ISLAND PONDS MITIGATION
MONITORING AND REPORTING
YEAR 5 – 2010

Prepared by

Santa Clara Valley Water District
U.S. Fish and Wildlife Service - Don Edwards National Wildlife Refuge

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TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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 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 5 (2010) monitoring results for both the District and the Refuge.

The following is a summary of the monitoring results:

4.5 years after breaching, sediment is continuing to accumulate in all three Ponds. Similar to previous years, the highest average rate of accretion occurred at Pond A20 followed by Pond A21, with Pond A19 having the least amount of sediment deposition. All sampling locations accumulated an average of approximately 0.14 ft of sediment in the past year, while average cumulative accumulation since the 2006 breaching was 0.67 ft across the 3 Ponds.

Levee breach widths seem to be reaching equilibrium as erosion at all of the breaches has slowed in the past 2 years. Both breaches at Pond A21 have widened slightly in the past year (1-4 feet) and the west breach of Pond A19 also enlarged by a three feet since the 2009 monitoring. However, the breach at Pond A20 has not widened in either of the past 2 years.

The outboard tidal channels, originally cut by the excavator, have also seemed to stabilize, as only 0.04 acres of scour has occurred in the past 2 years at all five channels combined.

A small amount of scour has continued in some areas of the fringe marsh along Coyote Creek, while accretion has occurred in others. Total loss of fringe marsh since 2006 is approximately 1.25 acres while total gain of fringe marsh is approximately 0.68 acres. As in previous years, no signs of scour have been detected at any of the levees opposite the breaches for Ponds A15, A17, and A18.

In 2010, the channel networks within the Ponds expanded more than in previous years, increasing the overall channel acreage by approximately 11 percent. There is now a total of 14.8 acres of channels within the Ponds.

Vegetation growth has shown a rapid expansion over the past 4 years from the 5.75 acres documented in 2006. As of the 2010 monitoring a total of 31.19 acres of native vegetation has established in the Ponds, with the majority (> 21 acres) colonizing in Pond A21. As in previous years, no invasive Spartina was observed within the Ponds.

No monitoring was conducted in 2010 for California clapper rail or salt marsh harvest mouse. However, monitoring conducted for shorebirds and waterfowl indicated that many bird species are utilizing these Ponds for foraging and roosting habitat.

1.0 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 by an amphibious excavator along the south side of the ponds 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 the natural sedimentation processes to restore the ponds to tidal marsh habitat and meet the project goals and objectives. The overall restoration goal is to successfully reestablish vegetation, promote re-colonization by benthic organisms and provide habitat for various wildlife species.

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 were adverse effects from the project (USFWS et al., 2006). Mitigation monitoring activities were anticipated to continue for 15 years. This report presents the Year 5 (2010) monitoring results.

1.2 PROJECTS WHICH REQUIRED MITIGATION

1.2.1 Initial Stewardship Plan (ISP)

The ISP was created as an interim step to manage the ponds while a long-term plan was 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 require tidal wetland mitigation is the San Francisco Bay Regional Water Quality Control Board - Order # R2-2004-0018.

1.2.2 Stream Maintenance Program (SMP)

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 (LGRP)

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). These ponds are part of a larger 25-pond system known as the Alviso Complex. Prior to their 2006 breaching, 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 allow full tidal inundation and permit 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 if the project is meeting performance criteria, permit requirements, and to provide data for adaptive management actions, if necessary.

Table 1-1 describes the 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)	Completed Task 2006 - 2007	---
	Substrate development	a) Years 1 and 2	Completed Task 2006-2007	---
		b) Years 3 to 5	Completed Task 2010	---
		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	Completed Task 2010	---

Off-Site Monitoring				
District	Rail bridge pier scour[4]	a) Years 1 to 5	Completed Task 2006-2008	---
		b) Years 1 to 5	Completed Task 2010	---
		c) Begin at implementation of corrective measures, end five years after	N/A	---
	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	Completed Task 2006 – 2008	---
		b) If outboard marsh retreats to levees opposite breach, then three additional years from occurrence	N/A	---
	Rail line erosion	a) Years 1 to 5	Completed Task 2010	---
		b) Years 1 to 5	Completed Task 2010	
	Deterioration of Town of Drawbridge structures	a) Years 1 to 5	Completed Task 2010	---
Refuge	Water Quality	a) Adjacent to breaches – Year 1	Completed Task 2006	---
		b) Upstream & downstream of ponds – Year 1	Completed Task 2006	---

* (Grayed out tasks above are considered complete)

[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.

[4] Bridge pier scour will continue to be monitored twice a year by the Union Pacific Railroad staff instead of additional monitoring being performed by this Project. (See Year 3-2008 monitoring report for additional details.)

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This report presents the monitoring results collected during the Year 5 (2010) monitoring period. The data are presented in detail and are compared to pre-breach and Year 1 - 4 results as well as the overall project 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 B & C), while the Refuge's results and conclusions are attached as Appendix A.

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.

1.4 CONTACTS

The District contact is Lisa Porcella, Santa Clara Valley Water District, 5750 Almaden Expressway, San Jose, CA 95118-3686. Tel: (408) 265-2607 ext. 2741.

The Refuge contact is Melisa Helton, Don Edwards San Francisco Bay National Wildlife Refuge, 9500 Thornton Ave., Newark, CA 94560. Tel: (510) 792-0222 ext. 124.

2.0 MONITORING METHODS (DISTRICT ACTIVITIES)

This section describes the methods used to carry out the Year 5 monitoring activities for the District. The monitoring responsibilities of the Refuge are described in Appendix A rather than being reported here.

2.1 ON-SITE MONITORING

2.1.1 Substrate Development/Sedimentation

Estuarine sediment deposition will form the substrate that is essential for plant colonization and growth at the Island Ponds. In addition, it will provide the habitat required for benthic organisms to live and thrive. Therefore, sedimentation needs to occur at the Island Ponds to meet the overall project goal of restoring tidal marsh habitat.

Prior to breaching in 2006, a total of 30 sedimentation pins were installed in the three ponds (15, 5, and 10 pins for Ponds A19, A20, and A21, respectively). The pins, made of 2-inch diameter, Schedule 80 PVC, were disbursed throughout each pond and were to be used to measure sediment deposition over time. Each pin was tagged with a unique ID number. The tag number and pin coordinates are presented in Appendix C.

The Year 1 and 2 sediment monitoring activities utilized two sampling methods: 1.) measuring the distance from the top of each sediment pin to the ground surface, and 2.) the "Depth Probe" method, which consisted of taking measurements of the average sediment thickness (distance between the gypsum layer and the sediment surface) adjacent to each sediment pin. Sediment modeling efforts were also attempted in Year 2 but were unfortunately not accurate enough to discern annual variation. In Year 3, it was determined that the depth probe method provided a more accurate picture of pond accretion than taking a single measurement at each sediment pin and performing sediment modeling efforts. Therefore, it was determined that future sampling efforts would exclusively utilize the depth probe method at all sediment pin locations. This sampling technique has been used successfully at Pond A21 by Dr. John Callaway (University of San Francisco) and Lisa Schile (University of California at Berkeley). The method involves taking multiple measurements of sediment thickness approximately 1 meter away from each sediment pin and sampling in a circular fashion around each pin. Sediment depth is measured by inserting a finely scaled ruler through the fresh mud until the hard gypsum layer is encountered. Eight measurements are taken around each pin to achieve a representative average of the sediment depth in each pin location.

Per the timeline in the RMMP, the annual sediment monitoring for Year 5 took place on October 12th, 13th, 15th, 28th and 29th, 2010.

Data generated from the sampling events are presented in both map and graphical form. Twelve month, 30 month, 43 month, and 55-month post-breach data are compared to show sediment accretion rates, across each pond, over time.

2.1.2 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 width of each levee breach and the total area of the outboard scour was measured in ArcMap using the 2010 aerial photographs. Breach widths were measured from east bank to west bank along the centerline of each levee, while the area of each outboard tidal channel was calculated by delineating the current marsh edge. Section 2.1.3 below provides details about the aerial photographs.

2.1.3 Aerial Photography

Aerial photographs were obtained for use in several of the Year 5 monitoring activities. 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 July 5, 2010. The photos were timed 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. Images were taken in both color and infrared. The spatial extent of the images included all three Island Ponds as well as the northern and southern banks of Coyote Creek.

2.2 OFF-SITE MONITORING

2.2.1 Fringe Marsh Scour in Coyote Creek

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. This monitoring task investigates the spatial changes in fringe marsh area and documents changes in the marsh to mudflat interface.

The extent of scour of the outboard fringe marsh along Coyote Creek was investigated by comparing the post-breach aerial imagery from Years 1 and 5. The analysis covered the eastern end of Pond A19 to the western end of Pond A21 and included marsh on both sides of Coyote Creek as well as approximately 200 feet of marsh upstream in Artesian Slough and the Coyote Creek Bypass Channel.

ArcMap was utilized to delineate and depict the marsh boundaries. The 2010 delineation was superimposed over the 2006 and 2009 delineations to highlight any changes in post-breach marsh boundaries and highlight any annual variability. Changes in marsh boundaries were then calculated using ArcMap.

2.2.2 Rail Levee Erosion

On June 9, 2010, a Civil Engineer from the District visually inspected the railway levee and took a series of photographs of the adjacent Pond A20 western levee and Pond A21 eastern levee. These photographs were compared to the Year 1 (2006) photographs to evaluate whether scour is occurring at the pond levees or along the railway levee.

2.2.3 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 task consist of monitoring the integrity of the pond levees adjacent to the Town of Drawbridge. 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 undermining of the historical structures.

In 2008, a benchmark and location stakes were installed in the southeast corner of Pond A21 to enable more accurate tracking of erosion advancement along this levee which has been seemingly caused by wave action and levee overtopping. An elevation was assigned to the benchmark which references the northwest abutment of the Coyote Creek railroad bridge. (The top of the benchmark is 4.55 ft lower than the bridge abutment.) Location stakes were installed to form a series of eight cross sections along the top of the levee and baseline elevations were gathered immediately adjacent to each stake. Annual site visits will obtain elevations at each stake and any changes will be documented in the annual monitoring reports.

On June 9, 2010, 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. In addition, the surveying work discussed above was performed to collect surface elevation data at the eight cross section locations. Based on the data collected during this visit it was determined that the survey equipment needed to be recalibrated. A subsequent visit was made on August 23, 2010 to collect a second round of elevation data.

3.0 MONITORING RESULTS (DISTRICT ACTIVITIES)

This section describes the results of the District's 2010 (Year 5) monitoring activities. The results of the Refuge's monitoring activities are described in Appendix A.

3.1 ON-SITE MONITORING

3.1.1 Substrate Development/Sedimentation

Sedimentation data has been collected at the Ponds on 8, 12, 30, 43, and 55-month post-breach intervals. These results are compared to each other to detect annual trends and differences within and between ponds. The data are visually presented in the following ways:

1. A map of the ponds depicting the sediment monitoring locations and the average sediment depths 55-months post-breach (Figure 2).
2. Graphs depicting average sediment accretion at each pin per year based on the distance from the nearest breach (Figures 3 - 5).
3. A table showing average sediment accretion rates for each pond per year (Table 3-1).
4. A graph illustrating cumulative sediment accretion averaged across all pins for each pond (Figure 6).

