ISLAND PONDS MITIGATION MONITORING
AND REPORTING
YEAR 2- 2007

Prepared by

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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 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 2 (2007) monitoring results for both the District and the Refuge.

The following is a summary of the monitoring results:

Both the 2006 and 2007 data demonstrate that the excavated breaches are providing full tidal inundation in all three ponds.

Sediment is continuing to deposit on the surface of all 3 ponds. Rates of accretion vary between ponds and across the surface of each pond. Accretion rates are higher in Ponds A20 and A21 than in Pond A19. In general, accretion is greater at the southern end of each pond near the breaches and diminishes at the northern end. Over 50% of the sediment monitoring stations are accreting sediment at rates greater than the 0.2 feet per year originally predicted.

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. A small strip of noticeable scour has occurred along the fringing marshes on both sides of Coyote Creek, resulting in the loss of approximately 1.14 acres of marsh. However, no signs of scour were detected in the levees opposite the breaches at Ponds A15, A17, and A18.

Although there has been a small increase in scour dimensions around the uppermost piles of the railroad bridge on the south bank, the scour is still limited. While there are no criteria to assess the significance of the observed scour, it is so minor that we conclude there is little risk to the structural integrity of the bridge due to the observed scour. It is important to understand that our observations are only of the intertidal zones on the sides of the channel. Our observations do not include the subtidal piles in the center of the channel where scour is more likely to occur.

The total surface area of tidal channels within the Island Ponds is 12.61 acres, unchanged from 2006. Total surface area of these channels accounts for approximately 2.6% of the total 475-acre complex.

A very limited amount of new, native vegetation was observed within the Ponds. The majority of this vegetation was pickleweed (*Sarcocornia pacifica*) growing adjacent to the levee. No invasive plant species were found within the Island Ponds.

Since the breaching of the Island Ponds in March 2006, waterbird use of the ponds has continued to increase for all species except eared grebes (*Podiceps nigricollis*). The decline in numbers of eared grebes is likely due to a loss of foraging habitat as the ponds turned less saline. There has also been a slight increase in shorebird use of the ponds and a more dramatic increase in the use of the ponds by gulls.

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 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 2 (2007) 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). 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 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

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 2 (2007) monitoring period. The data are presented in detail and are compared to pre-breach and Year 1 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 to D), 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 x2741.

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

2.0 MONITORING METHODS (DISTRICT ACTIVITIES)

This section describes the methods used to carry out the Year 2 monitoring activities for the District. The monitoring responsibilities of the Refuge are described in Appendix A 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.

Six water level sensors were installed at the recording stations shown in Figure 2 and Table 2-1. Two sensors were located on an old drawbridge piling in the centre of Coyote Creek immediately east of the railroad bridge and four 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 July 23-24, 2007, for a seven-week period, to capture the summer 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
YSI sonde/Pressure Transducer	North corner of Pond A19	1997976	6139505
Pressure Transducer	Northwest corner of Pond A20	1995972	6134204
Pressure Transducer	Northeast corner of Pond A21	1993506	6133747

* Recording station numbers correspond to GPS coordinates

The water level recording stations in each location 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.

Duplicate water level sensors were installed in Coyote Creek and Pond A19 given the importance of Coyote Creek as a point of comparison for measuring tide heights and the previous vandalism issues at Pond A19. The duplicate sensors consisted of YSI 6920 data collection sondes, which utilize a differential strain gauge transducer to measure pressure with one side of the transducer exposed to water. The sonde was mounted inside the same perforated stilling well used for the INW pressure transducers, well above the level of the freshly deposited unconsolidated sediment. 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.

All sensors were downloaded near the mid-point of the six-week sampling period to ensure the logging equipment was functioning properly. Data from the YSI 6920 sonde at Coyote Creek and the YSI sonde and INW pressure transducers at Pond A19 were downloaded on August 10, 2007 (18 and 19 days of data collection, respectively). Data from the INW pressure transducers at Coyote Creek and Ponds A20 and A21 were downloaded on August 13, 2007 (21 days of data collection). 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. The pressure transducer at Pond A19 was taken out of the field from August 10-12 to resolve these technical issues. However, this did not adversely affect the continuity of data in Pond A19 due to the presence of the redundant sensor (YSI sonde) at that location. 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	Interim Download	End	Gaps
Coyote Creek (YSI)	24 July 2007	10 August 2007	11 September 2007	None
Coyote Creek (Transducer)	24 July 2007	13 August 2007	11 September 2007	None
Pond A19 (YSI)	24 July 2007	10 August 2007	11 September 2007	None
Pond A19 (Transducer)	23 July 2007	10 August 2007	11 September 2007	Aug 10-13,2007
Pond A20 (Transducer)	23 July 2007	13 August 2007	11 September 2007	None
Pond A21 (Transducer)	23 July 2007	13 August 2007	11 September 2007	None

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 power source check. To ensure geodetic compatibility between all datasets, the water level sensors were tied to a common local benchmark through an elevation survey at the time of download, as well as a water surface elevation survey to check for instrument drift. The water level recording stations were all surveyed into the NAVD88 datum. The final download and equipment removal at all locations occurred on September 11, 2007 allowing for approximately seven weeks of total data collection.

Salinity data was also taken for Pond A19 and Coyote Creek via the *in situ* YSI 6920 sondes (Appendix D). Salinity data was taken every ten minutes from July 24 to September 11, 2007, with the exception of a gap in data from August 11 to August 25 at Coyote Creek due to biofouling of the conductivity sensors. In both locations, salinity levels corresponded with the ingoing and outgoing tidal cycles. Pond A19's salinity ranged from 12 to 25 ppt; somewhat muted compared to the Coyote Creek site, which had a salinity range of 10 to 32 ppt.

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.

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 to measure sediment deposition in various locations. Each pin was tagged with a unique ID number. The tag number and pin coordinates are presented in Appendix C.

The Year 1 sediment monitoring activities showed that the "Depth Probe" method (i.e., sampling the average sediment depth adjacent to each pin) provided a more accurate picture of accretion than taking a single measurement at each sediment pin. In addition, the sediment pin measurements proved to be less accurate due to measurement inconsistencies (i.e., uneven ground surfaces from which to survey the pins, inconsistent measurement locations on the domed sediment pin caps, and different measurement vantage points depending on the height of the surveyor), the inherent level of accuracy of the survey equipment, and the pins themselves being installed in biased locations (i.e., locations where the ground was either depressed or softer). Based on the results of the Year 1 monitoring activities, the fact that the gypsum layer was not showing signs of dissolving, and subsequent discussions with the Regulatory Agencies (April 2007), it was decided that the Year 2 sediment monitoring would include the following activities:

- Spring monitoring would consist of measuring sediment accretion using the "Depth Probe" method at all sediment pin locations. This technique 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 will be taken around each pin to achieve a representative average of the sediment depth in each location. A map of the ponds will be used to depict the sediment accumulation adjacent to each sediment pin. The data will be presented without contour lines and instead consist of the average sediment depths displayed at each sampling location.
- Summer/Fall monitoring shall be performed in conjunction with the annual aerial photography of the site. District Survey staff will establish several more horizontal and vertical control points within and adjacent to the ponds to improve the vertical accuracy and enable a Photogrammetrist to establish spot elevations which will be used to generate a model with contour information for each pond. The elevation data acquired using this technique will be compared to available pre-breaching elevation information to establish amounts of sediment accumulation throughout each pond. A map will be generated depicting elevational differences across each pond based on the Photogrammetrist's model. In addition, to verify the accuracy of this information, the Depth Probe method as described above will be used at 3-4 pins in each pond.

Spring monitoring for Pond A21 occurred on March 23 and 26, 2007 and April 13, 2007. Pond A20 was sampled on April 4, 2007 and Pond A19 was sampled on April 5 and 16, 2007. Summer/Fall monitoring occurred soon after the aerial photo was taken during the week of July 16-18, 2007.

Data generated from these sampling events are presented in both map and graphical form. The eight month, 12 month and 16 month post-breach data are compared to show sediment accretion rates across each pond over time.

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 2007 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 for the presence of perennial pepperweed and any remnant side-cast material.

2.1.4 Aerial Photography

Aerial photographs were obtained for use in the Year 2 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 July 5, 2007. 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 side of Coyote Creek and the majority of the southern side of the creek. The remainder of the southern edge of Coyote Creek that was not covered by the aerial photograph was mapped through other available rectified imagery from the summer of 2007 (City of San Jose 2007). This imagery, although only available at one-meter resolution, provided an adequate image for the tasks which involved mapping the south bank of Coyote Creek.

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. The bridge is oriented north to south across Coyote Creek and is supported by a series of bents each comprising three piles oriented west to east. For the purposes of this monitoring the bents on the south bank are designated 1S, 2S, 3S, etc, in a south to north direction. The bents on the north bank are designated 1N, 2N, 3N, etc, in a north to south direction. The piles in each bent are designated as A (west pile), B (central pile), and C (east pile).

On November 29, 2006, a set of ten photographs were taken of the railroad bridge piles from control points adjacent to the bridge to evaluate for signs of scour. The photographs comprised four general shots of the bridge piles across Coyote Creek and six close-up photographs to provide more detail of the mudflats around the pile bases. In the absence of pre-breach scour measurements, the November 29, 2006 (Year 1) data is used as the baseline for future monitoring.

The Year 2 monitoring consisted of four additional sets of photographs taken from the same stations on May 18, August 14, September 27, and November 21, 2007. All visual inspections were conducted above the water surface (i.e., not a diver inspection). At the time of photography, the bases of only six piles (three on the north bank; 1N-A, 1N-B, and 1N-C, and three on the south bank; 1S-A, 1S-B, 1S-C) located in the intertidal zone on each side of the bridge were visible.

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 the post-breach aerial imagery from Year 1 (August 2006) to the post-breach imagery from Year 2 (July 2007). The District provided 2006 and 2007 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. The 2007 imagery did not cover a portion of the south bank of Coyote Creek near the railroad trestle. This missing section was mapped through other available rectified imagery at a 1-meter resolution; see Section 2.14. Although the substitute imagery was adequate to map the fringe marsh, the mapping in this area should be viewed with a lower level of certainty. The six-inch resolution images used for the majority of the GIS analyses, however, are considered high quality and should be considered very reliable for mapping purposes.

ArcView GIS was utilized to delineate the marsh edges along Coyote Creek for both years. The 2007 delineation was superimposed over the 2006 delineation to highlight any changes in post-breach marsh boundaries. These changes in marsh boundaries were then calculated using ArcView GIS.

In addition, the creek-side levees opposite the breaches were evaluated by visual inspection and by comparing the 2006 and 2007 aerial images to evaluate the extent of any change.

