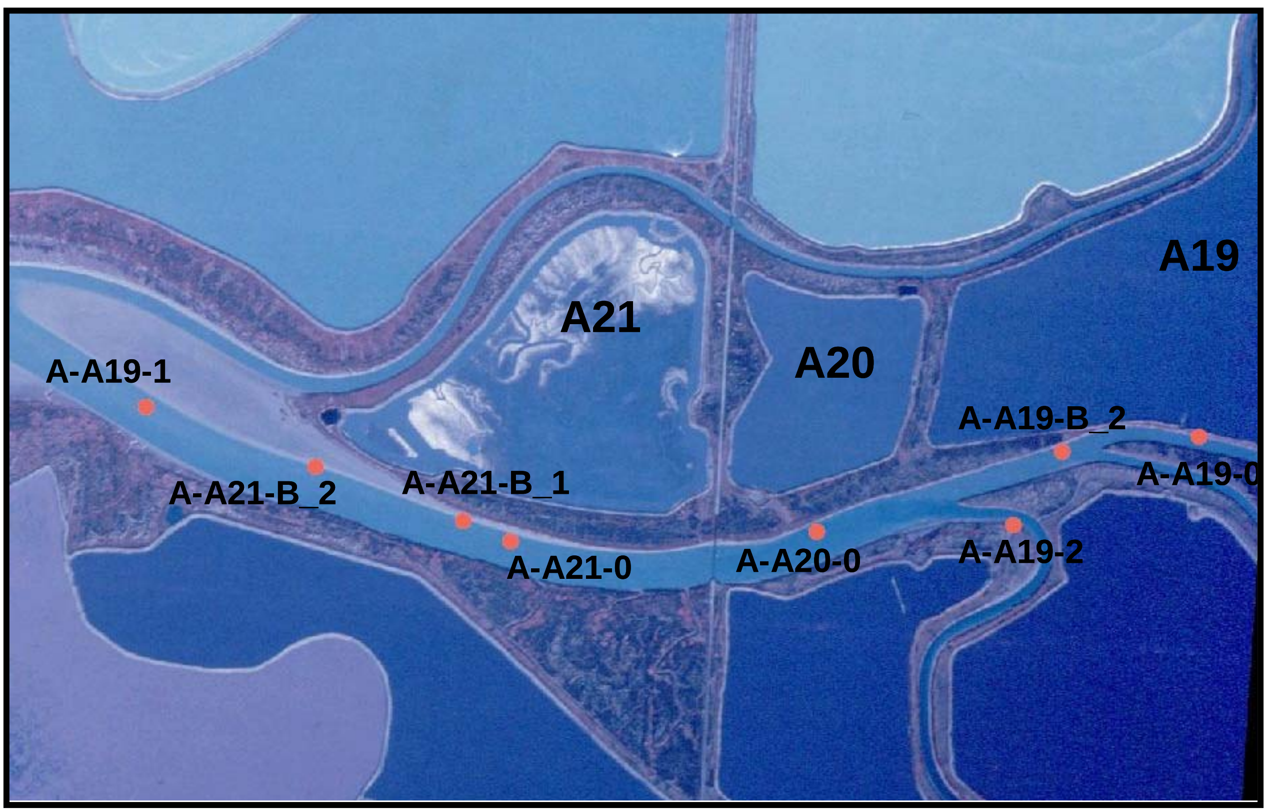


Figure 7: Map of Island Ponds Water Quality Sampling Locations

All other water quality parameters of pH, temperature, turbidity, and DO remained in normal ranges for all samples taken. During the receiving water sampling period, grab samples showed elevated salinity levels immediately after the first breach for each pond. Salinity ranged from 2.56 parts per thousand (ppt) to 39.5 ppt. Water quality sampling continued until March 29th, 2006 for weekly samples, when water quality was considered to be back to normal levels. Sampling then continued monthly in Coyote Creek at all sites from May through October. The samples showed normal readings during this period. In-pond water samples are also taken by USGS during their monthly bird surveys. Results of these samples showed no abnormal readings.

No adverse water quality impacts were detected due to the breaching of the Island Ponds. The pre- and post-breach sampling did show stratification by salinity levels immediately following the first breach of each pond. However, the salinity levels in Coyote Creek returned to normal within two weeks of all breaches, in some cases sooner. Other water quality parameters in the receiving waters remained consistently within normal ranges throughout the sampling period. This would indicate that for future breaches of the South Bay Salt Ponds, it may only be necessary for water quality sampling of breaches where the salinity levels inside the pond are at extremely elevated levels.

The RWQCB set a threshold limit for salinity at 135 ppt for initial discharging of the Island Ponds, which only may be breached during the months of March through April. All three Island Ponds were breached in March 2006, with a salinity level below the threshold limit and the ponds virtually dry except for water in the borrow pits.

Table D-8 provides results of the receiving water quality sampling for the Island Ponds during 2006.

Table D-1: Yearly Totals of Waterbird-Use in Island Ponds

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Oct - Dec 2002	High	All	0	0	0	0	0	40,160	0	15	0	16
Jan - Dec 2003	High	All	2	0	709	3	49	10,288	2	1,276	4	187
Jan - Dec 2004	High	All	62	21	2,355	19	56	5,881	3	1,701	0	2,573
Jan - Dec 2005	High	All	122	46	6,219	4	50	16,066	29	2,914	1	779
Jan - Nov 2006*	High	All	2,632	162	375	376	52	65,145	172	2,478	0	4,075
Apr - Nov 2006*	Low	All	1,078	18	0	351	36	55,631	203	2,140	0	17,279

* 2006 had the only low tide totals for the Island Ponds since being breached in March 2006.