All three ponds have accumulated substantial sediment in the 55 months since they were breached, with an average total accretion of 0.40 ft across Pond A19, 0.92 ft for Pond A20, and 0.70 ft for Pond A21 (Figures 2 - 6). For all 3 ponds combined, the average annual accretion rate for Year 5 was 0.14 ft which is just short of the originally predicted annual rate of 0.2 ft. The Year 5 average, however, was an increase over the Year 4 average of 0.09 ft and a decrease from the Year 1 and 2 averages of 0.27 ft and 0.17 ft respectively (Table 3-1).

Table 3-1 Average Sediment Accretion Rates (ft) per Year at the Island Ponds

Timeframe	Pond A19	Pond A20	Pond A21	Average
1 year post breach	0.17	0.36	0.28	0.27
31 months post breach	0.05	0.28	0.19	0.17
43 months post breach	0.09	0.1	0.09	0.09
55 months post breach	0.09	0.18	0.14	0.14

In general sedimentation is higher at the southern end of the ponds while the northern end, furthest from the breaches, is accruing at a slower rate. This trend is statistically significant for Pond A19 (R^2 = 0.34, p = 0.02) but not statistically significant for Ponds A20 or A21. Collectively, however, there is a statistically significant trend between the distance from the nearest breach and sediment deposition when the data is combined for all 3 ponds (R^2 = 0.29, p = 0.001).

Similar to Years 1-4, Pond A19 had the lowest annual accretion rate of all three Ponds in Year 5, ranging from 0.03 ft to 0.31 ft. Three of the 15 pins in Pond A19 accumulated more than 0.2 ft of sediment, the annual projected accretion rate, since the prior year's measurements (Figure 3). A small reduction in sediment of 0.02 ft and 0.05 ft ft was documented around two pins farthest from the breaches, pins A1901 and A1902 respectively. Average annual accretion rates in Pond A19 stayed the same as Year 4 (0.09 ft/yr; Table 3-1). Similar to Year 4, sediment depths could not be measured at pin A1912. Monitoring at this location is no longer representative of sediment depths in Pond A19 because the channel adjacent to this pin has scoured and widened, leaving the pin suspended in the center of the channel.

Pond A20 has accumulated the highest average rate of sedimentation of all three Ponds (Figures 2 & 4). Annual sediment accumulation ranged from 0.07 ft to 0.34 ft in Pond A20 in Year 5. Two out of the five pins in Pond A20 accreted more than 0.2 ft between the 43 and 55 month post-breach sampling dates. No significant signs of erosion occurred at any of the pins within Pond A20 and average accretion rates increased by 0.08 ft over the Year 4 rates to 0.18 ft/yr (Table 3-1).

Sediment has continued to accrete at Pond A21 with annual accumulation ranging from 0.03 ft to 0.42 ft in Year 5 (Figures 2 and 5). Two out of the ten sediment pins accreted more than 0.2 ft of sediment in Pond A21 between the 43 and 55 month post-breach sampling dates. A small reduction in sediment of 0.03 ft was documented at pin A2108. Average annual accretion rates increased by 0.05 ft over the Year 4 rates to 0.14 ft/yr (Table 3-1).

3.1.2 Levee Breach and Outboard Channel Geometry

The excavated breaches in the levees and outboard marshes were designed to have the same top width (40 feet), bottom width (6 feet), and invert elevations (2.7 feet NAVD88). Side slopes were variable due to large height differences between the top of the levee and the design invert (average difference of 7.0 feet), as well as smaller height differences between the top of the marsh and the design invert (average difference of 2.5 feet) (SCVWD, 2006a, b).

The 2010 aerial photographs were analyzed and the current width of each breach was compared to the 2006 widths (Table 3-2). Breach widening has slowed down over the past couple of years. Changes in breach widths from 2007 to 2008 ranged from 4 to 18 ft, while width changes from 2009 to 2010 ranged from 0 to 4 feet.

Table 3-2. Breach Widths (feet)

Breach	Breach Widths 2006*	Breach Widths 2007	Breach Widths 2008	Breach Widths 2009	Breach Widths 2010
A19 East	110	122	140	147	147
A19 West	22	28	32	34	37
A20	76	82	89	89	89
A21 East	32	37	45	45	46
A21 West	76	79	95	96	100

*number inclusive of constructed width and subsequent breach widening 6 months post-breach in 2006

The 2010 aerial photographs were analyzed and the extent of outboard tidal channel scour was compared to the 2006 scour measurements (Table 3-3). Erosion of the outboard tidal channels remains gradual, with incremental marsh loss from 2006 to 2010 of 0.16 acres. Total marsh loss to date, including loss associated with construction impacts is 1.39 acres.

Table 3-3. Marsh Loss from Scour of Outboard Channels (acres)

Breach	Marsh Scour 2006 *	Marsh Scour to date	Incremental Marsh Scour 2006 - 2010
A19 East	0.05	0.07	0.02
A19 West	0.05	0.06	0.01
A20	0.55	0.59	0.04
A21 East	0.33	0.38	0.05
A21 West	0.25	0.29	0.04
Totals	**1.23**	**1.39**	**0.16**

*number inclusive of construction impacts and marsh scour 6 months post-breach in 2006

3.2 OFF-SITE MONITORING

3.2.1 Fringe Marsh Scour in Coyote Creek

The fringe marshes of Coyote Creek that are adjacent to the island ponds are showing signs of scour in some locations and accretion in others (Figure 7). Total collective marsh loss since 2006 is 1.25 acres, and total marsh accretion is 0.68 acres (Table 3-4 & 3-5). The south bank of Coyote Creek is showing slightly more accretion than the north bank with 0.36 acres and 0.32 acres of accretion respectively. The north bank is showing more signs of scour than the south bank with 0.68 acres and 0.57 acres of scour respectively. Collectively (i.e., calculating scour minus accretion) the north bank has lost 0.36 acres of marsh, while the south bank has lost 0.21 acres.

Table 3-4. Fringe Marsh Scour (acres)

Location	2008	2009	2010
North Bank Coyote Creek	0.26	0.44	0.68
South Bank Coyote Creek	0.43	0.52	0.57
Total Scour	**0.69**	**0.96**	**1.25**

Table 3-5. Fringe Marsh Accretion (acres)

Location	2008	2009	2010
North Bank Coyote Creek	0.29	0.32	0.32
South Bank Coyote Creek	0.11	0.16	0.36
Total Accretion	**0.40**	**0.48**	**0.68**

The breaches appear to be having no localized effect on the levees opposite the Island Ponds. Ponds A15, A17, and A18 levees were evaluated by both visual inspection and by comparing the 2006 and 2010 aerial images. The outboard marshes adjacent to these levees are still providing a buffer from any scour that could potentially undermine these existing levees.

3.2.2 Rail Levee Erosion

The June 9, 2010, field inspection revealed no apparent signs of rail levee erosion or erosion of the adjacent Pond A20 or A 21 levees. However, the inboard edge of Pond A21 in the southeast corner has experienced more loss of earthen material; see Section 3.2.3 for details. Appendix B-1 provides a comparison of the 2006 and the 2010 photographs of the rail levee and the adjacent Pond A20 and A21 levees.

3.2.3 Accelerated Deterioration of the Town of Drawbridge

In 2008, field inspectors noted large amounts of debris and litter on top of a section of the Pond A21 levee in the southeast corner, mostly along the marsh vegetation and outboard slope interface. At that time, inspection staff interpreted the deposition of litter and debris as a sign that wave action and wind related run-up had caused floating trash to transfer from the pond area onto the levee surface. To establish an ability to accurately monitor the changes, in December 2008 a surveyed benchmark was installed to assist with collecting surveying measurements at this levee location.

On June 9, 2010 and August 23, 2010, District staff performed basic surveying work to collect surface elevation data at the 8 cross sections previously identified in December 2008. The data collected is shown in Appendix B-2. A comparison of the data collected in August 2010 and December 2008 shows a fairly consistent degradation of the levee surface, averaging between 1 to 2 inches of lost levee material. In addition, lateral measurements taken at this location show a loss of earthen material along the inboard slope of Pond A21. This inboard levee slope consists of a vertical edge, approximately 2 - 3 feet in height, with debris, slumped material, and newly growing pickleweed along the toe. The offset measurements taken in this location show an overall reduction in levee width. The loss of material ranges from a few inches to almost 3 feet at one of the cross sections. In fact, five of the eight cross sections indicated a loss of at least one foot over the last 14 months.

These measurements confirm the trend shown in previous surveys that the width of the pond levee is decreasing over time, with many locations experiencing several feet of lost girth. Future monitoring efforts will include the collection of data at this location. At this time, the levee doesn’t appear to be at risk of failure, but future evaluations should continue until the data indicates the situation is stable.

4.0 DISCUSSION (DISTRICT ACTIVITIES)

Across all three ponds, sediment has continued to accumulate 4.5 years after the ponds were breached. Accumulation rates remain higher in Ponds A20 and A21 than in A19. Although average sedimentation rates are lower than the original prediction of 0.2 ft/yr, the rates have overall increased in the past year, from 0.09 ft/yr in 2009 to 0.14 ft/yr in 2010. In addition, sediments are beginning to consolidate and form acceptable substrate for vegetation colonization. Vegetation has rapidly colonized the western side of Pond A21. As the sediment continues to accumulate it is anticipated that vegetation will continue to colonize the remainder of Pond A21 as well as Ponds A20 and A19.

Although the rates of sedimentation at these Ponds indicate that rapid restoration of salt ponds is possible in the South Bay, it should be noted that there is historical evidence that the shallow subtidal areas south of the Dumbarton bridge, like Ponds A19-A21, are generally depositional, while other areas in the South Bay may be erosional or oscillate between depositional and erosional states (Foxgrover et al. 2004, Jaffe and Foxgrover 2006). Restoration projects in other regions of the South Bay may not accumulate sediment as quickly as the Island Ponds.

Analyses of the 2010 aerial photographs confirm that breach scour has slowed down considerably since 2007. In addition, erosion of the outboard tidal channels remains gradual suggesting the breaches and outboard tidal channels are beginning to reach a state of equilibrium.

The fringe marshes on both sides of Coyote Creek are showing signs of both scour and accretion, however neither is considered significant (i.e., Per the RMMP, 48 acres of scour is considered significant). Since the 2006 measurements (6 months post breach) 1.25 acres of fringe marsh has scour, while 0.68 acres has accreted.

Data collected from 2008 to 2010 indicates there is some deterioration occurring along the southeast levee of pond A21. The inboard levee slope has continued to recede by as much as 3 feet in one location. Additionally, since the 2009 measurements, the levee height has been reduced by up to 2 inches. The levee doesn’t appear to be at risk of failure at this time and it is possible that the pickleweed growing at the toe of the slope will act as a future buffer for the levee, however, future evaluations are planned until the data indicates the situation is stable.