2.2.3 Rail Levee Erosion

On May 18, 2007, 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. These photographs are shown in Appendix B-2.

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 May 18, 2007 and October 26, 2007, 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. Similar to Year 1, photographs were taken of any area with visible erosion. These photographs are compared to the Year 1 photographs in Appendix B-3.

3.0 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 A and are not reported here.

3.1 ON-SITE MONITORING

3.1.1 Inundation Regime

Figures 3a through 5c present time-series comparisons of the recorded tidal elevations in Coyote Creek against those from Ponds A19, A20, and A21. The complete tidal cycle was recorded in Coyote Creek and Ponds A19 and A21. However, in Pond A20 practical constraints in installation resulted in a sensor position just above the lowest tides. Therefore, data for the lowest tides are not available for this location.

Similar to the 2006 data, high tide water levels in all three ponds track the Coyote Creek water levels fairly closely. In Pond A19, the high tide levels are within 0.1 feet of those in Coyote Creek, within 0.2 feet in Pond A20, and within 0.25 feet in Pond A21. The timing of high tide in Pond A19 shows a small lag (approximately 0.5 hrs) compared to Coyote Creek whereas the timing of high tides in Ponds A20 and A21 are close to those in Coyote Creek.

Low tide water levels varied by pond. Ebb low tide drainage is impeded in Pond A19, with the lowest tides draining to approximately +1.4 to +1.5 feet NAVD88, compared to -1 to -2 feet NAVD88 in Coyote Creek (Figures 3a-3b). Water levels for Pond A19 show a small time lag (approximately 1 hr) in ebb tide drainage compared to Coyote Creek. Ebb low tide drainage is also impeded in Pond A21, with the lowest tides draining to approximately +0.2 to +0.3 feet NAVD88 (Figures 5a-5b). However, there appears to be no time lag in ebb tide drainage from Pond A21 compared to Coyote Creek. Low tides for Pond A20 were not available below +0.8 feet NAVD88 (Figures 4a-4b). However, for the part of the tide range for which data are available, the timing of the ebb tide drainage for Pond A20 lags slightly behind that of Coyote Creek (approximately 0.5 hrs). Overall, Pond A19 shows the greatest constraint on ebb tide drainage of the three ponds.

Similar to the 2006 results, restricted low tide drainage in the Ponds 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 (+4 feet NAVD88) with a root zone depth of approximately one foot. Using these data, the bottom of the root zone would be approximately +3 feet NAVD88. This is above the elevation of the impeded low tide drainage in Pond A19 (+1.5 feet NAVD88), Pond A21 (+0.3 feet NAVD88) and the potentially impeded drainage in Pond A20 (+0.8 feet NAVD88).

3.1.2 Substrate Development/Sedimentation

Sedimentation data has been collected at the Island Ponds on 8, 12 and 16-month post-breach intervals. These results are compared to each other to estimate sediment accretion over that period and discern trends within and between ponds (Appendix C). The data are visually presented in the following ways:

1. A map of the ponds depicting the sediment monitoring locations and the average sediment depth 8, 12 and 16-months post-breach at each location (Figure 6).
2. Graphs depicting average sediment accretion, based on the "Depth Probe" method, plotted against the distance from the nearest breach (Figures 7 to 9)
3. A chloropleth map depicting elevation differences across each pond based on the 16-month post-breach model. (Figure 10)

Depth Probe Data. In general, Pond A19 has shown the lowest sediment accretion of the three ponds. Utilizing the average accretion values for each sampling location (i.e., the average of the 8 measurements taken at each sediment pin) only six of the fifteen locations (40%) met the predicted sedimentation rate of 0.2 feet per year (Figure 7). Utilizing the maximum accretion values for each location (i.e., the maximum of the 8 measurements taken at each sediment pin) ten of the fifteen sampling stations (67%) met the predicted sedimentation rate (0.2ft/yr). Of the five stations, which are ultimately deficient with regard to the sediment projections, four are located at the northern end of the pond, furthest from the breaches, and the fifth is located in the southwestern corner of the pond (Figure 6).

With regard to sediment accretion extremes in Pond A19, the minimum amount of sediment, 0.05 feet, was recorded near the northern extent of the pond (over 3000 feet from the nearest breach) and the maximum, 0.35 feet, accrued near the east breach (545 ft northwest of east breach). General trends across the pond show higher sediment deposition in the lower 2/3 of the pond.

Pin A1912 was designated an anomaly in Year 1 due to low sediment yield given its close proximity to the west breach, a high sediment yield area. In Year 2, sediment has begun to build up on the northeastern side of this pin, however, since the pin is located directly at the mouth of a large channel, the channel side of the pin has continued to scour.

Pond A20 has shown the highest averages in sediment deposition of the three ponds. Three of the five sampling stations (60%) over-doubled the predicted sedimentation rate of 0.2ft/yr (Figure 8). The remaining two sampling stations, located furthest from the breach at the north end of the pond, achieved maximum accretion values above the 0.2 ft/yr predicted rate, but did not achieve an average rate higher than that prediction.

The minimum amount of sediment, 0.13 ft, accrued at the northwestern corner of Pond A20, furthest from the breach (1500 ft). The maximum amount of sediment, 0.74 ft, accumulated near the midline of the pond on the western side. General trends across the pond show higher sediment deposition in the southwestern portion of the pond.

Pond A21 has performed most similarly to Pond A20 in relation to sediment deposition. However, Pond A21 has displayed the highest accretion values of all three ponds (> 1.1 ft). Utilizing the average accretion values for each sampling location, 60% of the Pond A21 sites (6 of 10 sites) met the predicted sedimentation rate of 0.2 ft/yr (Figure 9). Utilizing the maximum accretion values for each location, 90% of the sampling stations met the predicted sedimentation rate. The one site that did not achieve the predicted sedimentation rate is located at the northeastern corner of the pond and is farthest away from any of the breaches (> 2400 ft).

With regard to sediment accretion extremes in Pond A21, the minimum amount of sediment, 0.12 feet, was recorded in the northeastern corner of the pond while the maximum, 0.62 feet, accrued near the west breach (682 ft north of west breach). Similar to Pond A19, general trends across Pond A21 show higher sediment deposition in the lower 2/3 of the pond.

In summary, rates of accretion vary between the ponds and across the surface of each pond. Accretion rates are higher in Ponds A20 and A21 than in Pond A19 (Figure 6). In general, accretion is greater at the southern end of each pond near the breaches and diminishes at the northern end. An accretion rate of 0.2 ft/yr was predicted by HTH and PWA (2005). Average sediment depths at each monitoring location indicate that 50% of the monitoring stations are accreting sediment at rates greater than predicted, while maximum sediment depths at each location indicate that 80% of the sampling locations are above the predicted rate. These results indicate that the project is exceeding the performance criteria for accretion and is currently on track to meet the mitigation requirements.

<u>16-Month Post-Breach Sediment Model</u>. Figure 10 displays a chloropleth map that uses color gradation to depict elevation differences across the ponds. The data used to produce this figure came from the 16-month post-breach model created by the Photogrammetrist using established vertical control points and the July 5, 2007 aerial photographs.

Results from the model were compared to two sets of field data collected within two weeks of the aerial photo date. These field measurements consisted of elevation data collected by the Survey staff at eight sediment pin locations (4 in Pond A19, 1 in Pond A20, and 3 in Pond A21) and Depth Probe measurements taken at ten different locations throughout the ponds (4 in Pond A19, 3 in Pond A20, and 3 in Pond A21; See Figure 6). The model was shown to be off by up to 0.5 ft in some locations, but on average by less than 0.2 ft. However, given that the predicted accretion rate per year is 0.2 ft, the level of accuracy of the model seems to be inadequate for annual based estimations and comparisons.

In addition, to determine post-breach sediment accrual rates from the model, the pre-breach elevation for each location needs to be subtracted from the model elevation. The 2005 USGS bathymetric data taken prior to the breaching does not appear to be at a level of accuracy desirable for this purpose since various correction factors need to be applied. The base elevations established at each sediment pin prior to breaching have also proven inadequate for the very same reasons the Year 1 sediment pin measurements were deemed substandard: measurement inconsistencies (i.e., uneven ground surfaces from which to survey the pins, inconsistent measurement locations on the domed sediment pin caps, and different measurement vantage points depending on the height of the surveyor), the inherent level of accuracy of the survey equipment, and the pins themselves being installed in biased locations (i.e., locations where the ground was either depressed or softer). Consequently, there does not appear to be adequate pre-breach elevation data which can be used as a baseline for this project.

3.1.3 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). For the purposes of the levee breach monitoring, the 2007 aerial photographs were reviewed and erosion at each breach was compared with the 2006 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 2007 photographs and comparing them to the 2006 delineation. The results are shown in Figures 2, 11-15. In addition, to photographically illustrate how the breaches have performed and the effects of these breaches over time, Appendix B-4 provides photos from July 24, 2007 to show examples of scour occurring at the breaches and associated fringe marsh 16 months post-breach.

<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. In July 2007, total breach width was 122 feet. Therefore, approximately 12 feet of scour has occurred within the past year, and a total of 82 feet of levee scour has occurred since the breaching on March 7, 2006, according to GIS analysis. For comparison purposes, the actual field measurement of the breach width taken on July 18, 2007 was 123 feet, only a one-foot difference from the GIS measurement. For consistency across monitoring years, the GIS method will be used. The outboard marsh loss due to breaching activities was 0.02 acres, with subsequent scour of the outboard tidal channel resulting in 0.03 acres of marsh loss in 2006, with an additional 0.01 acres of scour occurring in 2007. Total outboard marsh loss and scour two years post-breach is approximately 0.06 acres (Figure 11).

<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 12 August 2006 was 22 feet. In July 2007, total breach width was 28 feet. Therefore, approximately 6 feet of scour has occurred within the past year. For comparison purposes, the actual field measurement of the breach width taken on July 18, 2007 was 27 feet, only a one-foot difference from the GIS measurement. Similar to last year, 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. The large amount of scour which is occurring in the outboard marsh, adjacent to this breach, has not yet resulted in significant widening of this breach. Future monitoring efforts will continue to document the rate of erosion at this breach. The outboard marsh loss due to breaching activities was 0.03 acres, with subsequent scour of the outboard tidal channel resulting in 0.02 acres of marsh loss in 2006, with an additional 0.01 acres of scour occurring in 2007. Total outboard marsh loss and scour two years post-breach is approximately 0.06 acres (Figure 12).