Table D-2: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2002

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Oct-02	High	A19	0	0	0	0	0	1,700	0	0	0	0
Nov-02	High	A19	0	0	0	0	0	35,092	0	0	0	0
Nov-02	High	A20	0	0	0	0	0	0	0	0	0	0
Nov-02	High	A21	0	0	0	0	0	0	0	0	0	0
Dec-02	High	A19	0	0	0	0	0	1,615	0	15	0	6
Dec-02	High	A20	0	0	0	0	0	500	0	0	0	10
Dec-02	High	A21	0	0	0	0	0	1,253	0	0	0	0
		Totals for Year	*0*	*0*	*0*	*0*	*0*	*40,160*	*0*	*15*	*0*	*16*

Table D-3: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2003

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Jan-03	High	A19	0	0	0	0	0	7	0	159	0	0
Jan-03	High	A20	0	0	0	0	0	55	0	0	0	0
Jan-03	High	A21	0	0	0	0	0	550	0	12	0	5
Feb-03	High	A19	1	0	31	0	17	50	0	0	0	101
Feb-03	High	A20	0	0	4	0	0	381	0	0	0	0
Feb-03	High	A21	0	0	0	0	0	1,120	0	6	0	7
Mar-03	High	A19	0	0	130	0	3	182	0	3	0	0
Mar-03	High	A20	0	0	15	3	6	1	0	0	0	0
Mar-03	High	A21	0	0	0	0	2	738	0	20	0	0
Apr-03	High	A19	0	0	0	0	2	2	0	0	0	0
Apr-03	High	A20	0	0	123	0	0	1	0	3	0	0
Apr-03	High	A21	0	0	0	0	0	44	1	84	0	0
May-03	High	A19	1	0	0	0	2	0	0	2	0	0
May-03	High	A20	0	0	4	0	3	0	0	5	0	0
May-03	High	A21	0	0	0	0	0	2	0	142	0	3
Jun-03	High	A19	0	0	0	0	0	1,178	0	0	0	0
Jun-03	High	A20	0	0	0	0	14	0	0	7	0	0
Jun-03	High	A21	0	0	0	0	0	126	0	276	4	0
Jul-03	High	A19	0	0	0	0	0	401	0	1	0	0
Jul-03	High	A20	0	0	0	0	0	0	0	0	0	0
Jul-03	High	A21	0	0	0	0	0	20	0	10	0	1
Aug-03	High	A19	0	0	0	0	0	2,869	0	0	0	0
Aug-03	High	A20	0	0	0	0	0	65	0	0	0	0
Aug-03	High	A21	0	0	0	0	0	235	0	0	0	4
Sep-03	High	A19	0	0	0	0	0	17	0	0	0	5
Sep-03	High	A20	0	0	0	0	0	0	0	0	0	2
Sep-03	High	A21	0	0	0	0	0	199	0	0	0	4
Oct-03	High	A19	0	0	1	0	0	1,346	0	0	0	0
Oct-03	High	A20	0	0	0	0	0	54	0	0	0	0
Oct-03	High	A21	0	0	0	0	0	509	0	0	0	18

Table D-3: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2003

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Nov-03	High	A19	0	0	0	0	0	32	0	0	0	0
Nov-03	High	A20	0	0	0	0	0	0	0	0	0	0
Nov-03	High	A21	0	0	0	0	0	1	0	450	0	23
Dec-03	High	A19	0	0	191	0	0	26	1	3	0	0
Dec-03	High	A20	0	0	111	0	0	9	0	0	0	0
Dec-03	High	A21	0	0	99	0	0	68	0	93	0	14
		Totals for Year	*2*	*0*	*709*	*3*	*49*	*1,0288*	*2*	*1,276*	*4*	*187*

Table D-4: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2004

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Jan-04	High	A19	4	0	125	0	0	30	1	0	0	0
Jan-04	High	A20	0	0	118	0	19	0	0	0	0	0
Jan-04	High	A21	0	0	351	0	0	86	0	46	0	84
Feb-04	High	A19	0	0	163	0	6	5	0	0	0	0
Feb-04	High	A20	0	0	165	0	17	1	1	0	0	0
Feb-04	High	A21	0	1	442	0	0	256	0	100	0	2
Mar-04	High	A19	0	0	1	0	0	10	0	0	0	0
Mar-04	High	A20	0	0	43	0	2	0	0	0	0	0
Mar-04	High	A21	0	19	146	0	0	17	0	10	0	0
Apr-04	High	A19	0	0	22	0	0	0	0	0	0	0
Apr-04	High	A20	0	0	8	0	0	0	0	0	0	0
Apr-04	High	A21	0	0	104	0	0	0	0	58	0	0
May-04	High	A19	0	0	0	0	0	0	0	0	0	0
May-04	High	A20	0	0	0	0	0	0	0	0	0	0
May-04	High	A21	0	0	0	0	0	19	0	35	0	0
Jun-04	High	A19	0	0	0	0	0	595	0	4	0	0
Jun-04	High	A20	0	0	0	0	0	0	0	13	0	0
Jun-04	High	A21	0	0	0	0	0	0	0	78	0	0
Jul-04	High	A19	0	0	0	1	0	1,597	0	0	0	0