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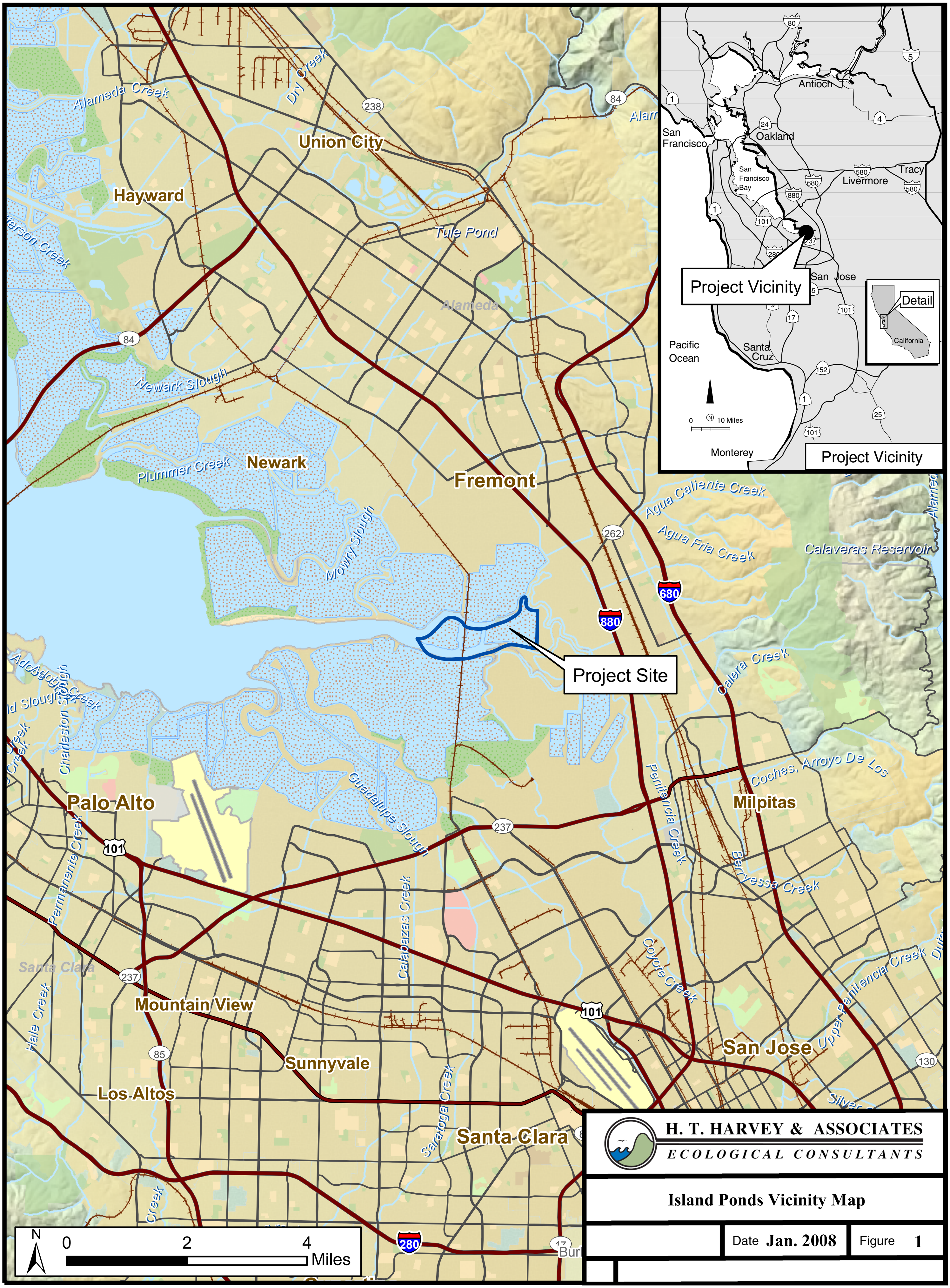
7.0 FIGURES



H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

Island Ponds Vicinity Map

Date Jan. 2008 | Figure 1

Figure 2. Average Sediment Depths 55 Months Post-Breach (feet)

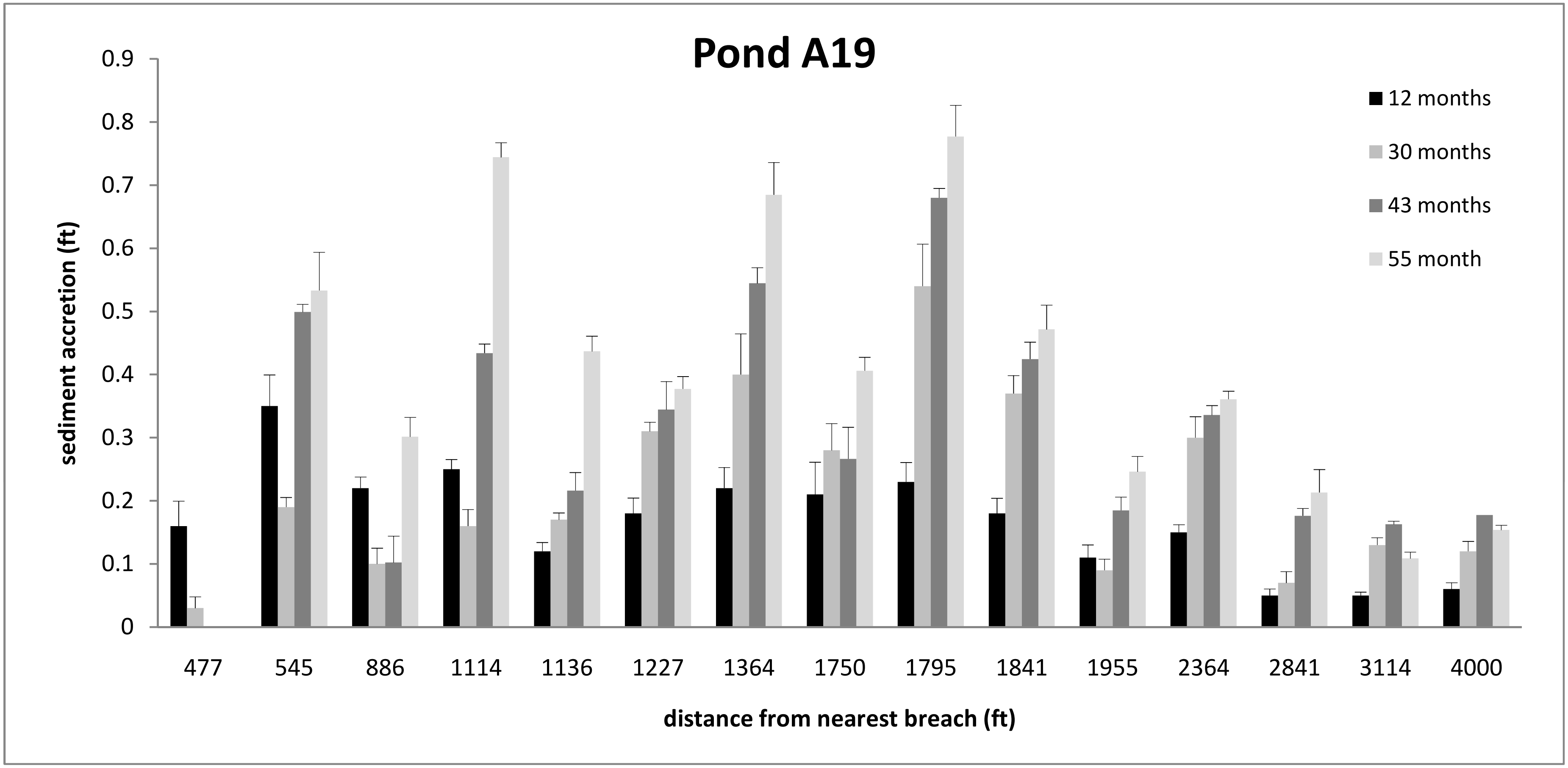


Figure 3. Average sediment deposition over time at each pin in Pond A19
(error bars represent +/- 1 standard error)

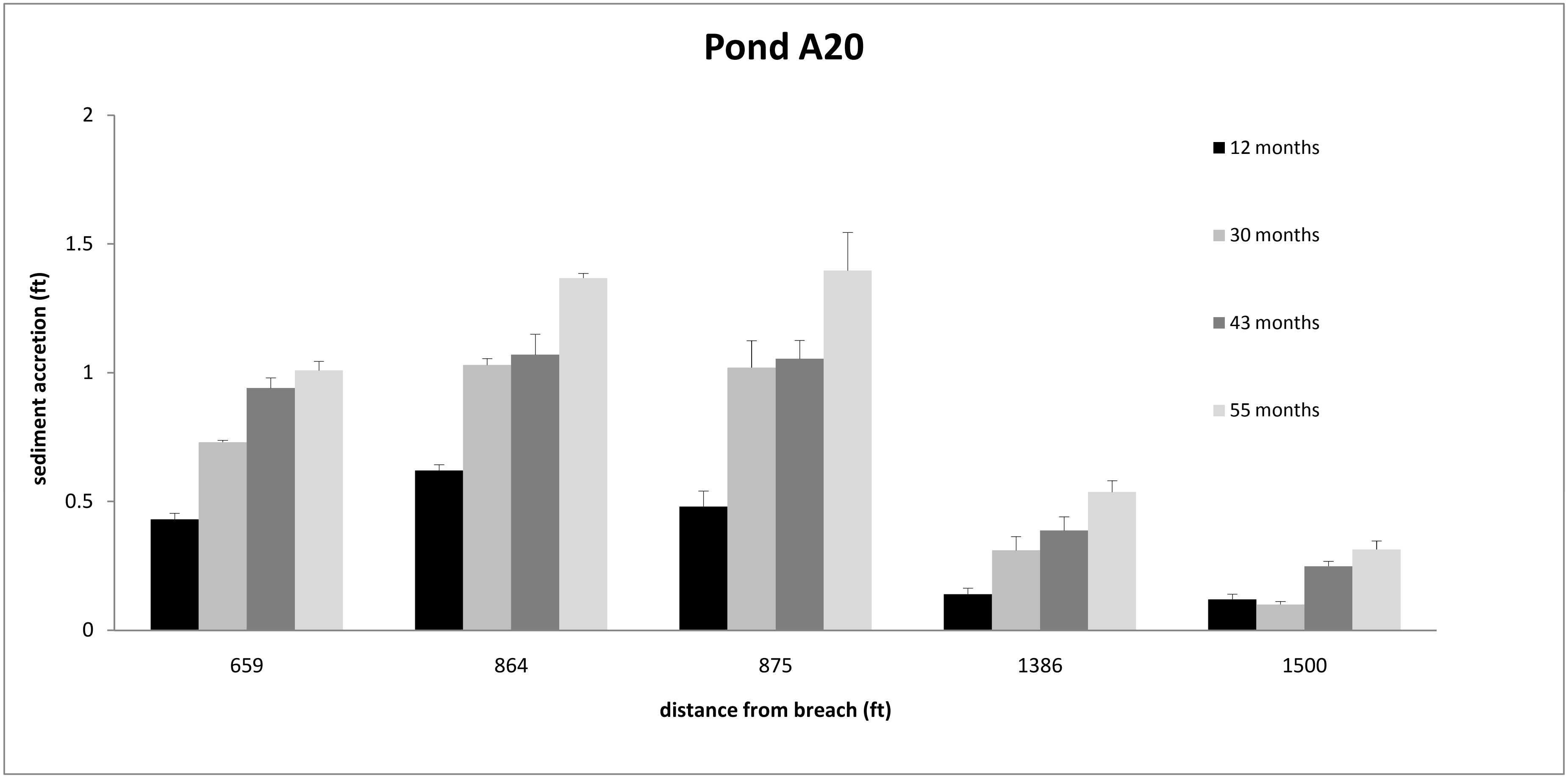


Figure 4. Average sediment deposition over time at each pin in Pond A20
(error bars represent +/- standard error)