<u>Pond A20 - Breached on March 13, 2006.</u> The width of the erosion within the former levee footprint at the Pond A20 breach on August 12, 2006 was 76 feet. In July 2007, total breach width was 82 feet. Therefore, approximately 6 feet of scour has occurred within the past year, and a total of 42 feet of levee scour has occurred since the breaching on March 13, 2006. For comparison purposes, the actual field

measurement of the breach width taken on July 18, 2007 was 85 feet, only a three-foot difference from the GIS measurement. The outboard marsh loss due to breaching activities was 0.72 acres, with no scour of the outboard tidal channel in 2006, and 0.05 acres of subsequent scour occurring in 2007. Total outboard marsh loss and scour two years post-breach is approximately 0.77 acres (Figure13).

During construction of the Pond A20 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 2007 aerial photographs indicate that all of this footprint has now been scoured, and the side-cast materials have been actively redistributed (Figures 2 and 13). No excavated material remains on the marsh surface and the side-cast berms are no longer visible during a mid to high tide. No evidence of perennial peppergrass was observed adjacent to the Pond A20 tidal channel during field visits or on the 2007 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 at this location.

<u>Pond A21 East - Breached on March 29, 2006.</u> The width of the erosion within the former levee footprint at the Pond A21 East breach on August 12, 2006 was 32 feet. In July 2007, total breach width was 37 feet. Therefore, approximately 5 feet of scour has occurred within the past year. For comparison purposes, the actual field measurement of the breach width taken on July 18, 2007 was 37 feet, no difference from the GIS measurement. The outboard marsh loss due to breaching activities was 0.28 acres, with subsequent scour of the outboard tidal channel resulting in 0.05 acres of marsh loss in 2006, with an additional 0.06 acres of scour occurring in 2007. Total outboard marsh loss and scour two years post breach is approximately 0.39 acres (Figure 14).

<u>Pond A21 West - Breached on March 21, 2006.</u> The width of the erosion within the former levee footprint at the Pond A21 West breach on August 12, 2006 was 76 feet. In July 2007, total breach width was 79 feet. Therefore, approximately 3 feet of scour has occurred within the past year. For comparison purposes, the actual field measurement of the breach width taken on July 18, 2007 was 79 feet, no difference from the GIS measurement. The outboard marsh loss due to breaching activities was 0.11 acres, with subsequent scour of the outboard tidal channel resulting in 0.14 acres of marsh loss in 2006, with an additional 0.01 acres of scour occurring in 2007. Total outboard marsh loss and scour two years post breach is approximately 0.26 acres (Figure 15).

Continued widening of the five levee breaches was observed between 2006 and 2007 (Table 3-1). Marsh loss in 2007 associated with scour of the outboard tidal channels totaled 0.14 acres (Table 3-2). Total marsh loss to date at the five breaches, including marsh loss associated with construction impacts, totaled 1.54 acres (Table 3-2).

Table 3-1. Breach Widths (feet)

Breach	6 Months Post-Breach Widths (2006)*	Breach Widths in 2007	Breach Widening 2006-2007
A19 East	110	122	12
A19 West	22	28	6
A20	76	82	6
A21 East	32	37	5
A21 West	76	79	3

*number inclusive of constructed width and subsequent breach widening in 2006

Table 3-2. Marsh Loss from Scour of Outboard Channels (acres)

Breach	6 Months Post-Breach Marsh Scour (2006)*	Total Marsh Scour to Date	Incremental Marsh Scour 2006-2007
A19 East	0.05	0.06	0.01
A19 West	0.05	0.06	0.01
A20	0.72	0.77	0.05
A21 East	0.33	0.39	0.07
A21 West	0.25	0.26	0.02
Totals	**1.40**	**1.54**	**0.14**

*number inclusive of construction impacts and marsh scour in 2006

3.2 OFF-SITE MONITORING

3.2.1 Railroad Bridge Scour

The 2007 photographs were compared to each other and the November 29, 2006 photographs to document changes at each of the control point locations. The photographs from November 2006 and November 2007 are provided in Appendix B-1. The May, August and September 2007 photographs can be made available on request. In addition, measurements of scour were made at the accessible piles on the south bank, with visual estimates of scour size made at the piles on the north bank.

A comparison of photographs between November 21, 2007 and November 29, 2006 show that small scour holes around the piles have persisted. The scour continues to be more pronounced on the piles 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). On the north side of the bridge the scour hole has increased in size around the pile 1N-C, decreased in size around pile 1N-A (sediment has been deposited in the scour hollow since November 2006), and is a similar size around pile 1N-B (Table 3-3). The scour holes on the south side of the bridge have increased slightly in dimensions between November 2006 and November 2007 (Table 3-3). This is particularly the case around the pile 1S-C where the scour now circles the entire pile.

Table 3-3. Comparison of railroad pier scour dimensions in 2006 and 2007 (measured on south bank, visual estimate on north bank)

Pile	November 2006 (ft)			November 2007 (ft)		
	E-W Length	N-S Width	Depth	E-W Length	N-S Width	Depth
1S-A	2	1	0.3	3.5	1	0.5
1S-B	2.5	1	0.3	3	1	0.5
1S-C	2.5	0.5	0.3	2.5	2	0.5
1N-A	2.5	0.7	0.5	1	1	0.5
1N-B	3	1.5	0.7	3	1.5	0.8
1N-C	2.5	1	0.7	4	2.5	1

There are no structural criteria to assess the significance of observed scour relative to pile function. However, the amount of scour at the base of all the piles is less than one foot deep and probably within the design allowance.

3.2.2 Fringe Marsh Scour in Coyote Creek/Scour of Levees Opposite the Breaches

Fringe marsh scour (Figures 2, 11-15) is more evident this year when compared to the previous year. Total marsh loss was calculated at 1.14 acres, and scour is noticeable on both the north and south banks of Coyote Creek (Figure 2 and Appendix B-4). The south bank was calculated as having 0.72 acres of scour in contrast to 0.42 acres of calculated scour on the north bank. Scour along the south bank has occurred more consistently than the patchier patterns of scour mapped along the north bank.

The breaches appear to be having no localized effect on the levees opposite the island ponds. The outboard marshes provide a buffer from any scour that could potentially undermine these existing levees. Future monitoring events will continue to document the progression of sediment dynamics over time.

3.2.3 Rail Levee Erosion

The May 18, 2007 field inspection revealed no apparent signs of rail levee erosion or erosion of the adjacent Pond A20 levee. However, there was evidence of erosion occurring on the adjacent Pond A21 levee. During the site visit, it was apparent that wave action and/or high water conditions had deposited a line of debris on top of the Pond A21 levee located at the southeast corner of the pond. In addition, there were similar piles of debris located outside of the pond, within the marsh area located between the Pond A21 levee and the rail levee. While there was no evidence of scour or erosion of the rail levee, the debris evidence indicates that water may be overtopping the Pond A21 salt pond levee.

In an attempt to verify whether or not the Pond A21 levee was being overtopped during a high tide event, District staff planned a site visit during an extremely high tide in the Fall on October 26, 2007 (10.7 ft predicted tide height at the Alviso Slough/Coyote Creek tide gage). Since this high tide occurred in the afternoon hours, District staff anticipated normal southerly winds to occur which would help verify whether or not the combination of windy conditions, wave action and high tides cause the water in the pond to overtop the levee. Unfortunately, the site visit occurred on a rare windless day in the South Bay and the only information gathered was that a high tide in and of itself (i.e., without wind or wave action) did not overtop the levee, in fact, there was at least one and half feet of freeboard remaining. Appendix B-2 provides a comparison of the 2006 and the 2007 photographs of the rail levee.

3.2.4 Accelerated Deterioration of the Town of Drawbridge

As mentioned above in Section 3.2.3, on May 18, 2007, it was observed that erosion had occurred on the southeast levee of Pond A21 (Appendix B-3). Wave action during high tide is the most likely culprit as this condition has deposited a line of debris atop the southeast corner of the Pond A21 levee. This eroding levee is adjacent to the Town of Drawbridge. However, since the erosion is minimal at this time, no structures appear to be in imminent danger.

The 2006 monitoring revealed one particular area of concern with regard to levee erosion. This eroded section is in the south-southeast corner of Pond A21, approximately 100 feet from two existing Town of Drawbridge structures and approximately 70 feet from the remnants of a previously collapsed structure. We have continued to monitor and photo-document this location. Based on a comparison of the 2006 and 2007 photographs, there are new signs that additional erosion has occurred at this previously stable location (Appendix B-3). While the erosion appears to have increased in size, the levee is still a barrier between the pond and the outboard marsh. At this time, it appears that there is no evident deterioration of any structures due to the breaching of the salt ponds. Measurement stakes will be installed in 2008 in this location to better track the progress of the erosion. A comparison of the 2006 and 2007 photographs are included in Appendix B-3.

4.0 DISCUSSION (DISTRICT ACTIVITIES)

4.1 LESSONS LEARNED

4.1.1 Activities on Target

Both Year 1 and Year 2 tidal inundation regime monitoring indicates that full tidal exchange is taking place during high tides in all three ponds. Ebb tide drainage is impeded in all three ponds however, these low tide water levels are below the anticipated vegetation root zone elevation and are therefore unlikely to impede marsh plant colonization within the ponds.

HTH and PWA (2005) predicted an accretion rate of 0.2 feet per year for all three ponds. The majority of the monitoring stations (> 50%) are showing sediment accretion greater than the predicted rates indicating that currently the ponds are exceeding their performance criteria for sedimentation.

Aerial photographs show that all of the outboard tidal channels have continued to widen since breaching. Levee breach widths have also widened, with marked variability in the amount of scour between individual breaches. Of the five breaches, both breaches at Pond A19 have shown the least amount of outboard marsh scour in the past year, while the breach at A19East has displayed the largest amount of breach widening in the past year. In contrast, both breaches at Pond A21 have shown the least amount of breach widening in the past year, while Pond A21East has shown the largest amount of outboard marsh scour. Pond A19 and Pond A21, where two breaches were constructed, continue to have one breach significantly wider than the other. With such a large dissimilarity in the current breach sizes, water exchange through the smaller breaches (A19W and A21E) appears to be compromised. Future monitoring will continue to reveal how the different breaches respond and if these results persist to be a consistent pattern. It should be noted however, that despite this discrepancy in breach widening, tidal circulation in these ponds has not been compromised (see Section 3.1.1).

In addition, no scour has been detected along the rail levee or along the levees opposite the breaches (Ponds A18, A17, and A15 levees).

4.1.2 Problems Encountered

There were minimal problems encountered with the pond water level sensors. No vandalism occurred at the Pond A19 sensor potentially due to the relocation of the sensor. A small gap in the data for the one of the A19 sensors was due to technical difficulties in the downloading process and limited access to the site due to low tides. Since redundant sensors were installed at this site, no data was lost.