Table D-4: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2004

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Jul-04	High	A20	0	0	0	0	0	0	0	0	0	0
Jul-04	High	A21	0	0	0	0	0	25	0	0	0	0
Aug-04	High	A19	0	0	0	0	0	242	1	0	0	0
Aug-04	High	A20	0	0	0	6	0	0	0	0	0	0
Aug-04	High	A21	0	0	0	12	0	2	0	1	0	8
Sep-04	High	A19	0	0	0	0	0	673	0	0	0	148
Sep-04	High	A20	0	0	0	0	0	0	0	0	0	0
Sep-04	High	A21	0	0	0	0	0	1,561	0	0	0	7
Oct-04	High	A19	0	0	0	0	0	3	0	10	0	2
Oct-04	High	A20	0	1	0	0	8	0	0	0	0	0
Oct-04	High	A21	0	0	0	0	3	106	0	361	0	209
Nov-04	High	A19	21	0	0	0	0	22	0	102	0	50
Nov-04	High	A20	0	0	0	0	0	0	0	3	0	0
Nov-04	High	A21	0	0	0	0	0	93	0	593	0	156
Dec-04	High	A19	32	0	485	0	1	340	0	0	0	0
Dec-04	High	A20	5	0	172	0	0	175	0	1	0	40
Dec-04	High	A21	0	0	10	0	0	23	0	286	0	1,867
		Totals for Year	*62*	*21*	*2,355*	*19*	*56*	*5,881*	*3*	*1,701*	*0*	*2,573*

Table D-5: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2005

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Jan-05	High	A19	44	0	1,207	0	0	642	0	0	0	0
Jan-05	High	A20	55	10	339	0	0	81	0	5	0	0
Jan-05	High	A21	1	0	65	1	0	11	0	737	0	24
Feb-05	High	A19	6	0	1,552	0	16	359	0	0	0	0
Feb-05	High	A20	0	0	320	0	8	14	0	0	0	0
Feb-05	High	A21	0	17	362	0	16	538	0	1,739	0	0
Mar-05	High	A19	10	0	160	0	6	1	0	0	0	0
Mar-05	High	A20	0	0	270	0	2	0	0	0	0	0

Table D-5: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2005

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Mar-05	High	A21	0	19	615	0	2	1	0	8	0	25
Apr-05	High	A19	0	0	993	0	0	9	0	1	0	0
Apr-05	High	A20	0	0	69	0	0	0	0	0	0	0
Apr-05	High	A21	0	0	231	0	0	0	0	34	0	1
May-05	High	A19	0	0	6	0	0	0	0	0	0	0
May-05	High	A20	0	0	0	0	0	0	0	0	0	0
May-05	High	A21	0	0	30	3	0	0	0	20	0	1
Jun-05	High	A19	1	0	0	0	0	1,716	0	59	0	0
Jun-05	High	A20	0	0	0	0	0	372	1	0	0	0
Jun-05	High	A21	0	0	0	0	0	1,090	0	99	0	0
Jul-05	High	A19	0	0	0	0	0	145	0	157	1	53
Jul-05	High	A20	0	0	0	0	0	0	0	0	0	0
Jul-05	High	A21	0	0	0	0	0	0	0	0	0	0
Aug-05	High	A19	0	0	0	0	0	19	26	5	0	134
Aug-05	High	A20	0	0	0	0	0	2,395	0	0	0	6
Aug-05	High	A21	0	0	0	0	0	0	0	0	0	46
Sep-05	High	A19	0	0	0	0	0	0	0	0	0	0
Sep-05	High	A20	0	0	0	0	0	0	0	0	0	0
Sep-05	High	A21	0	0	0	0	0	0	0	0	0	0
Oct-05	High	A19	0	0	0	0	0	231	0	5	0	343
Oct-05	High	A20	0	0	0	0	0	0	0	0	0	12
Oct-05	High	A21	0	0	0	0	0	0	0	0	0	12
Nov-05	High	A19	0	0	0	0	0	8,300	0	0	0	22
Nov-05	High	A20	0	0	0	0	0	0	1	3	0	23
Nov-05	High	A21	0	0	0	0	0	1	0	2	0	11
Dec-05	High	A19	0	0	0	0	0	1	0	29	0	0
Dec-05	High	A20	5	0	0	0	0	0	0	11	0	53
Dec-05	High	A21	0	0	0	0	0	140	1	0	0	13
		Totals for Year	*122*	*46*	*6,219*	*4*	*50*	*16,066*	*29*	*2,914*	*1*	*779*