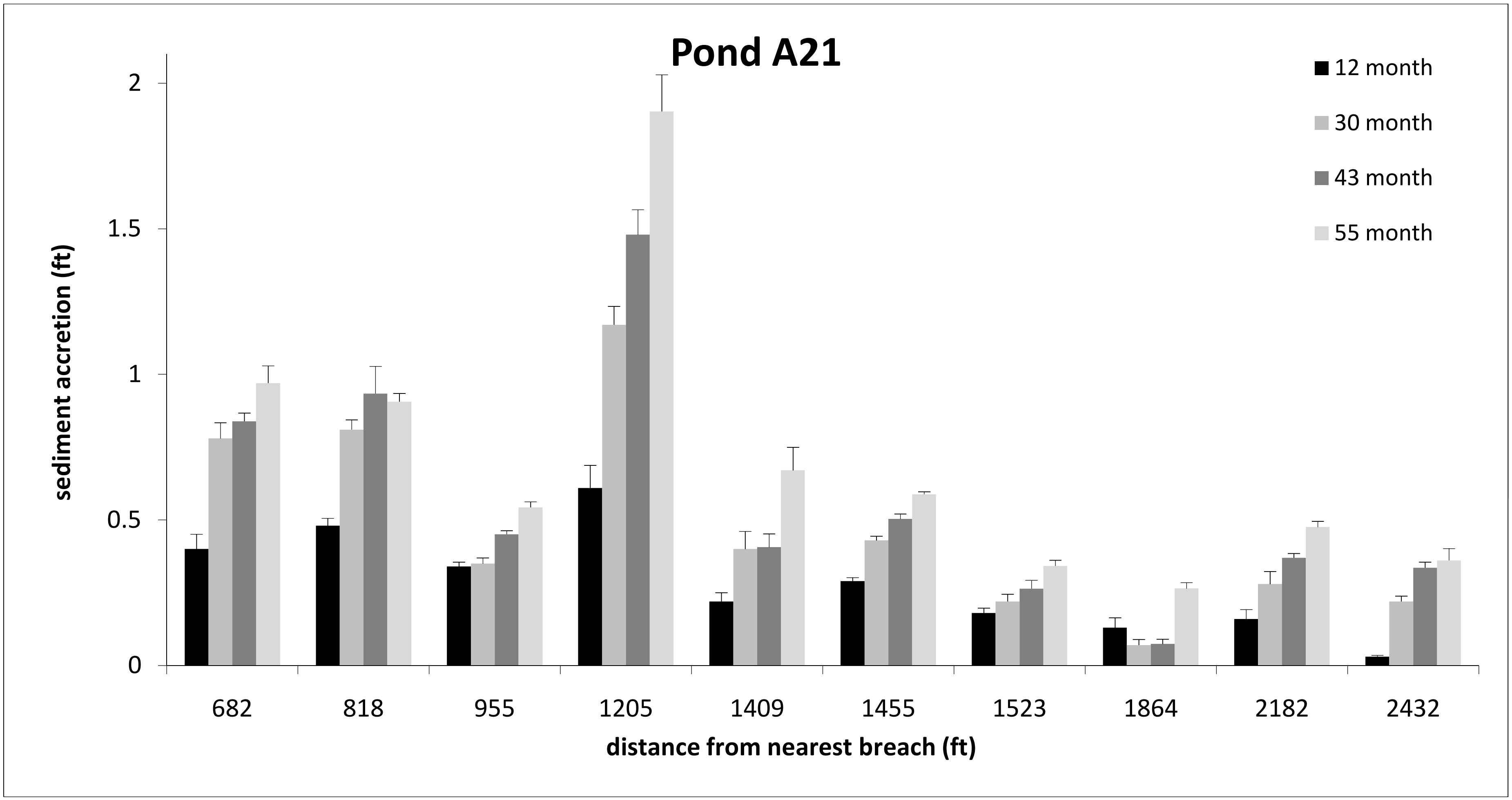


Figure 5. Average sediment deposition over time at each pin in Pond A21
(error bars represent +/- 1 standard error)