There were no problems encountered with the field logistics of the sedimentation pin measurements in Year 2. 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. When this occurs, sediment depths can be taken either by boat at higher tides, or by developing a photogrammetry model similar to the one utilized during this monitoring year. Both of these methods will show marked reduction in the level of accuracy, not only due to water obscuring the view of the sediment, but due to a variety of reasons detailed in Section 3.1.2. Next year, however, sediment accretion will be sampled using the "Depth Probe" method as described in Section 2.1.2

For future monitoring years we recognize that there are limitations to using aerial photographs for measuring the widths of the levee breaches. Given that these photographs are two-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. Similar to this year's monitoring activities, we plan to continue using the aerial photographs to measure erosion of the tidal channels and levee breaches, and supplement this information with field verification of the breach widths.

The flight line for the 2007 aerial photographs was off by a small margin and therefore the south bank of Coyote Creek near the railway was omitted from the photographs. The two monitoring tasks (fringe marsh scour in Coyote Creek and scour of levees opposite the breaches) which relied on these aerials needed to be supplemented with other available photography that, unfortunately, was not at the same resolution. For 2008 and beyond, the flight line will be corrected to avoid this problem and capture the entire site as specified in section 2.1.4.

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. In addition, we do not know the extent of the scour on the piers in the center of the channel. Seasonal photographic monitoring will continue through Year 5 to see if the scour continues to advance over time. In addition, we recommend that a meeting with railroad staff be scheduled to discuss whether or not there is a need for subtidal data collection.

The fringe marsh on both sides of Coyote Creek is beginning to show signs of scour (1.14 acres in 2007). We will continue to monitor this phenomenon using the annual aerial photographs and report any increase or decrease in fringe marsh size in the annual report.

There is evidence of erosion occurring on the southeast levee of Pond A21 near the Town of Drawbridge (Appendix B-3). Wave action during high tides is the most likely culprit as this condition has deposited a line of debris on top of the southeast corner of the Pond A21 levee. For future monitoring, we plan to install measurement stakes in this location to better track the erosion which is occurring.

4.2 ADAPTIVE MANAGEMENT RECOMENDATIONS

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

- The RMMP states that tidal inundation monitoring can cease once two monitoring cycles indicate full tidal exchange. Since both the 2006 and 2007 monitoring have shown that full tidal exchange is occurring, no inundation monitoring will be performed in Year 3 (2008).

- Since there does not appear to be adequate pre-breach elevation data which can be used as a baseline and the accuracy of the Photogrammetrist's 2007 model was inadequate for annual based sediment estimations and comparisons, we recommend continued use of the "Depth Probe" method to measure sediment accretion in the ponds. When sediment depths become such that walking is unsafe in the ponds, then we shall re-visit other available methodologies.
- The rail bridge scour photographs document only the piles located at the highest intertidal edges of Coyote Creek. Since the largest increase in tidal velocity, due to an increase in upstream tidal prism, would likely take place through the deepest part of the channel, the current method of collecting photographs above the waterline is inadequate to assess the condition of the subtidal piles. Therefore, we recommend that a meeting with railroad staff be scheduled to discuss whether or not there is a need for subtidal data collection. If it is determined that additional data is necessary, a subsequent meeting will be scheduled between the District and Refuge staff to determine appropriate actions and responsibilities.
- Year 2 inspections indicate that an erosion scour in the south-southeast corner of the Pond A21 levee is advancing. We recommend installation of measurement devices in this location to more accurately characterize and track the erosion. This should include collecting top of levee elevations and installation of measurement stakes so that future measurements can be easily repeated for comparison purposes. In addition, a meeting between District and Refuge staff should be scheduled to discuss the current threats to the Town of Drawbridge and possible future actions.

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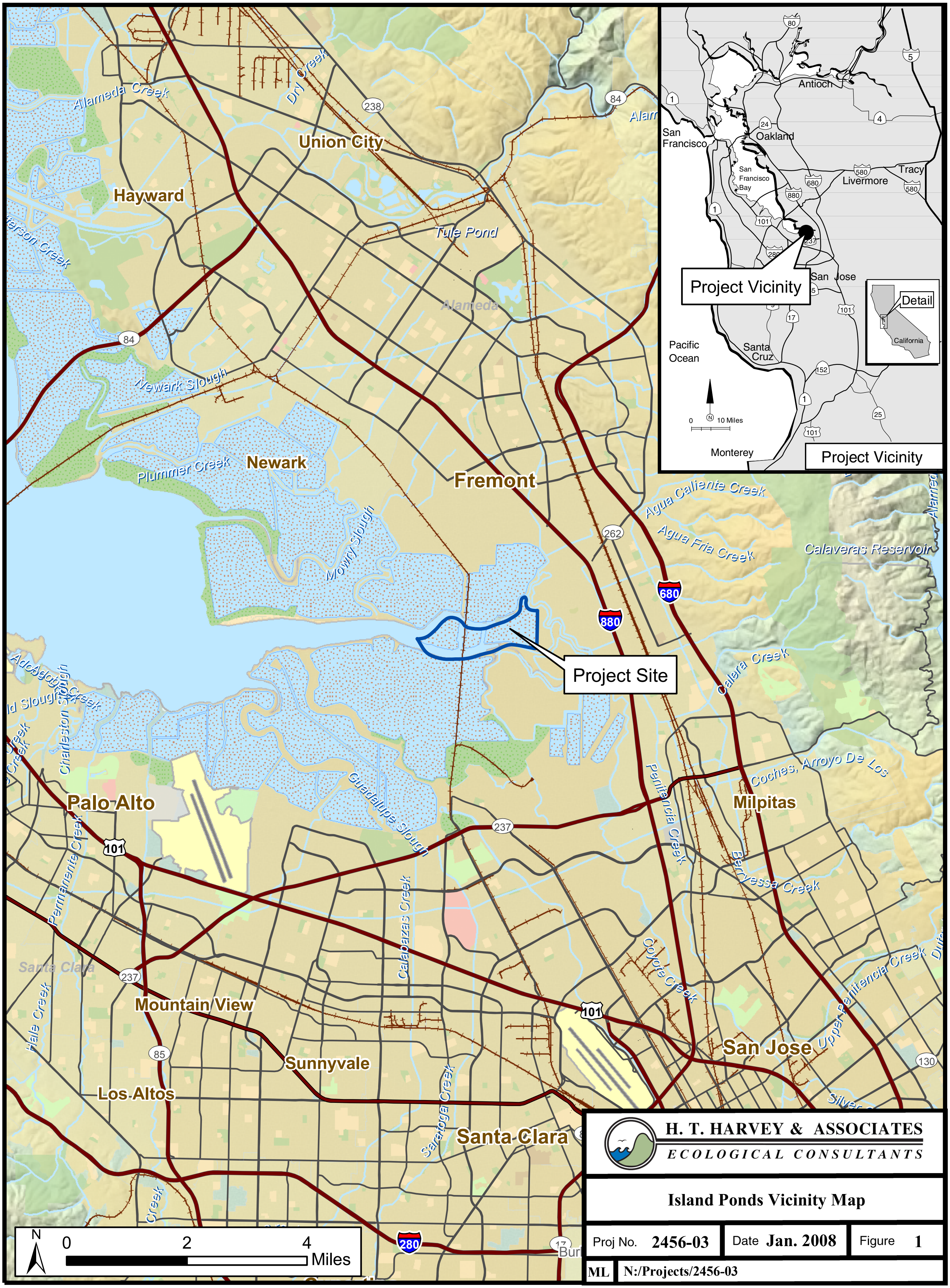
7.0 FIGURES



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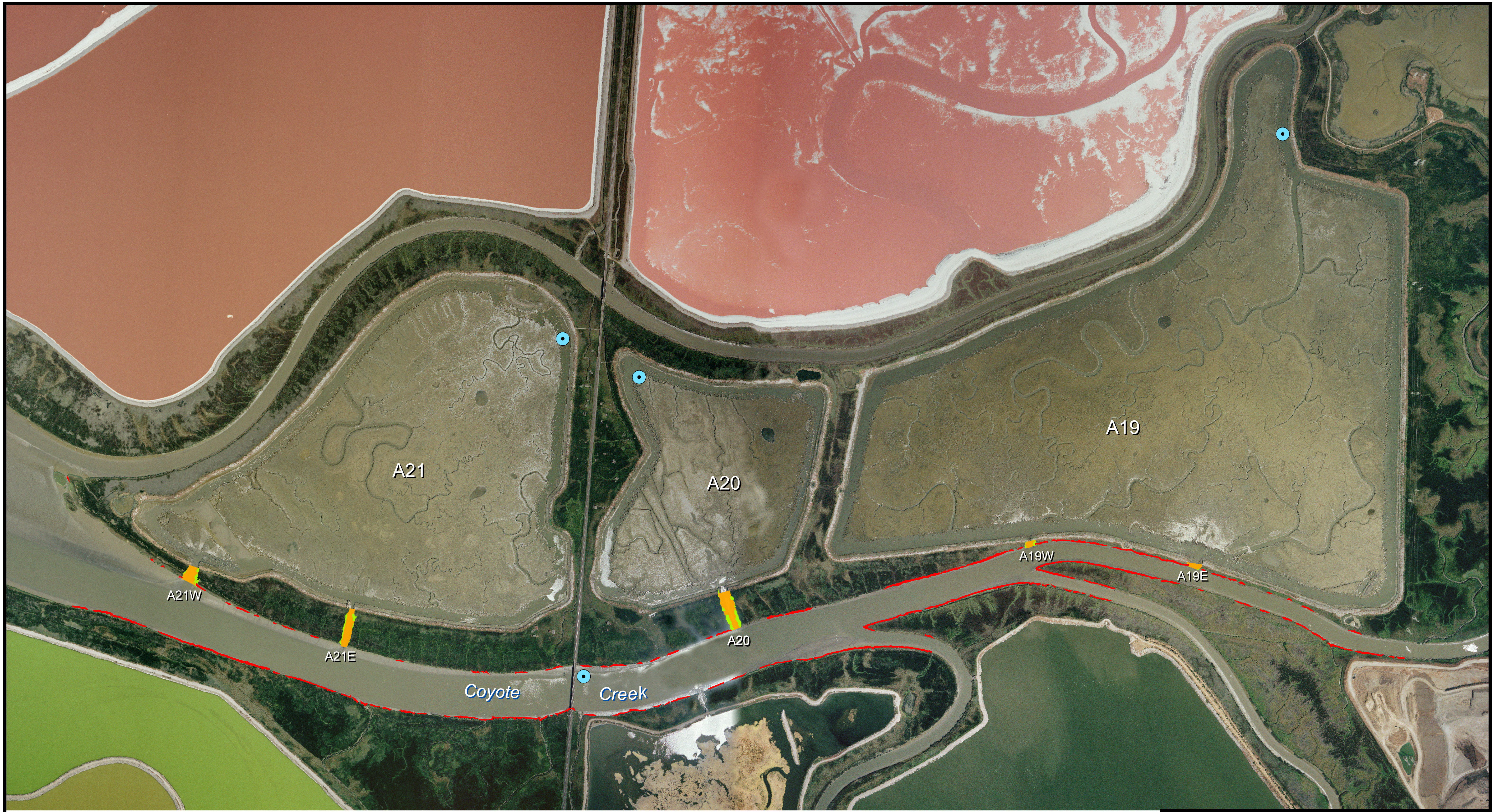
Island Ponds Vicinity Map