Table D-6: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2006

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Jan-06	High	A19	180	0	0	0	7	11,200	0	0	0	0
Jan-06	High	A20	75	7	0	0	0	6,850	0	45	0	0
Jan-06	High	A21	10	11	1	0	2	26	0	47	0	1,735
Feb-06	High	A19	0	0	260	0	6	1,565	0	221	0	75
Feb-06	High	A20	0	3	0	0	0	12	0	4	0	2
Feb-06	High	A21	0	35	40	0	0	819	0	31	0	141
Mar-06	High	A19	0	0	58	0	0	3,100	1	10	0	1
Mar-06	High	A20	0	13	10	0	0	2,300	0	0	0	0
Mar-06	High	A21	0	64	0	0	4	1	0	0	0	132
Apr-06	High	A19	15	17	2	0	18	6,626	0	20	0	4
Apr-06	High	A20	11	0	0	0	5	0	1	8	0	0
Apr-06	High	A21	1	3	3	0	1	2,362	0	0	0	20
May-06	High	A19	24	0	0	0	1	479	2	9	0	0
May-06	High	A20	3	0	0	0	2	0	1	0	0	0
May-06	High	A21	31	0	0	0	4	87	0	4	0	0
Jun-06	High	A19	5	0	0	1	0	1,071	1	0	0	0
Jun-06	High	A20	2	0	0	0	0	75	2	0	0	0
Jun-06	High	A21	8	0	0	0	0	559	0	40	0	0
Jul-06	High	A19	3	0	0	0	0	792	61	0	0	600
Jul-06	High	A20	0	0	0	0	0	226	4	3	0	0
Jul-06	High	A21	0	0	0	0	0	550	5	8	0	0
Aug-06	High	A19	0	0	0	107	0	6,205	1	0	0	80
Aug-06	High	A20	0	0	0	0	0	6	2	1	0	0
Aug-06	High	A21	0	0	0	9	2	468	34	755	0	210
Sep-06	High	A19	700	0	0	134	0	13,276	1	0	0	19
Sep-06	High	A20	19	0	0	4	0	58	2	0	0	0
Sep-06	High	A21	272	0	0	10	0	535	20	0	0	100
Oct-06	High	A19	122	3	0	81	0	1,820	19	5	0	112
Oct-06	High	A20	77	2	0	10	0	181	5	6	0	0
Oct-06	High	A21	195	0	1	10	0	796	1	7	0	53
Nov-06	High	A19	329	0	0	5	0	2,816	1	227	0	112

Table D-6: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2006

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Nov-06	High	A20	185	4	0	3	0	160	3	43	0	26
Nov-06	High	A21	365	0	0	2	0	124	5	984	0	653
		Totals for Year	*2,632*	*162*	*375*	*376*	*52*	*65,145*	*172*	*2,478*	*0*	*4,075*

Table D-7: Monthly Totals of Waterbird-Use at Low Tide in Island Ponds During 2006

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Apr-06	Low	A19	6	13	0	1	7	6,690	0	31	0	0
Apr-06	Low	A20	0	0	0	0	9	0	0	0	0	0
Apr-06	Low	A21	7	0	0	0	0	2	0	0	0	1
May-06	Low	A19	32	0	0	0	4	8,105	0	8	0	0
May-06	Low	A20	0	0	0	0	7	168	7	0	0	0
May-06	Low	A21	3	0	0	0	7	0	0	0	0	0
Jun-06	Low	A19	0	0	0	1	0	1,626	6	2	0	0
Jun-06	Low	A20	0	0	0	0	2	213	4	2	0	0
Jun-06	Low	A21	7	0	0	0	0	32	2	105	0	0
Jul-06	Low	A19	0	0	0	31	0	3,276	9	275	0	10,000
Jul-06	Low	A20	0	0	0	0	0	686	1	64	0	43
Jul-06	Low	A21	2	0	0	8	0	359	5	4	0	12
Aug-06	Low	A19	0	0	0	125	0	12,025	19	454	0	4053
Aug-06	Low	A20	0	0	0	1	0	1	6	14	0	104
Aug-06	Low	A21	0	0	0	0	0	676	27	5	0	0
Sep-06	Low	A19	274	0	0	12	0	9,150	38	803	0	300
Sep-06	Low	A20	186	0	0	2	0	8	3	10	0	479
Sep-06	Low	A21	28	0	0	1	0	286	27	66	0	658
Oct-06	Low	A19	181	0	0	146	0	4,929	12	6	0	142
Oct-06	Low	A20	8	2	0	5	0	400	5	12	0	329
Oct-06	Low	A21	170	2	0	18	0	873	14	66	0	996
Nov-06	Low	A19	111	1	0	0	0	6,087	8	192	0	40

Table D-7: Monthly Totals of Waterbird-Use at Low Tide in Island Ponds During 2006

Month-Year	Tide Level	Pond #	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Phalaropes Total	Small Shorebirds Total
Nov-06	Low	A20	14	0	0	0	0	11	6	18	0	91
Nov-06	Low	A21	49	0	0	0	0	28	4	3	0	31
		Totals for Year	*1,078*	*18*	*0*	*351*	*36*	*55,631*	*203*	*2,140*	*0*	*17,279*