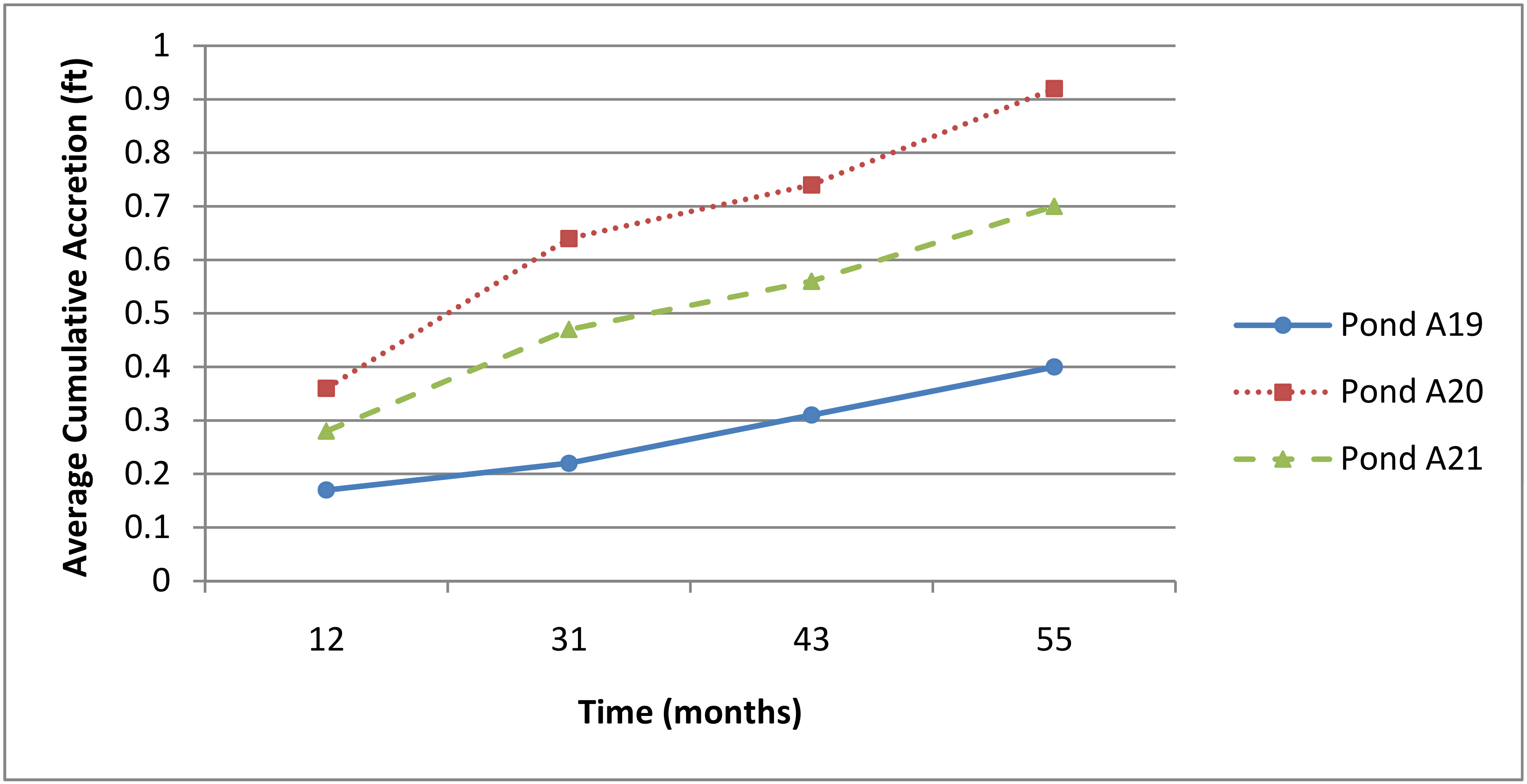


Figure 6. Cumulative sediment accretion averaged across all pins for each pond

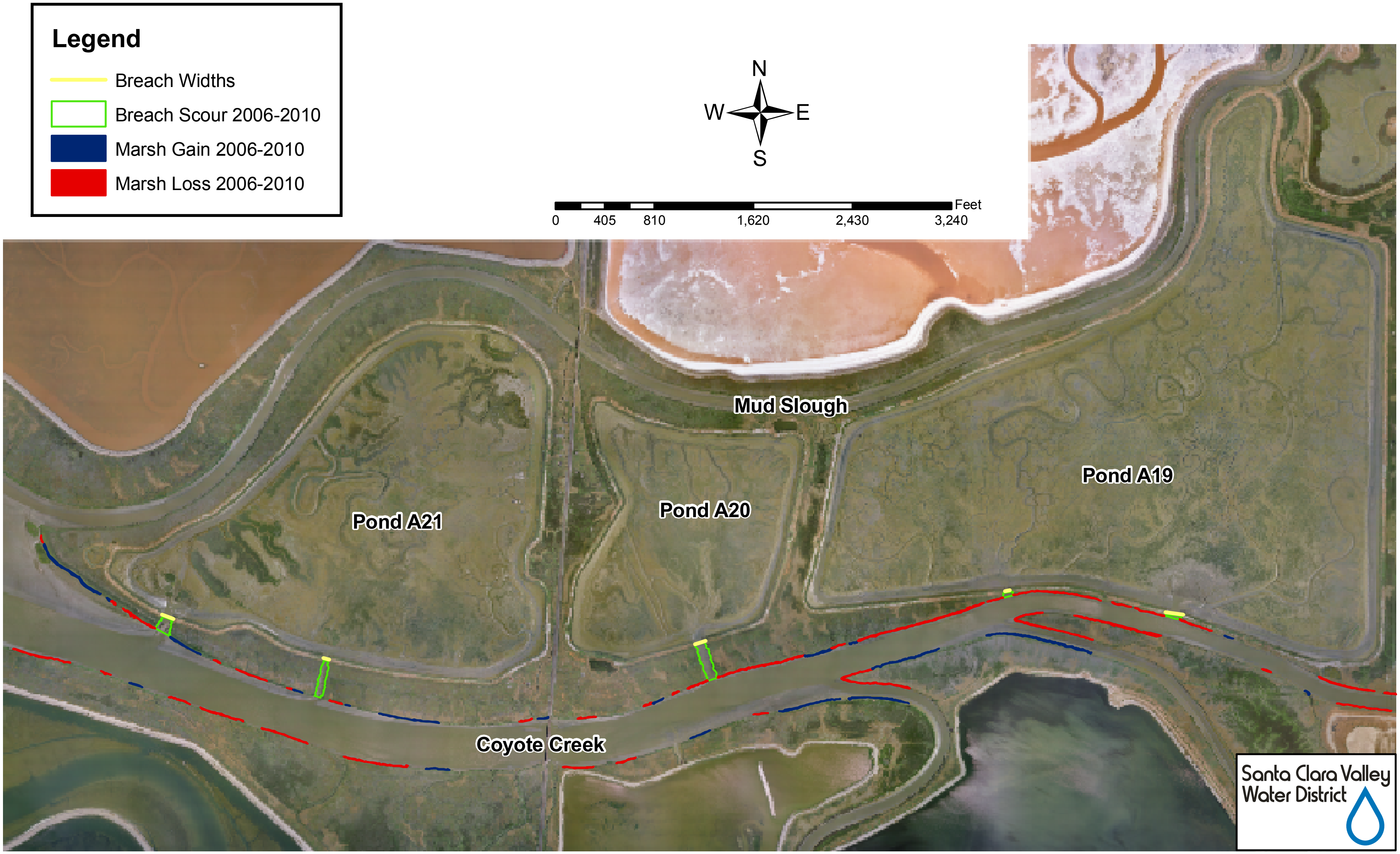


Figure 7. Breach & Fringe Marsh Scour

Image Date: July 15, 2010

APPENDIX. A.
REFUGE MONITORING

APPENDIX A

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

Don Edwards San Francisco Bay National Wildlife Refuge Monitoring Requirements for Island Ponds Tidal Wetland Restoration Year 5

Summary of Tasks

During Year Five (Y5) of the Island Ponds Tidal Wetland Restoration program, Tasks 5.2.3, 5.2.4, 5.2.6, and 5.2.7 were conducted. The following provides a brief description of these tasks and their Y5 results.

Task 5.2.3: In 2010, Island Pond channels expanded more than previous years increasing the overall channel acreage by approximately 11 percent, which is a much larger percentage increase in channel acreage in 2009 or 2008.

Task 5.2.4: Monitoring vegetation establishment is a requirement and was done in 2010. A total of 31.19 acres of native vegetation has established in all three ponds and has shown rapid expansion from the baseline acreage of 5.75 acres in 2006. Because there are at least 30 acres of vegetation, ground-based vegetation monitoring will begin in 2011.

Task 5.2.6: The Invasive *Spartina* Project (ISP) did not treat invasive *Spartina alterniflora* hybrids in Pond A19, Pond A20 or Pond A21 in 2010, however, based on aerial surveys, no non-native *Spartina* species were observed.

Task 5.2.7: Not enough acreage of marsh vegetation has developed to monitor for California clapper rail and salt marsh harvest mouse, however, monitoring of shorebirds and waterfowl on the Island Ponds indicates that many bird species are utilizing these ponds for foraging and roosting habitat.

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."

In 2010 the Island Pond channels expanded compared to previous years. Many channels widened and some new channels were added, increasing overall channel acreage by about 11 percent (Table 1). This is a much larger percentage increase in channel acreage than in 2009 or 2008 when channel acreage grew by only 1.5 percent and 3.8 percent respectively.

Figures 1 - 3 show the GIS generated channels from previous years along with the new or widened channels added in 2010.

Table 1: Channel Networking in Island Ponds

Year	Pond	Pond Acreage	Total Channel Acreage	Percent Pond as Channel	% Change in Acreage from Previous Year
2006	A19	265	8.74	3.30	
	A20	63	0.85	1.35	
	A21	147	3.02	2.05	
		total	12.61		
2007	A19	265	8.74	3.30	0
	A20	63	0.85	1.35	0
	A21	147	3.02	2.05	0
		total	12.61		0
2008	A19	265	9.06	3.42	3.64
	A20	63	1.01	1.60	18.52
	A21	147	3.02	2.05	0
		total	13.09		3.81
2009	A19	265	9.20	3.47	1.55
	A20	63	1.04	1.65	2.97
	A21	147	3.05	2.07	1.0
		total	13.29		1.53
2010	A19	265	9.78	3.69	6.3
	A20	63	1.44	2.29	38.46
	A21	147	3.58	2.44	17.38
		total	14.8		11.36

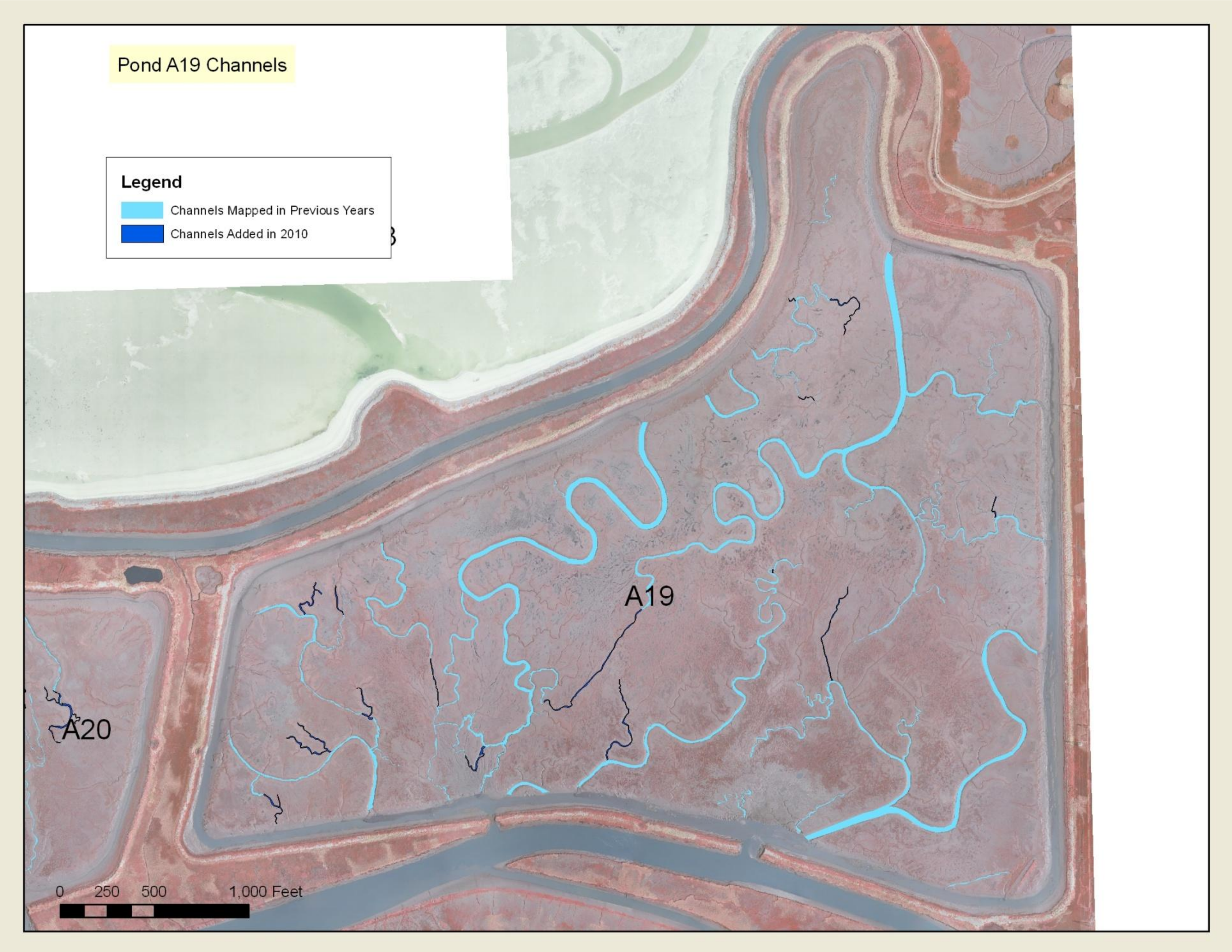


Figure 1: Channel Networking in Pond A19 during 2010 and in Previous Years.

Figure 2: Channel Networking in Pond A20 during 2010 and in Previous Years.

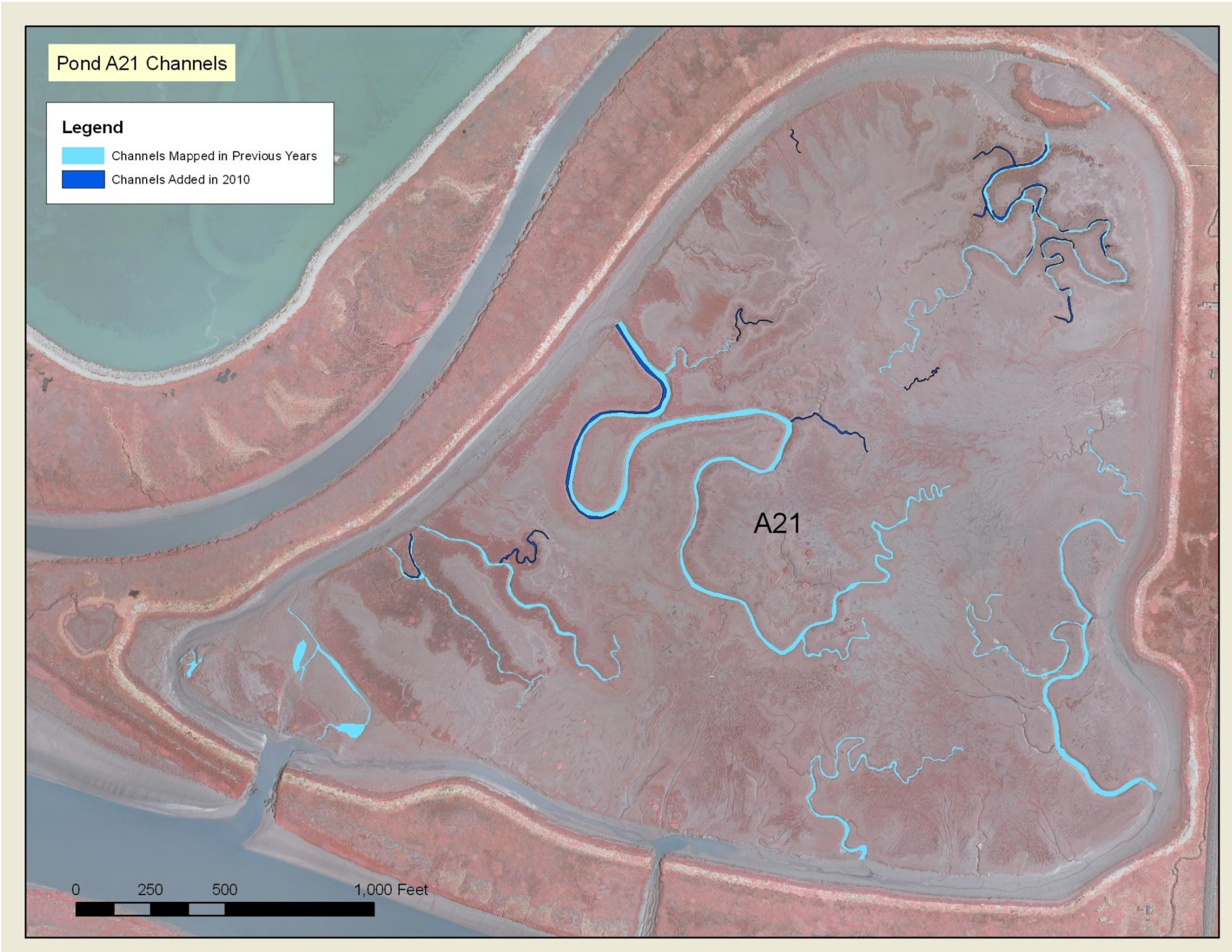


Figure 3: Channel Networking in Pond A21 during 2010 and in previous years.