Proj No.	2456-03	Date	Jan. 2008	Figure	1
ML	N:/Projects/2456-03				



Legend

- Water Level Stations
- Breach Scour 2006
- Breach Scour 2007
- Fringe Marsh Loss 2006-2007 (1.13 ac)

Breach Name	Breach Widths (2007)	Total Breach Scour to Date
A21W	79 ft	0.26 ac
A21E	37 ft	0.39 ac
A20	82 ft	0.77 ac
A19W	28 ft	0.06 ac
A19E	122 ft	0.06 ac

N

0 750 1,500 Feet

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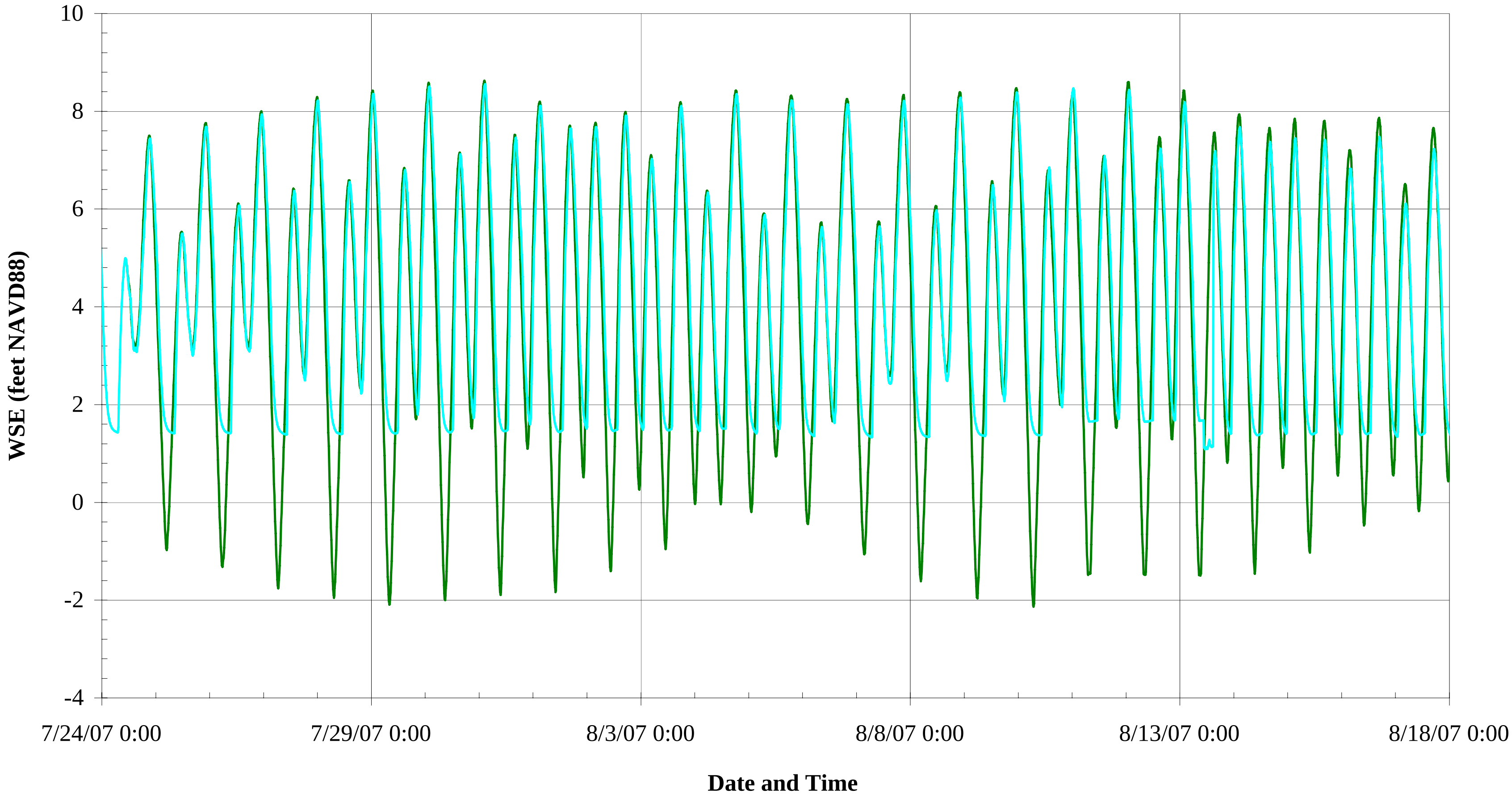
Island Pond Breach / Fringe Marsh Scour & Location of Water Level Sensors