Table D-8: Receiving Water Sampling for Island Ponds

Pond #	Sampling Location	Date	Time	Depth	Specific Condition (mS/cm)	Minisonde Temp. (°C)	Turbidity (NTU)	pH	D.O. (mg/L)	Minisonde Salinity
5-Days Before A19 Breach - Benthic Samples Taken										
A19	A-A19-1	3/3/2006	13:20	S	3.563	12.86	84.10	7.68	7.34	1.94
A19	A-A19-1	3/3/2006	13:23	B	3.634	12.87	169.90	7.62	7.11	1.97
A19	A-A19-0	3/3/2006	14:31	S	2.695	13.60	84.60	7.78	6.76	1.45
A19	A-A19-0	3/3/2006	14:28	B	2.756	13.55	152.10	7.70	6.79	1.49
A19	A-A19-2	3/3/2006	15:02	S	3.190	13.47	87.70	8.08	6.91	1.73
A19	A-A19-2	3/3/2006	15:04	B	3.196	13.42	87.50	8.04	6.78	1.73
A19 In-Pond and Slough Sampling Pre-Breach										
A19	A-A19 inside pond	3/7/2006	14:05	S	n/a	15.24	n/a	8.27	7.28	n/a
A19	A-A19	3/7/2006	14:16	S	0.668	12.54	n/a	8.14	8.45	0.34
A19	A-A19	3/7/2006	14:18	B	0.668	12.54	103.70	8.08	8.43	0.34
1-day After A19 Breach - Benthic Samples Taken										
A19	A-A19-1	3/8/2006	7:51	S	6.772	12.42	52.30	7.36	8.13	3.72
A19	A-A19-1	3/8/2006	7:53	B	45.29	13.64	50.30	8.05	5.36	29.32
A21	A-A21-0	3/8/2006	8:43	S	6.910	13.29	40.60	7.67	7.84	3.86
A19	A-A19-B #2	3/8/2006	9:39	S	9.312	14.08	54.10	7.78	7.77	5.29
A19	A-A19-B #2	3/8/2006	9:41	B	33.05	13.65	62.80	8.14	6.58	23.10
A19	A-A19-B #1	3/8/2006	9:49	S	23.47	13.38	31.20	8.00	7.52	14.16
A19	A-A19-B #1	3/8/2006	9:52	B	29.39	13.39	69.70	8.21	7.18	18.21
A19	A-A19-2	3/8/2006	10:31	S	5.202	17.71	24.70	7.48	7.82	2.91
A19	A-A19-2	3/8/2006	10:33	B	59.09	13.21	45.50	8.14	4.19	39.53
8-Days After A19 Breach										
A19	A-A19-2	3/15/2006	9:39	S	6.811	13.23	56.20	7.50	7.37	3.76
A19	A-A19-2	3/15/2006	9:41	B	7.601	13.12	79.80	7.44	7.22	4.23
A19	A-A19-B #1	3/15/2006	9:47	S	7.080	12.99	44.00	7.58	8.16	4.04
A19	A-A19-B #1	3/15/2006	9:49	B	10.52	12.67	46.80	7.69	8.36	5.37
A19	A-A19-B #2	3/15/2006	9:53	S	8.044	13.14	42.70	7.63	7.63	3.05
A19	A-A19-B #2	3/15/2006	9:55	B	9.640	12.44	65.40	7.95	7.95	5.37
A19	A-A19-1	3/15/2006	10:04	S	7.627	12.54	52.90	7.59	8.51	4.26

Table D-8: Receiving Water Sampling for Island Ponds

Pond #	Sampling Location	Date	Time	Depth	Specific Condition (mS/cm)	Minisonde Temp. (°C)	Turbidity (NTU)	pH	D.O. (mg/L)	Minisonde Salinity
A19	A-A19-1	3/15/2006	10:06	B	11.50	12.62	196.80	7.52	7.55	6.56
13-Days After A19 Breach										
A19	A-A19-1	3/20/2006	13:26	S	4.507	14.87	62.60	7.77	7.57	2.46
A19	A-A19-1	3/20/2006	13:23	B	5.366	14.80	80.30	7.70	7.33	2.96
A19	A-A19-2	3/20/2006	13:42	S	4.411	14.38	55.40	7.78	7.23	2.41
A19	A-A19-2	3/20/2006	13:41	B	4.000	14.46	53.00	7.74	7.16	2.41
A19 In-Pond Sampling Post-Breach										
A19	A-A19 inside pond (grid A6)	3/21/2006	9:23	S	7.790	10.29	n/a	8.46	12.27	4.35
15-Days After A19 Breach										
A19	A-A19-1	3/22/2006	8:52	S	6.775	15.07	n/a	7.66	7.32	3.73
A19	A-A19-1	3/22/2006	8:50	B	21.49	13.12	72.70	8.04	6.69	12.89
A19	A-A19-B #1	3/22/2006	10:13	S	0.6158	11.95	70.80	8.13	8.85	0.31
A19	A-A19-B #1	3/22/2006	10:09	B	1.503	11.47	76.40	8.12	8.76	0.83
A19	A-A19-B #2	3/22/2006	10:29	S	1.056	11.70	771.70	8.06	9.05	0.54
A19	A-A19-B #2	3/22/2006	10:26	B	2.007	12.14	68.20	8.09	9.18	1.17
A19	A-A19-2	3/22/2006	10:44	S	3.311	18.59	16.80	7.80	7.70	1.79
A19	A-A19-2	3/22/2006	10:42	B	3.323	18.59	11.60	7.73	7.64	1.75
22-Days After A19 Breach										
A19	A-A19-1	3/29/2006	9:41	S	7.171	12.71	149.60	7.62	7.92	3.99
A19	A-A19-1	3/29/2006	9:39	B	7.841	12.78	219.90	7.60	7.78	4.39
A19	A-A19-B #1	3/29/2006	10:50	S	7.856	13.19	69.30	7.65	7.61	4.39
A19	A-A19-B #1	3/29/2006	10:47	B	8.567	12.80	97.40	7.68	7.94	4.75
A19	A-A19-B #2	3/29/2006	11:04	S	7.032	13.33	81.10	7.66	7.53	4.08
A19	A-A19-B #2	3/29/2006	11:01	B	7.369	13.13	270.20	7.65	7.49	4.10
A19	A-A19-2	3/29/2006	11:17	S	7.662	13.01	157.10	7.70	7.58	4.28
A19	A-A19-2	3/29/2006	11:15	B	7.706	13.00	154.40	7.69	7.67	4.30
5-Days Before A19 Breach - Benthic Samples Taken										
A20	A-A20-0	3/3/2006	14:16	S	3.138	13.11	93.90	7.83	7.18	1.69
A20	A-A20-0	3/3/2006	14:18	B	3.153	13.13	102.50	7.79	7.06	1.71
5-Days Before A20 Breach - Benthic Samples Taken										
A20	A-A20-0	3/8/2006	8:54	S	6.486	13.69	50.20	7.74	7.83	3.55