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. This is a biennial requirement and was last done in 2008 and was required for 2010.

Before the breaching in 2006, the Island Ponds had no established vegetation due to 99 percent of the total area was covered with a hard salt crust gypsum layer (H.T. Harvey & Associates 2004). The Island Pond Complex also became subsided since diking, so plant colonization could only occur when sedimentation reached appropriate marsh plain elevation. Vegetation has established at all three ponds, although Pond A21 has the most vegetation coverage out of all three ponds. Elevation and sedimentation levels in Pond A21 now appear to be ideal for marsh vegetation establishment.

In 2010, native salt marsh vegetation was mapped by digitizing from the color infrared photos. Total native vegetation was 31.19 acres and has shown rapid expansion from the baseline acreage of 5.75 acres in 2006. In 2007, vegetation increased 73 percent, in 2008 it increased 33 percent, and in 2010 it increased 135 percent. Almost all of the increase in vegetation since 2008 has been in Pond A21, which has seen an over 400 percent increase, while Ponds A19 and A20 had modest increases of approximately 6 to 9 percent (Table 2). Native salt marsh vegetation was seen throughout the interior of Pond A21, while it is still found primarily along the borrow ditches in Ponds A19 and A20. Ground-based vegetation monitoring is required when there are at least 30 acres of vegetation, which has now been reached. Therefore, ground monitoring will begin in 2011. Figures 4 - 6 illustrate the increase in vegetative cover in Ponds A19, A20, and A21.

Table 2: Increase in Native vegetation on Island Ponds

Year	Pond	Acreage of Native Salt Marsh Vegetation	Percent Change in Acreage from Previous Year
2006	A19	2.99	
	A20	1.56	
	A21	1.20	
	total	5.75	
2007	A19	5.10	70.6
	A20	2.20	41.0
	A21	2.65	120.8
	total	9.96	73.2
2008	A19	6.07	19.0
	A20	2.93	33.2
	A21	4.29	61.9
	total	13.29	33.4
2010	A19	6.42	5.77
	A20	3.18	8.53
	A21	21.59	403.3
	total	31.19	134.7

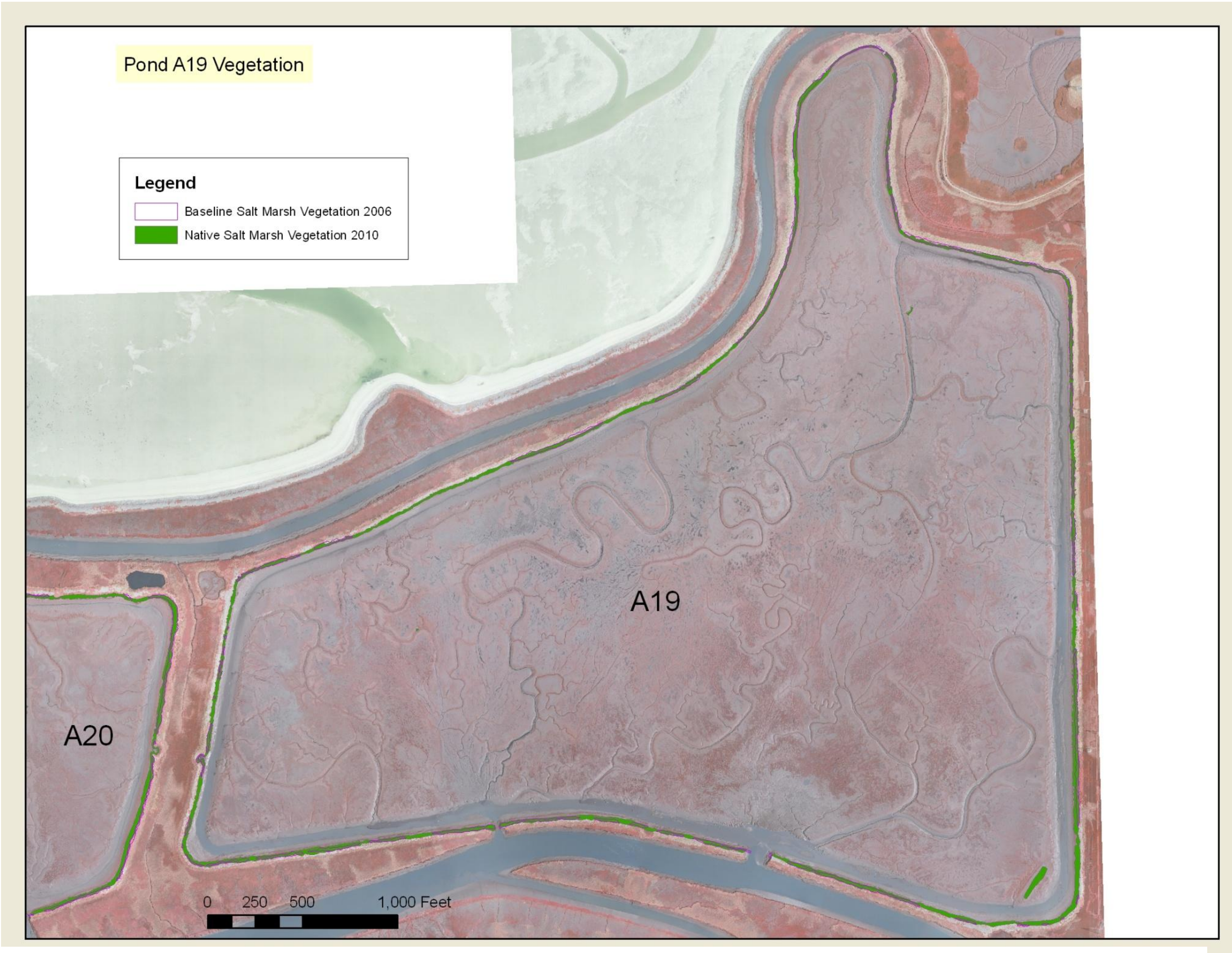


Figure 4: Native Vegetation Development in Pond A19 during 2010.

Figure 5: Native Vegetation Development in Pond A20 during 2010.

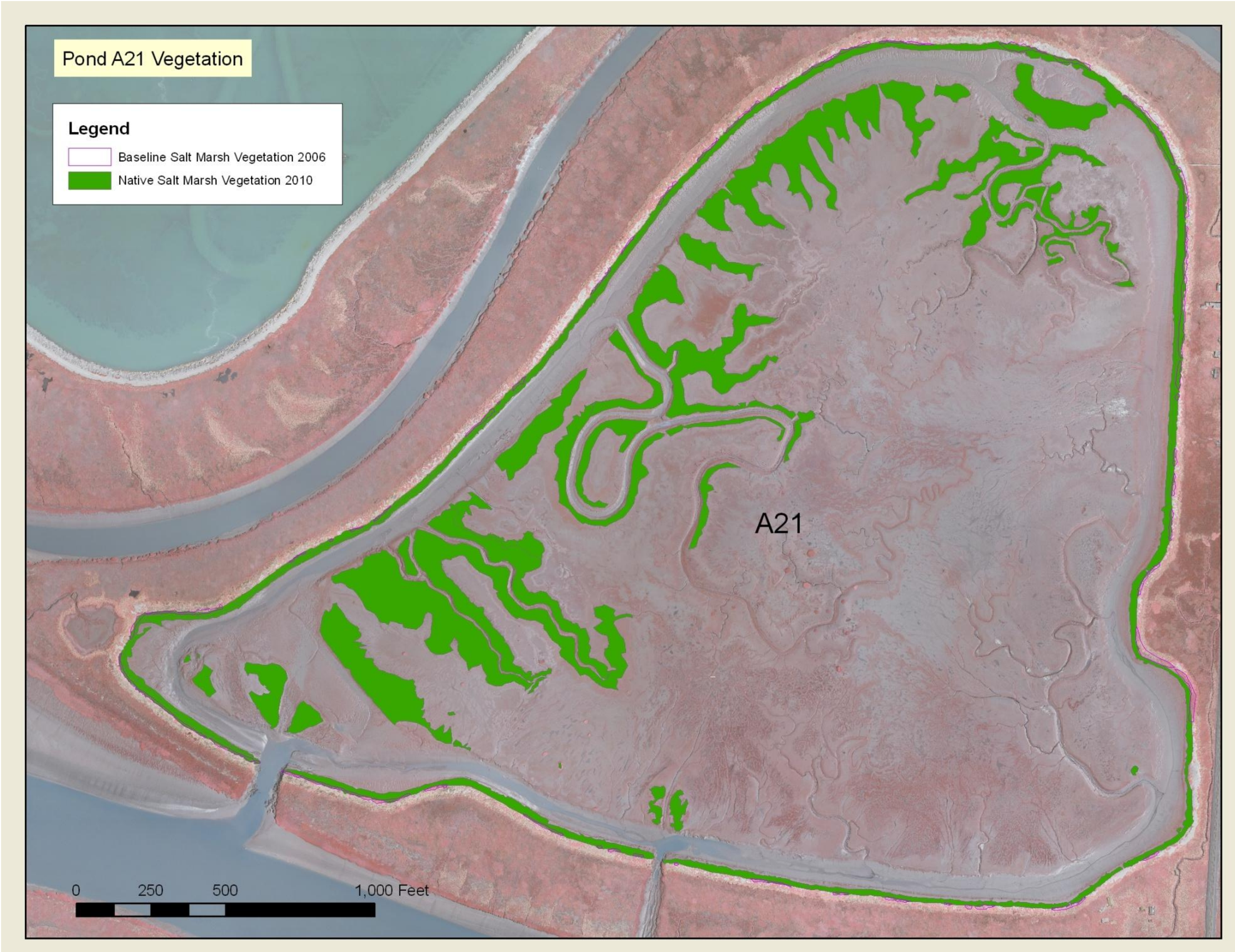


Figure 6: Native Vegetation Development in Pond A21 during 2010.