Proj No. 2456-03 | Date Jan. 2008 | Figure 2

ML | N:\Projects\2456-03



Source: PWA Field Services, HTH Consultants

Coyote Creek — A19

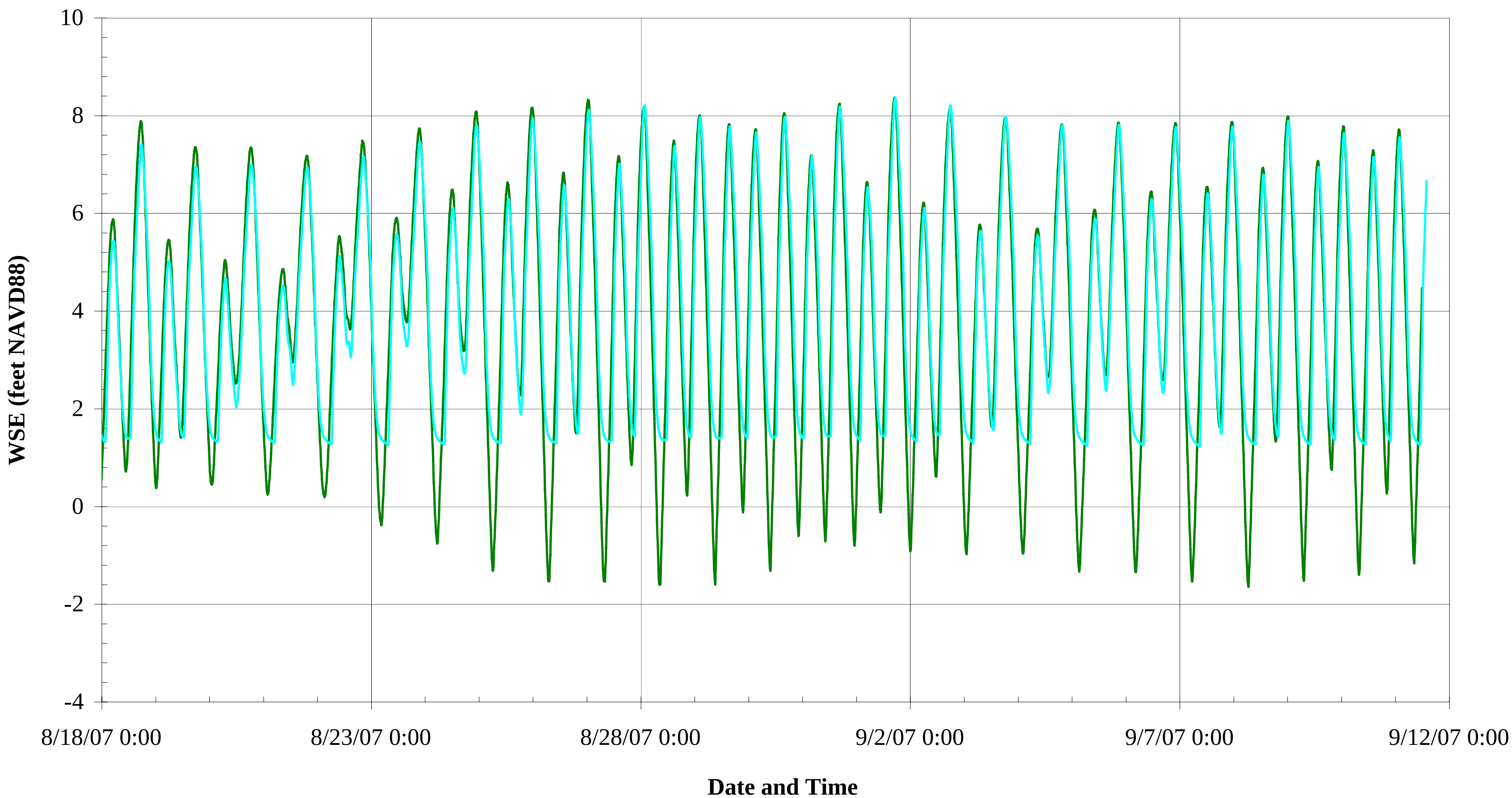
figure 3A

Tidal Comparison Between Coyote Creek and Pond A19

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01

PWA



Source: PWA Field Services, HTH Consultants

Coyote Creek — A19

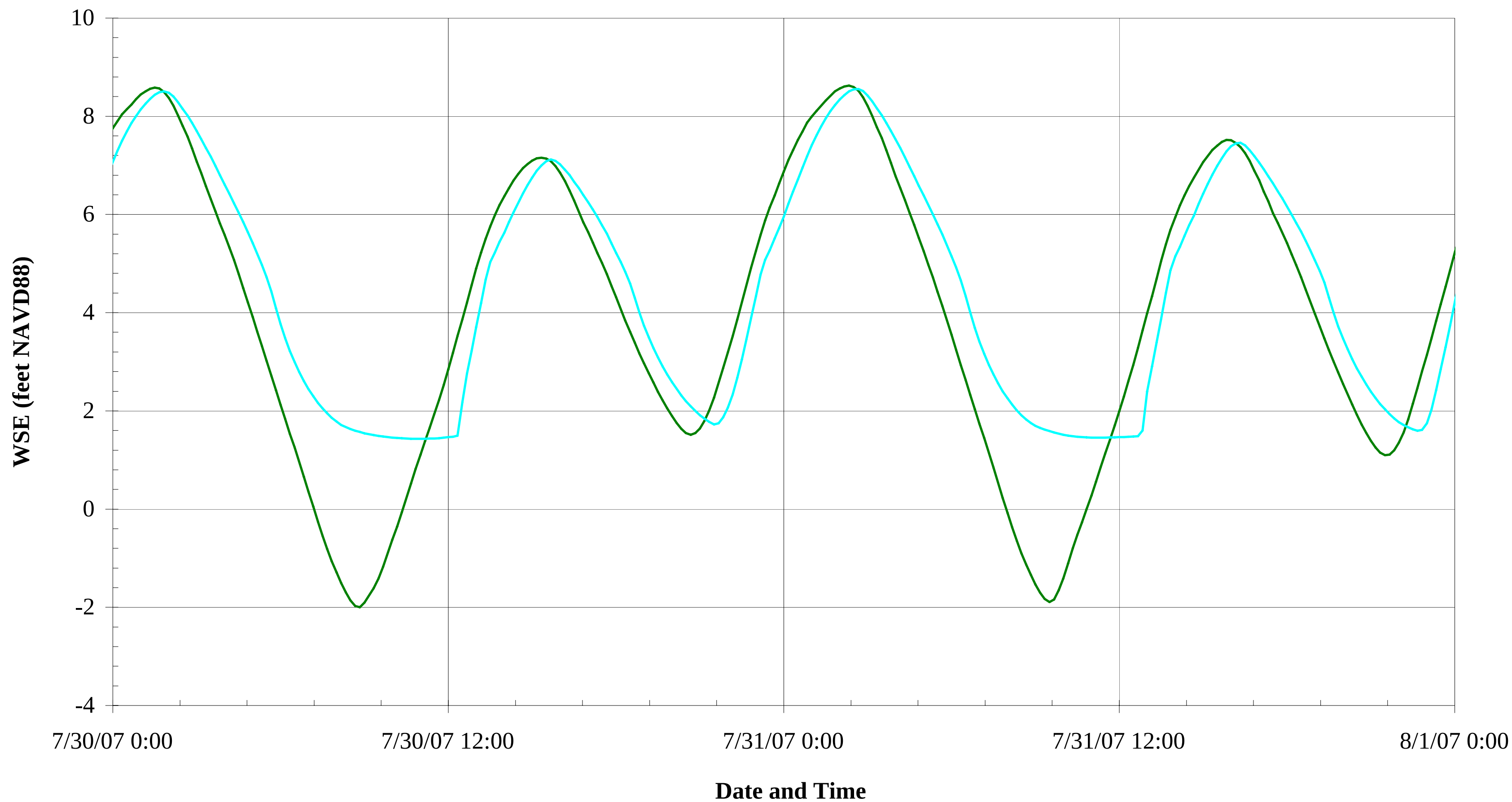
figure 3B

Tidal Comparison Between Coyote Creek and Pond A19

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01

PWA



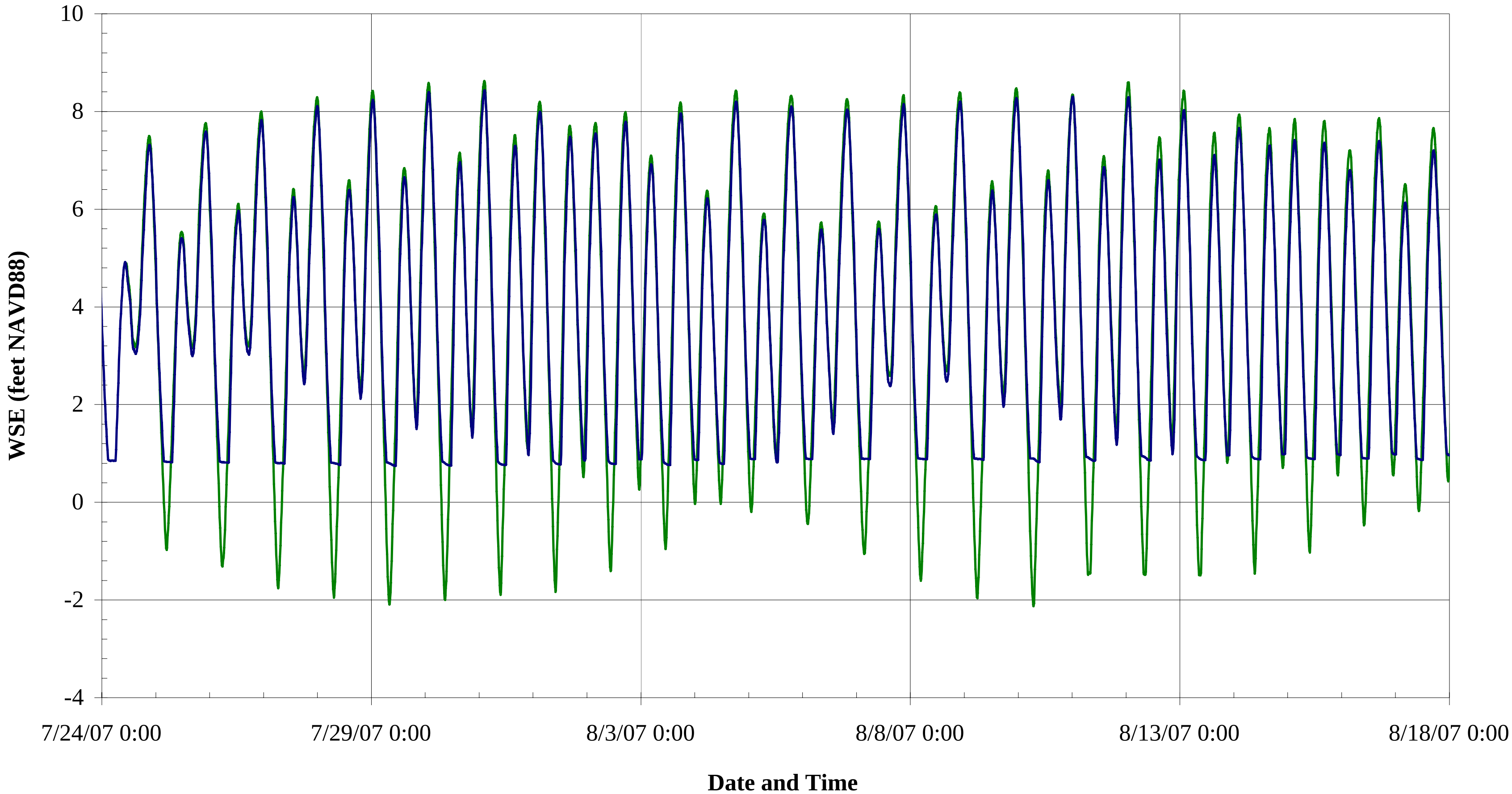
Source: PWA Field Services, HTH Consultants