Table D-8: Receiving Water Sampling for Island Ponds

Pond #	Sampling Location	Date	Time	Depth	Specific Condition (mS/cm)	Minisonde Temp. (°C)	Turbidity (NTU)	pH	D.O. (mg/L)	Minisonde Salinity
A20	A-A20-0	3/8/2006	8:56	B	16.97	13.52	44.40	7.78	6.76	10.10
A20 In-Pond and Slough Sampling Pre-Breach										
A20	A-A20 inside pond	3/11/2006	13:21	S	n/a	14.16	n/a	8.39	8.51	n/a
A20	A-A20	3/11/2006	13:39	S	10.19	12.56	n/a	7.68	8.37	5.77
1-Day After A20 Breach - Benthic Samples Taken										
A20	A-A20-0	3/13/2006	11:02	S	12.81	12.60	31.90	7.89	8.64	7.31
A20	A-A20-0	3/13/2006	11:05	B	14.88	11.98	85.50	7.74	7.88	8.55
8-Days After A20 Breach										
A20	A-A20-0	3/20/2006	13:35	S	3.813	14.64	47.40	7.72	7.46	2.07
A20	A-A20-0	3/20/2006	13:34	B	6.730	13.46	51.50	7.81	8.06	3.69
A20 In-Pond Sampling Post-Breach										
A20	A-A20 inside pond (grid A1)	3/21/2006	10:04	S	4.748	11.23	n/a	7.93	9.38	2.61
17-Days After A20 Breach										
A20	A-A20-0	3/29/2006	10:37	S	7.018	13.33	127.40	7.67	7.63	3.90
A20	A-A20-0	3/29/2006	10:34	B	7.463	13.08	252.20	7.65	7.65	4.15
5-Days Before A19 Breach - Benthic Samples Taken										
A21	A-A21-0	3/3/2006	14:07	S	3.493	13.14	92.40	7.85	7.24	1.90
A21	A-A21-0	3/3/2006	14:10	B	3.584	12.97	123.70	7.78	6.99	1.95
1-Day After A19 Breach - Benthic Samples Taken										
A21	A-A21-0	3/8/2006	8:43	S	6.910	13.29	40.60	7.67	7.84	3.86
A21	A-A21-0	3/8/2006	8:45	B	19.92	13.16	48.50	7.75	7.05	11.67
7-Days Before A21 Breach - Benthic Samples Taken										
A21	A-A21-B #2	3/13/2006	11:59	S	13.62	12.80	35.30	7.80	9.35	7.85
A21	A-A21-B #2	3/13/2006	12:02	B	20.68	10.74	143.20	7.69	8.83	12.43
A21	A-A21-B #1	3/13/2006	12:11	S	12.84	13.03	48.90	7.76	9.31	7.39
A21	A-A21-B #1	3/13/2006	12:13	B	16.34	11.39	91.50	7.66	8.34	9.44
A21	A-A21-0	3/13/2006	12:45	S	13.33	12.92	38.70	7.78	9.45	7.65
A21	A-A21-0	3/13/2006	12:47	B	15.37	11.56	90.00	7.64	8.22	8.95
A21 In-Pond Sampling Pre-Breach										
A21	A-A21 inside pond (grid D4)	3/21/2006	10:51	S	n/a	11.73	3.00	8.50	6.74	n/a

Table D-8: Receiving Water Sampling for Island Ponds

Pond #	Sampling Location	Date	Time	Depth	Specific Condition (mS/cm)	Minisonde Temp. (°C)	Turbidity (NTU)	pH	D.O. (mg/L)	Minisonde Salinity
A21	A-A21 inside pond (grid A5)	3/21/2006	11:26	S	95.15	12.13	n/a	8.64	7.84	67.02
				1-Day After A21 Breach - Benthic Samples Taken						
A21	A-A21-B #2 (actually first breach)	3/22/2006	9:13	S	6.003	13.25	n/a	7.89	7.82	3.32
A21	A-A21-B #2 (actually first breach)	3/22/2006	9:08	B	19.05	13.14	232.20	8.47	7.84	11.28
A21	A-A21-B #1 (not breached yet)	3/22/2006	9:54	S	4.656	14.24	n/a	7.77	7.76	2.56
A21	A-A21-B #1 (not breached yet)	3/22/2006	9:51	B	4.793	14.16	79.10	7.78	7.78	2.63
				8-Days After A21 Breach						
A21	A-A21-B #2 (actually first breach)	3/29/2006	9:59	S	7.263	12.96	113.00	7.67	7.94	4.04
A21	A-A21-B #2 (actually first breach)	3/29/2006	9:57	B	7.160	13.02	105.40	7.66	7.95	3.99
A21	A-A21-B #1 (breached today, when sampling)	3/29/2006	10:13	S	7.591	12.88	155.20	7.69	7.74	4.24
A21	A-A21-B #1 (breached today, when sampling)	3/29/2006	10:10	B	7.613	12.95	165.80	7.68	7.78	4.25
A21	A-A21-0	3/29/2006	10:26	S	7.610	12.79	152.00	7.69	7.64	4.25
A21	A-A21-0	3/29/2006	10:24	B	7.642	12.77	203.90	7.68	7.66	4.27