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 percent 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 Invasive *Spartina* Project (ISP) visited Pond A21 in September 2010 and treated 1 or 2 *Spartina* plants just outside of the pond. Based on observations from an airboat inside Pond A21, all of the *Spartina* appeared to be native. Pond A19 and A20 was not accessible via airboat because of the low train trestles over Coyote Creek upstream of A21, however, the aerial surveys conducted of the area a few weeks prior did not indicate any areas of concern within those marshes (E. Grijalva, ISP, pers. comm. 2010).

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 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 rails) and mammal species (particularly salt marsh harvest mice). In addition, the Santa Clara Valley Water 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 within the Island Ponds as soon as 30 acres of native vegetation develop. We expect to perform call-count surveys or other methods for determining use of the habitat for California clapper rail in spring 2011 from levees surrounding the ponds.

B) Salt marsh harvest mouse monitoring – The Refuge will monitor for salt marsh harvest mice in the Island Ponds as soon as five acres of contiguous suitable habitat develop. As of Y5, there was not enough suitable habitat available for the salt marsh harvest mouse.

C) Waterfowl and shorebird species – The U.S. Geological Survey (USGS) has been counting waterbirds at the Island Ponds monthly since October 2002 and has continued to do so in 2010. Before the ponds were breached, their 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 monthly low tide surveys 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 (e.g., dowitchers and 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 igricollis*); 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*).

Since the breach of the Island Ponds in March 2006, overall waterbird use has increased in almost all guilds of birds with the exception of eared grebes,gulls, and terns (Figure 7). The decline in eared grebe use can be attributed to a loss of high-salinity foraging areas when the Island Ponds were changed from salt making ponds into tidal ponds. The decline in the numbers of gulls and terns could be due to abatement measures taken at the landfill adjacent to these ponds as well as a loss of roosting habitat in the form of dry salt ponds.

Use of the Island Ponds by dabbling ducks and shorebirds decreased in 2010 during high tide surveys (Figure 8); however numbers of dabbling ducks and small shorebirds increased during low tide surveys (Figure 9). As vegetation increases within these ponds (especially Pond A21) we may see a further decline in use by shorebirds due to a decrease in foraging habitat in the form of mudflats. Dabbling ducks may continue to increase, however, as they are able forage in vegetated channels within tidal areas.

Tables 3 and 4 document the monthly totals of waterbird use at the Island Ponds during high and low tide surveys from January to December 2010.

Figure 7: Average numbers of waterbirds counted 2002-2010 by USGS during high tide surveys at all ponds (A19-A21) before the after the breach of March 2006.

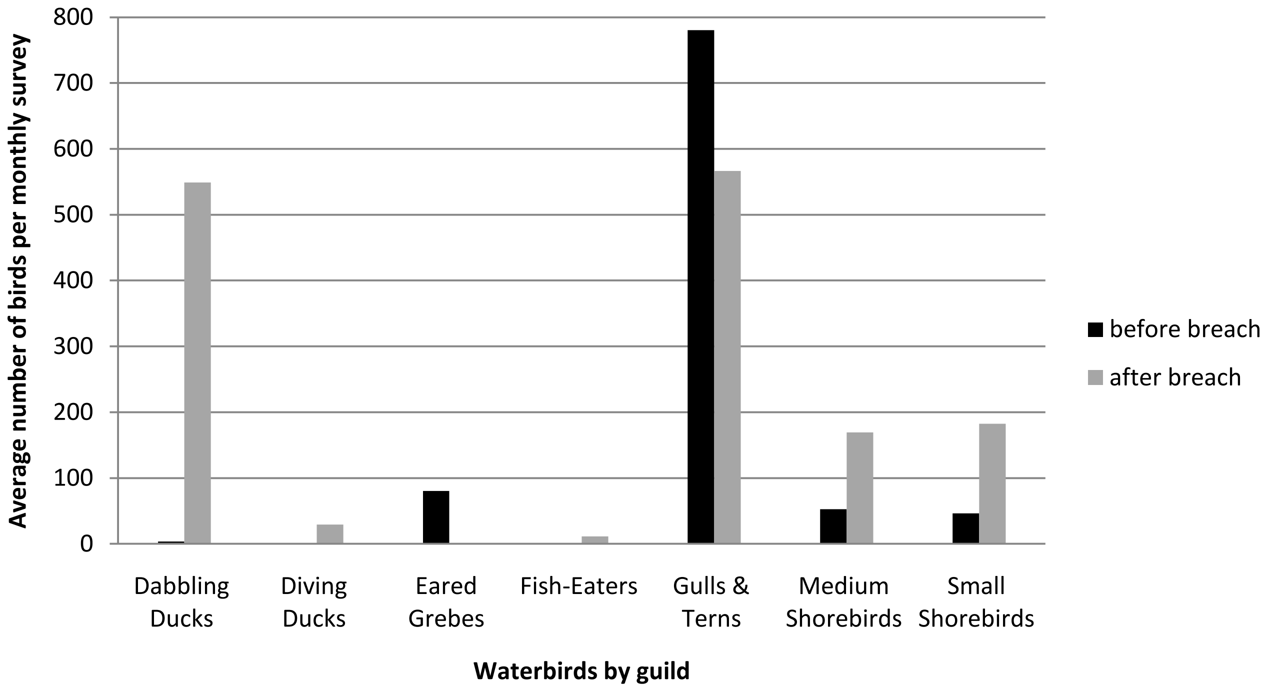


Figure 8: Average numbers of three major guilds of waterbirds counted by USGS during high tide surveys at all ponds (A19-A21), by year.

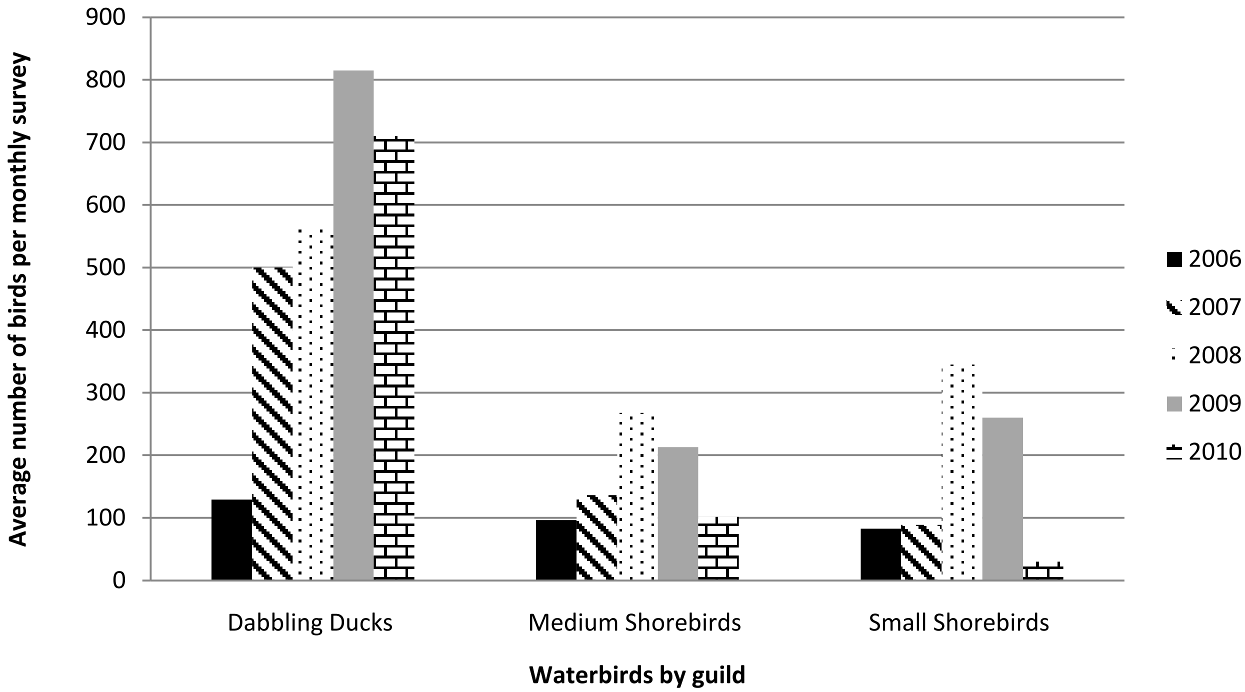


Figure 9: Average numbers of three major guilds of waterbirds counted by USGS during low tide surveys at all ponds (A19-A21), by year.

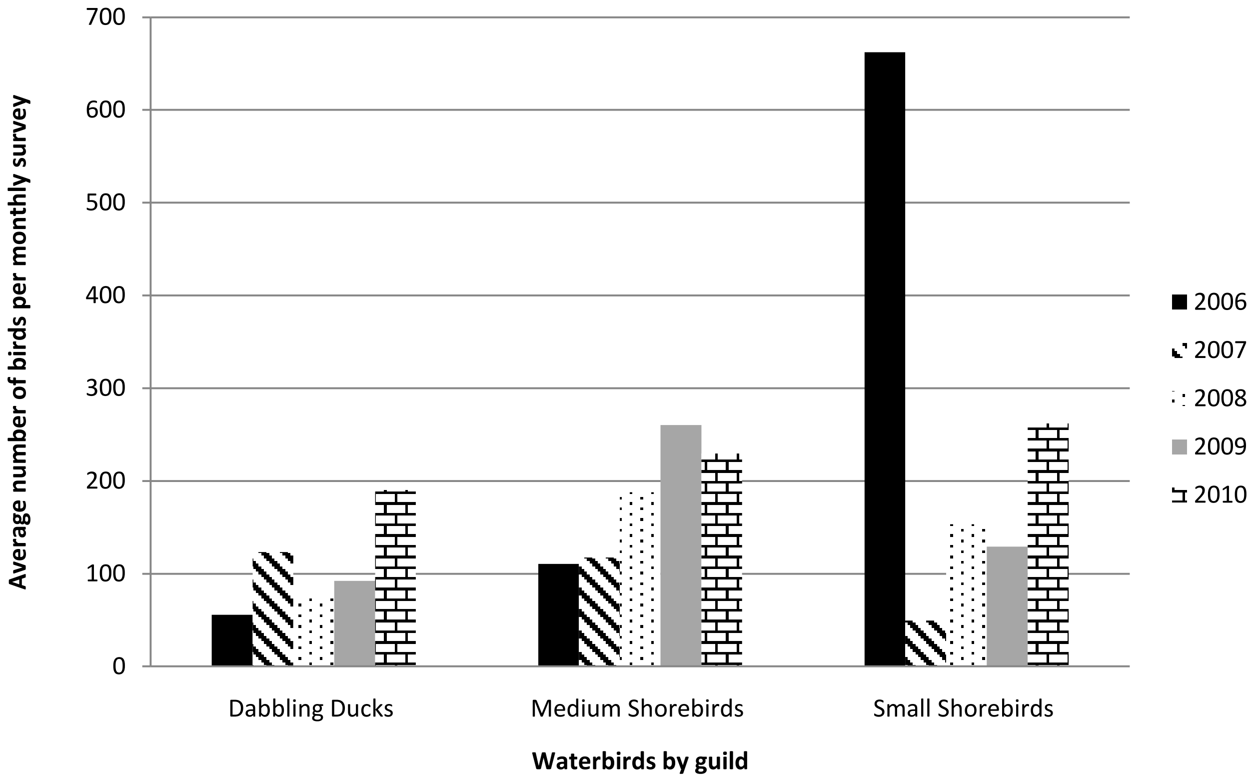


Table 3: Total numbers of waterbirds using ponds A19-A21 in 2010 during monthly high tide surveys by USGS.