figure 3C

Tidal Comparison Between Coyote Creek and Pond A19

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01



Source: PWA Field Services, HTH Consultants

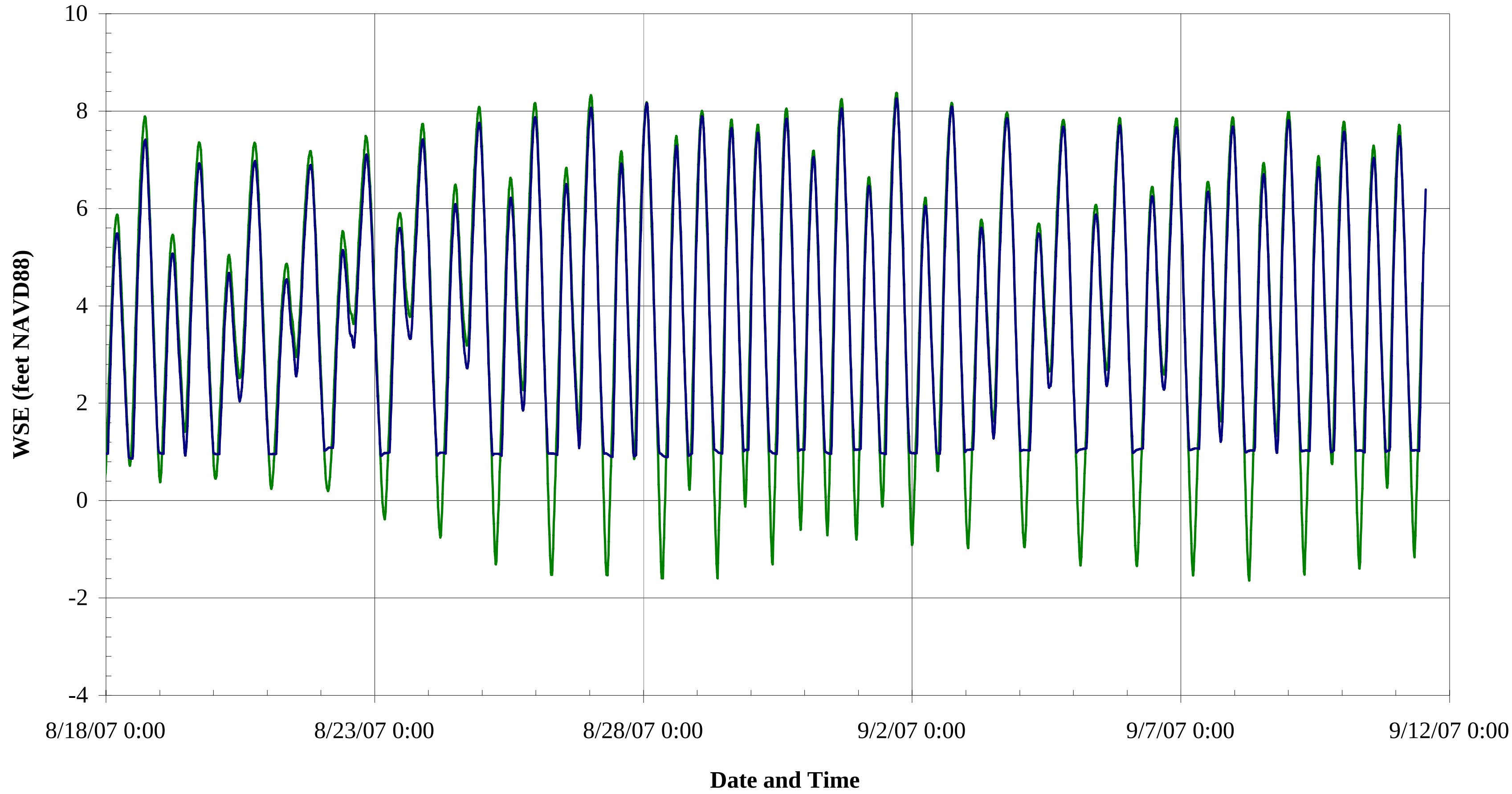
figure 4A

Tidal Comparison Between Coyote Creek and Pond A20

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01

PWA



Source: PWA Field Services, HTH Consultants

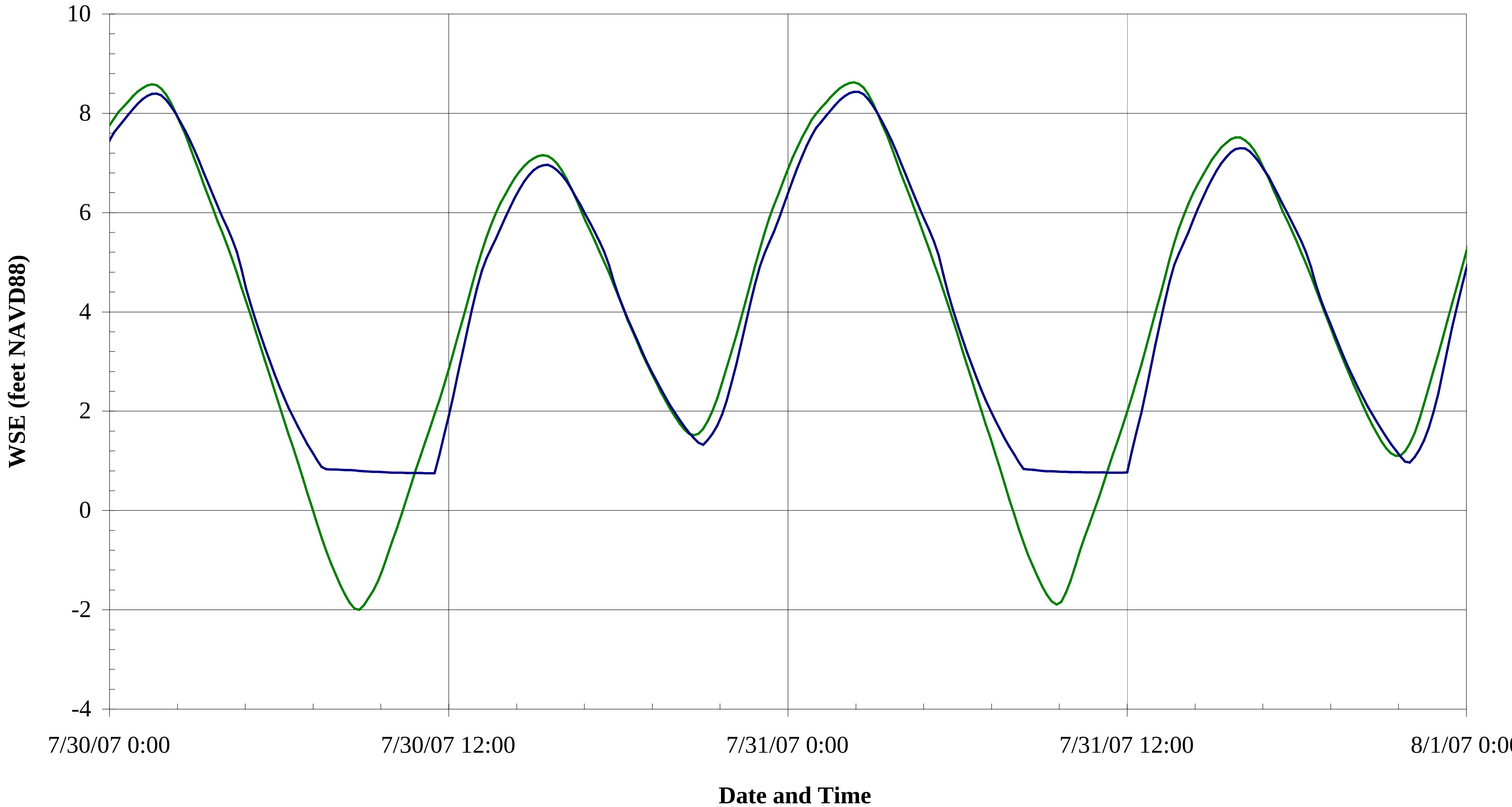
Coyote Creek — A20

figure 4B

Tidal Comparison Between Coyote Creek and Pond A20

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01



Source: PWA Field Services, HTH Consultants

Coyote Creek — A20

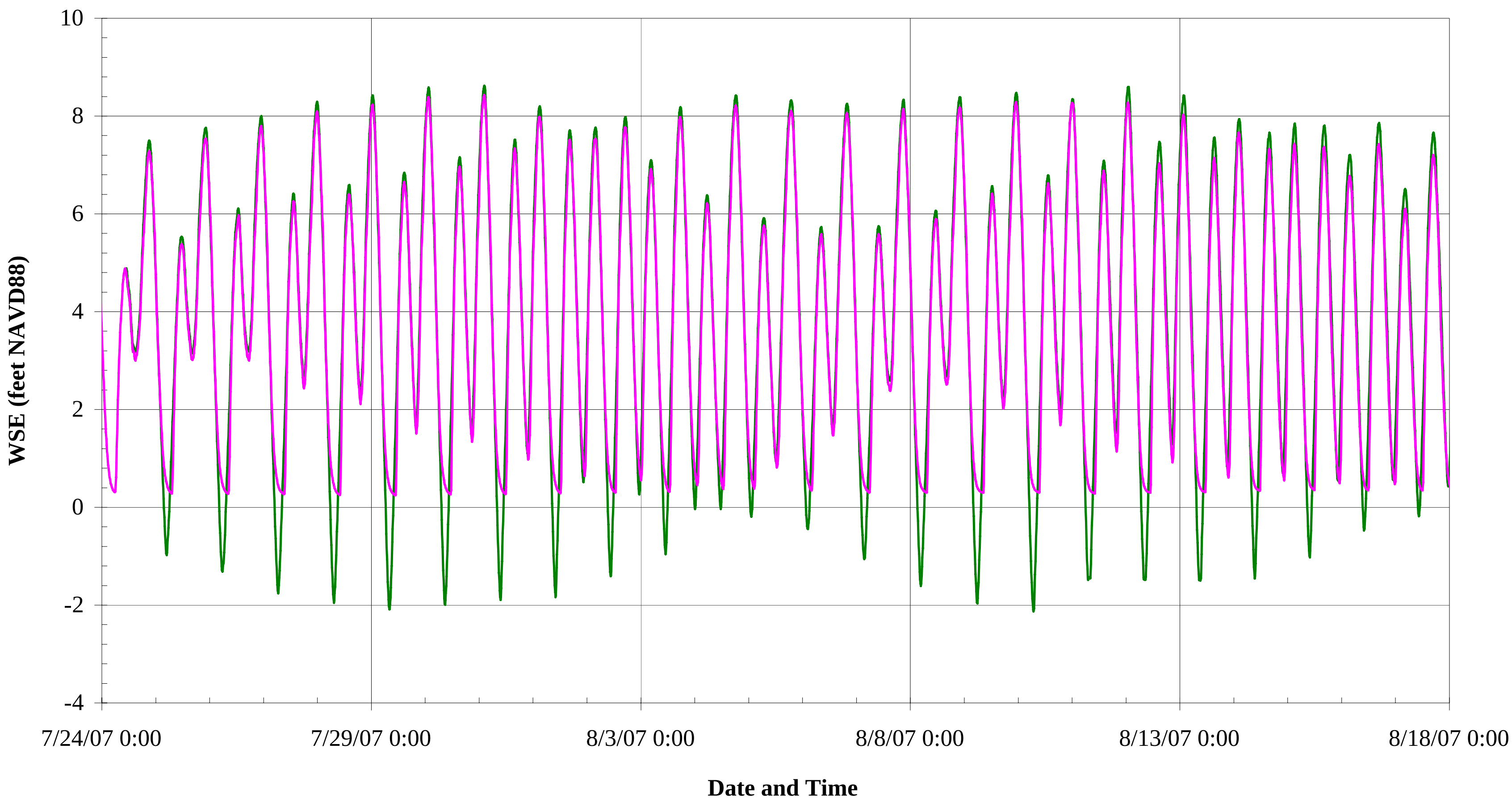
figure 4C

Tidal Comparison Between Coyote Creek and Pond A20

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01

PWA