* S: Near-Surface Measurement; B: Near-Bottom Measurement

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APPENDIX E
BREACH PHOTOGRAPHS

Photos of the eastern breach of Pond A19, known as Pond A19E

Pond A19E on March 7, 2006, hours before breaching and during breach.


Pond A19E on March 8, 2006 looking west towards Coyote Creek and to the old levee


Left: Pond A19E breach shown from helicopter on August 8, 2006, looking from Coyote Creek to pond.
Right: Pond A19E on November 28, 2006, looking from Coyote Creek towards the pond

Photos of the western breach of Pond A19, known as Pond A19W

Pond A19W on March 7, 2006, looking from Coyote Creek towards the old levee

Pond A19W breach on April 29, 2006, looking from pond towards old levee and Coyote Creek

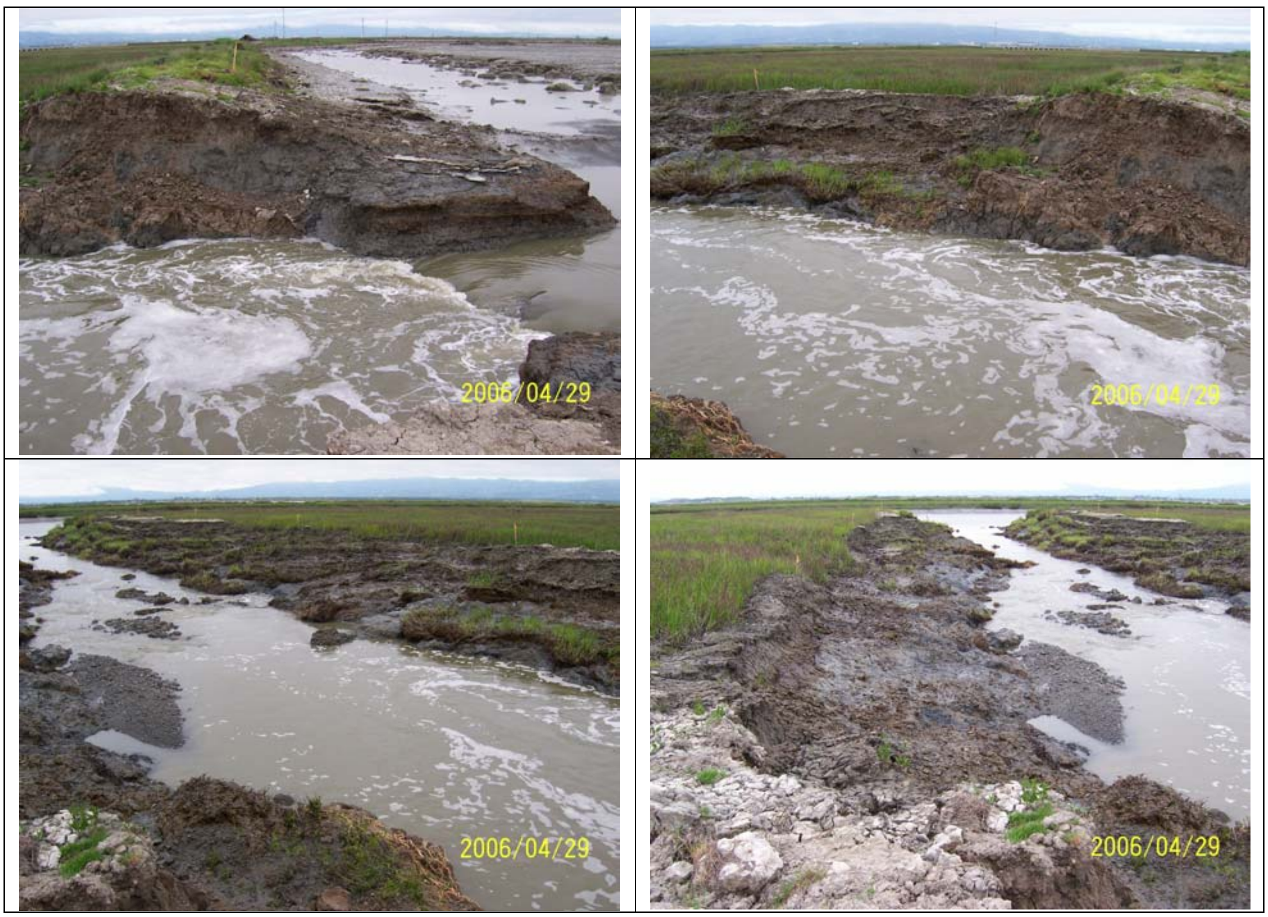
Photos of the western breach of Pond A19, known as Pond A19W

Pond A19W breach on June 27, 2006, looking east towards old levee and Coyote Creek