2010 survey totals	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Small Shorebirds Total	Grand Total
High Tide										
A19										
January	402	12								414
February	339	110	1	2	14	5				471
March	401	62			19		2	190		674
April	262	77			5		4			348
May	9	7					4			20
June	20	5		16		20	1	4		66
July	4	3		3	7	7	1			25
August	1			14		13	1			29
September	1259					57				1316
October	2494	2				1				2497
November	146			2		1				149
December	116	7				10				133
A20										
January	570	60		1	9	16				656
February	311	110		1	11	2	2	1		438
March	397	60			6	4	1	163		631
April	330	12		1	9	9		14		375
May	18	2		1	1	3	1	57		83
June	14	1		1		1		2		19
July	3					1				4
August						1				1
September	415					34				449
October	970									970
November	261									261
December	594	4		2		6		50		656
A21										
January	2417	139		1	4	1	1			2563
February	1066	221			10					1297
March	789	39			31	18	1	232		1110
April	745	41		2	15	5	12	104	30	954
May	23			2		2	6	106		139
June	24			1		3	1			29
July	1			2		4	5	27		39
August	1			1		3		118		123
September	2828					3	6			2837
October	2371					15	1	91		2478
November	1683				2		3	60		1748
December	3569	188		3		9	1	404		4174

Table 4: Total numbers of waterbirds using ponds A19-A21 in 2010 during monthly low tide surveys by USGS.

2010 survey totals	Dabbling Ducks Total	Diving Ducks Total	Eared Grebes Total	Fish-Eaters Total	Geese Total	Gulls & Terns Total	Herons Total	Medium Shorebirds Total	Small Shorebirds Total	Grand Total
Low Tide										
A19										
January	1					85	1	705	120	912
February					5	13		35		53
March					9	260		48		317
April					4			4	395	403
May	6			5	2	5		6		24
June	2			12		15		38		67
July				259		7	1	166		433
August				45		64	7	254	37	407
September	246					40	1	653	248	1188
October	442					82		335	79	938
November	43					683		866	240	1832
December	56					627		329		1012
A20										
January	1							279	72	352
February					2	1		36		39
March					4	203		89		296
April	1				7			3	43	54
May					3					3
June				1						1
July						2		53		55
August							2	239	438	679
September	212					46		130	415	803
October	48					101		46		195
November						1010		167	59	1236
December	34					1464		275		1773
A21										
January	245				10			169	146	570
February					4	1158		45		1207
March					14	1604		42		1660
April					5				1200	1205
May	1									1
June						1		5		6
July						1	2	411	27	441
August							1	531	942	1474
September	643					23		484	80	1230
October	1196					5		329	24	1554
November	212					168		307	153	840
December	36					566	1	267		870

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APPENDIX B.
PHOTOGRAPHS

APPENDIX B-1.
RAIL LEVEE PHOTOGRAPHS

APPENDIX B-1
RAIL LEVEE PHOTOGRAPHS
2006 VS. 2010

Photo 1. Pond A21 Levee located west of Rail Levee, view looking north - July 13, 2006.

Photo 2. Same location as above – June 9, 2010.

Photo 3. Pond A21 Levee located west of Rail Levee, view looking south – July 13, 2006.

Photo 4. Same location as above – June 9, 2010.

Photo 5. West Rail Levee adjacent to Pond A21, view looking north – July 13, 2006.

Photo 6. Same location as above – June 9, 2010.

Photo 7. West Rail Levee adjacent to Pond A21, view looking south – July 13, 2006.

Photo 8. Same location as above – June 9, 2010.

Photo 9. Pond A20 Levee located east of Rail Levee, view looking north – July 13, 2007.

Photo 10. Same location as above – June 9, 2010.

Photo 11. Pond A20 Levee located east of Rail Levee, view looking south – July 13, 2006.

Photo 12. Same location as above – June 9, 2010.

Photo 13. East Rail Levee adjacent to Pond A20, view looking north – July 13, 2006.

Photo 14. Same location as above – June 9, 2010.

Photo 15. East Rail Levee adjacent to Pond A20, view looking south – July 13, 2006.

Photo 16. Same location as above – June 9, 2010.

APPENDIX B-2.
POND A21 LEVEE EROSION DATA & PHOTOGRAPHS

Pond A21 Levee Erosion Data & Photographs

date of survey 06/09/10 and 08/23/10 survey data by: S. Katric, M. Moore, L. Mercado and L. Porcella

Notes:

1. spreadsheet represents elevations taken to monitor Pond 21 levee height where wave action appears to be overtopping southeastern corner of pond

2. Eight sections are being monitored, all within 100 +/- feet of each other

3. Wooden stakes (usually 2, 3 at one location) were installed at each section where elevations adjacent to the stakes were taken

4. Measurements were taken between stakes and the pond side edge of levee in order to monitor how quickly the pond side of the levee is eroding.

5. Photos of each section were taken to identify stake locations and section numbers.

6. A benchmark was installed using a metal "T" stake.

7. The T-stake elevation was established by surveying an "X" on the northwest railroad bridge abutment, calling the abutment elevation 10.00 (ten)

8. If RR abutment is elev 10.0, then T-stake benchmark elevation is 5.45 feet, the 08/23/10 survey comfirmed this elevation.

9. elevation and offset data was collected on both survey dates providing similar results, the 08/23/10 results are represented below.

10. new to this report, only the offset difference between the pond edge and the first stake is being reported because earlier surveys indicate no change between stakes

	Stake Nearest Pond						Middle Stake				Stake furthest from Pond/closest to outboard Marsh			
Section #	2008 ground surface elevation (ft)	2010 ground surface elevation (ft)	change in elevation between 2008 and 2010 (ft)	2008 offset between pond and stake (ft)	2010 offset between pond and stake (ft)	change in offset between 2008 and 2010 (ft)	2008 ground surface elevation (ft)	2010 ground surface elevation (ft)	change in elevation between 2008 and 2010 (ft)	2010 offset between pond and middle stake (ft)	2008 ground surface elevation (ft)	2010 ground surface elevation (ft)	change in elevation between 2008 and 2010 (ft)	2010 offset between pond and outboard stake (ft)
1	6.53	6.47	-0.06	5.25	4.00	-1.25					5.69	5.67	-0.02	
2	6.31	6.31	0.00	7.33	4.17	-3.17					5.61	5.62	0.01	
3	6.32	6.21	-0.11	2.83	1.62	-1.21	6.43	6.47	0.04		5.54	5.59	0.05	
4	6.39	6.37	-0.02	5.00	3.33	-1.67					5.44	5.43	-0.01	
5	6.39	6.26	-0.13	1.83	1.75	-0.08					5.5	5.53	0.03	
6	6.44	6.40	-0.04	3.17	2.42	-0.75					5.45	5.48	0.03	
7	6.68	6.64	-0.04	8.00	6.17	-1.83					5.58	5.54	-0.04	
8	6.94	6.89	-0.05	6.00	3.92	-2.08					5.49	5.41	-0.08	

NOTES/OBSERVATIONS based on 08/23/10 survey:

1. most elevations decreased, averaging between 0.5 to 1.9 inches of material has eroded from the levee surface in the last 14 months
2. most offsets indicate continued loss of levee material on pond side with Station 2 losing 2.9 feet of levee over the last 14 months
3. offsets between first stake and pond should continute to decrease, likely due to wave action (see photos)

2009 photo looking northerly
with section 4 and 5 in the background

below - 2010 photo looking northerly
with section 6 at bottom of photo

2009 photo looking westerly
of marking stakes and debris pile inboard of levee

below - 2010 photo looking westerly at marking
stakes and debris pile on inboard of pond levee

APPENDIX C.
SEDIMENTATION DATA

APPENDIX C

Summary of Sediment Accretion at the Island Ponds

Pond	Pin ID	Northing	Easting	Distance from Nearest Breach (ft)	12 months Post-breach accretion (ft)	30 months Post-breach accretion (ft)	43 months Post-breach accretion (ft)	55 months Post-breach accretion (ft)
A19	A1912	1994802	6137896	477	0.16	0.03		
A19	A1913	1994943	6138503	545	0.35	0.19	0.50	0.53
A19	A1914	1994981	6139508	886	0.22	0.1	0.10	0.30
A19	A1915	1994441	6139937	1114	0.25	0.16	0.43	0.74
A19	A1911	1994902	6136328	1136	0.12	0.17	0.22	0.44
A19	A1909	1995850	6137503	1227	0.18	0.31	0.34	0.38
A19	A1910	1995754	6136634	1364	0.22	0.4	0.54	0.68
A19	A1908	1995661	6140093	1750	0.21	0.28	0.27	0.41
A19	A1906	1996260	6138748	1795	0.23	0.54	0.68	0.78
A19	A1907	1996306	6138209	1841	0.18	0.37	0.42	0.47
A19	A1905	1996246	6139614	1955	0.11	0.09	0.18	0.25
A19	A1904	1996794	6139043	2364	0.15	0.3	0.34	0.36
A19	A1903	1997004	6140052	2841	0.05	0.07	0.18	0.21
A19	A1902	1997533	6139359	3114	0.05	0.13	0.16	0.11
A19	A1901	1998378	6139462	4000	0.06	0.12	0.18	0.15
A20	A2005	1994548	6134334	659	0.43	0.73	0.94	1.01
A20	A2004	1995023	6134585	864	0.62	1.03	1.07	1.37
A20	A2003	1995020	6135241	875	0.48	1.02	1.05	1.40
A20	A2002	1995551	6135296	1386	0.14	0.31	0.39	0.54
A20	A2001	1995675	6134580	1500	0.12	0.1	0.25	0.31
A21	A2109	1994879	6131048	682	0.40	0.78	0.84	0.97
A21	A2108	1994879	6131709	818	0.48	0.81	0.93	0.91
A21	A2107	1994877	6132369	955	0.34	0.35	0.45	0.54
A21	A2110	1994221	6133040	1205	0.61	1.17	1.48	1.90
A21	A2106	1994858	6133026	1409	0.22	0.4	0.41	0.67
A21	A2105	1995539	6131707	1455	0.29	0.43	0.50	0.59
A21	A2104	1995507	6132381	1523	0.18	0.22	0.26	0.34
A21	A2103	1995533	6133027	1864	0.13	0.07	0.07	0.26
A21	A2102	1996203	6132359	2182	0.16	0.28	0.37	0.48
A21	A2101	1996190	6133043	2432	0.03	0.22	0.34	0.36