Left: Pond A19 W breach shown from helicopter on August 8, 2006
Right: Pond A19W breach on November 28, 2006, looking towards pond from Coyote Creek

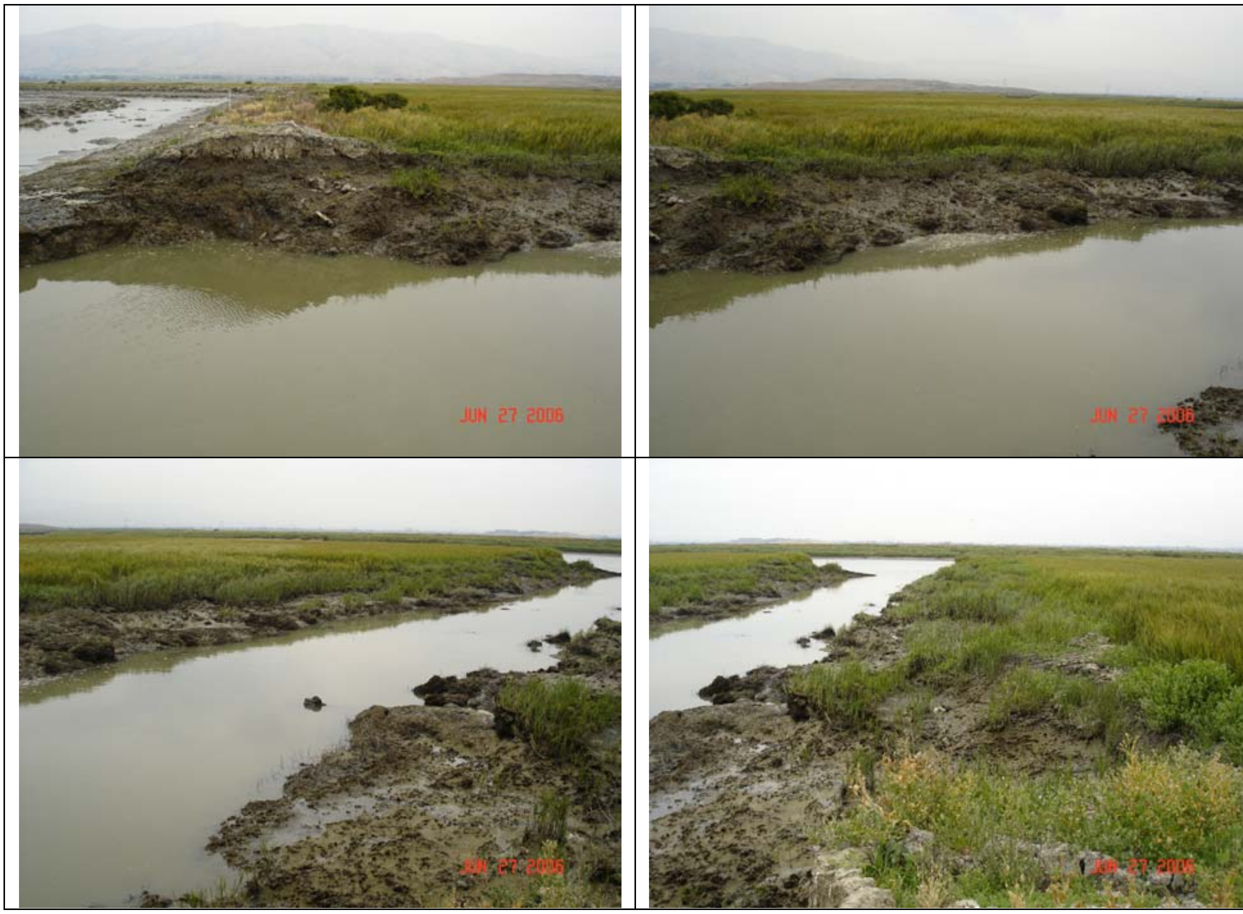
Photos of the Pond A20 breach

Pond A20 sidecast berm construction, looking towards Coyote Creek from old levee



Pond A20 panoramic photos taken from the old levee on April 29, 2006. Remnants of the sidecast material noticeable in lower photos.

Photos of the Pond A20 breach



Pond A20 panoramic photos taken from the old levee on June 27, 2006. Notice much of the sidecast material has eroded or slumped into the breach channel.

Left: Pond A20 on November 28, 2006, looking from Coyote Creek towards pond
Right: Pond A20 on August 8, 2006, taken from helicopter looking from Coyote Creek to pond.

Photos of the breach of Pond A21, known as Pond A21E

Construction of Pond A21E breach on March 27, 2006

Left: Pond A21E breach on November 28, 2006, looking from Coyote Creek towards pond
Right: Pond A21E breach on November 28, 2006, looking from breach channel to pond

Pond A21W breach on August 8, 2006, taken from helicopter looking from Coyote Creek towards pond

Photos of the western breach of Pond A21, known as Pond A21W

Pond 21W breach on March 22, 2006, initial days after being breached before major erosion

Pond 21W breach on April 29, 2006

Photos of the western breach of Pond A21, known as Pond A21W

Pond A21W panoramic photos taken of breach from the old levee on June 27, 2006

Left: Pond A21W breach on November 28, 2006, looking from Coyote Creek towards pond
Right: Pond A21W breach on August 8, 2006, taken from helicopter looking from Coyote Creek towards pond