Source: PWA Field Services, HTH Consultants

Coyote Creek A21

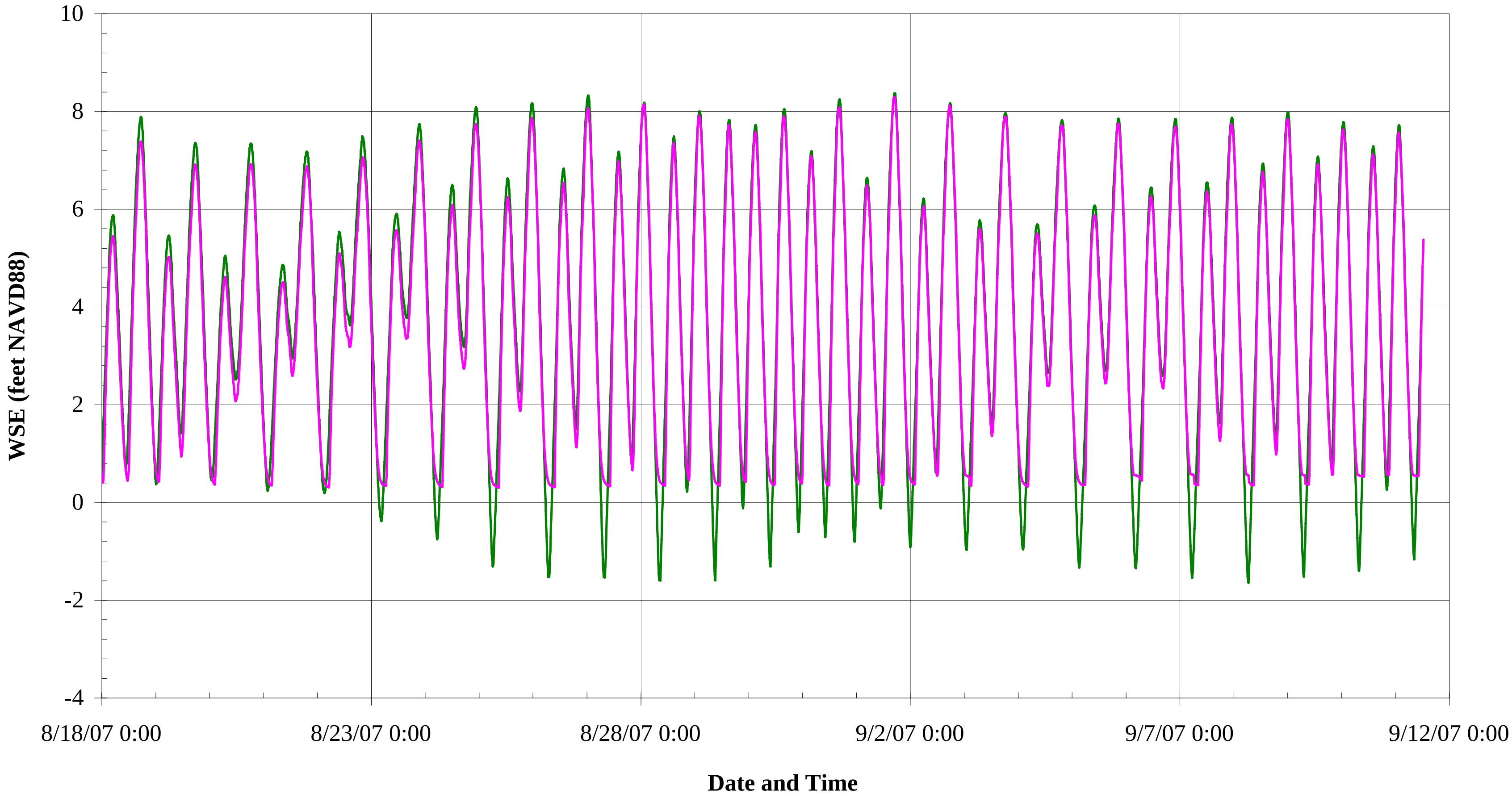
figure 5A

Tidal Comparison Between Coyote Creek and Pond A21

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01

PWA



Source: PWA Field Services, HTH Consultants

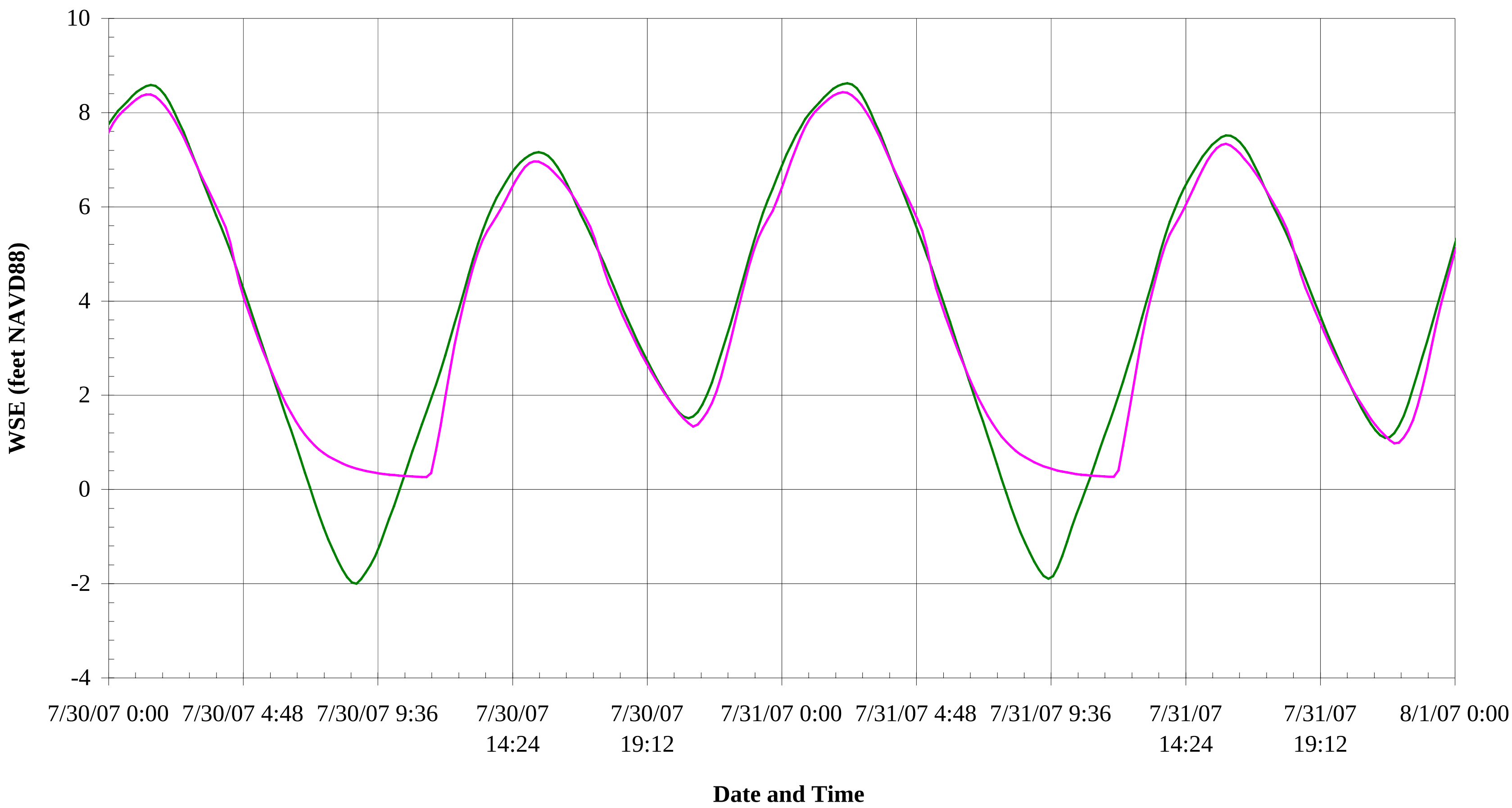
Coyote Creek — A21

figure 5B

Tidal Comparison Between Coyote Creek and Pond A21

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01



Source: PWA Field Services, HTH Consultants

Coyote Creek A21

figure 5C

Tidal Comparison Between Coyote Creek and Pond A21

Island Ponds Mitigation Monitoring

PWA Ref# 1864.01

PWA

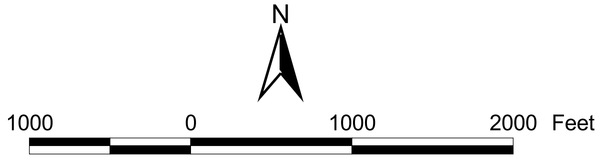
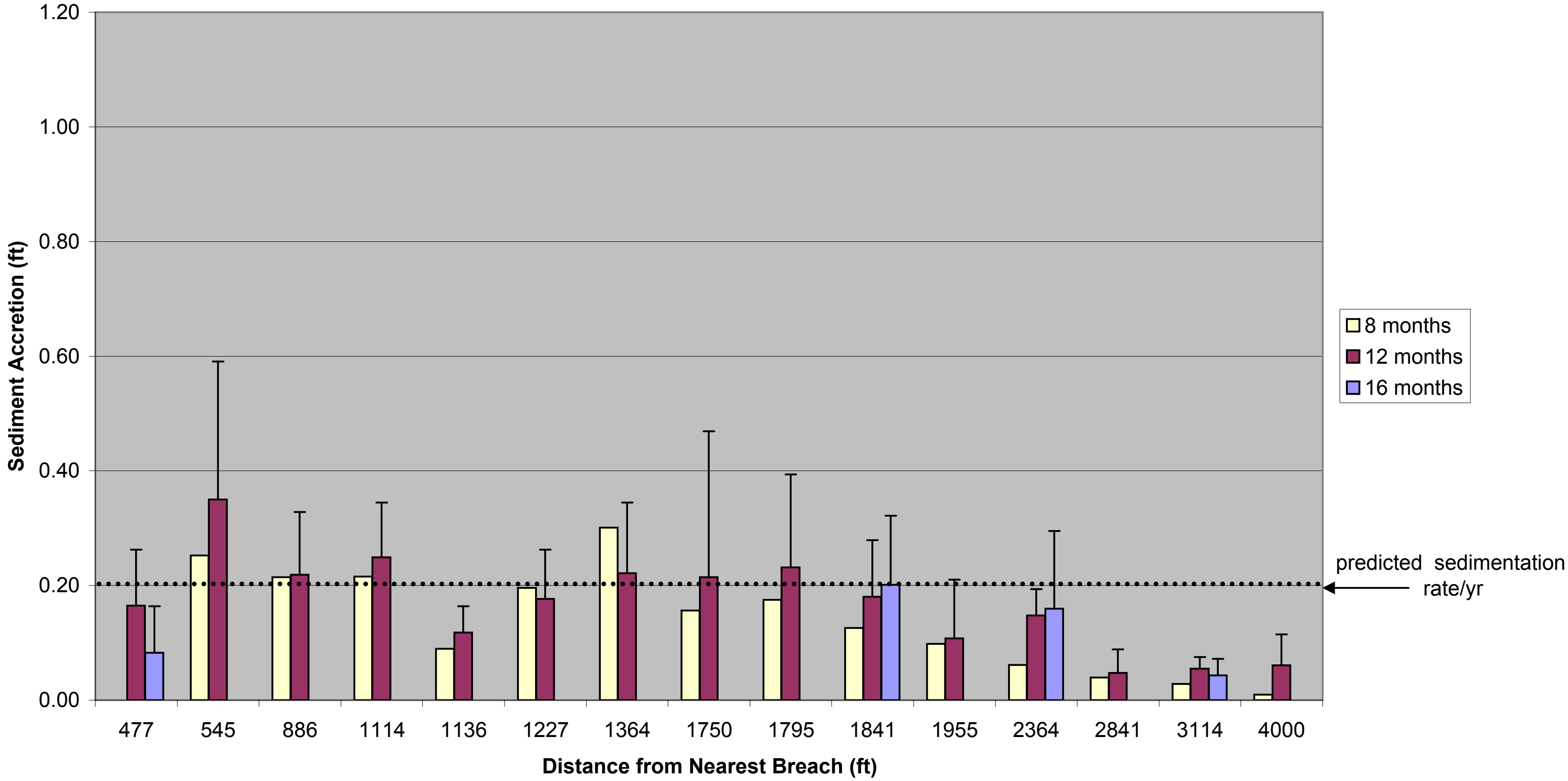


Figure 6. Island Ponds Sedimentation Data
Average Sediment Depths 8, 12 and 16 Months Post-Breach

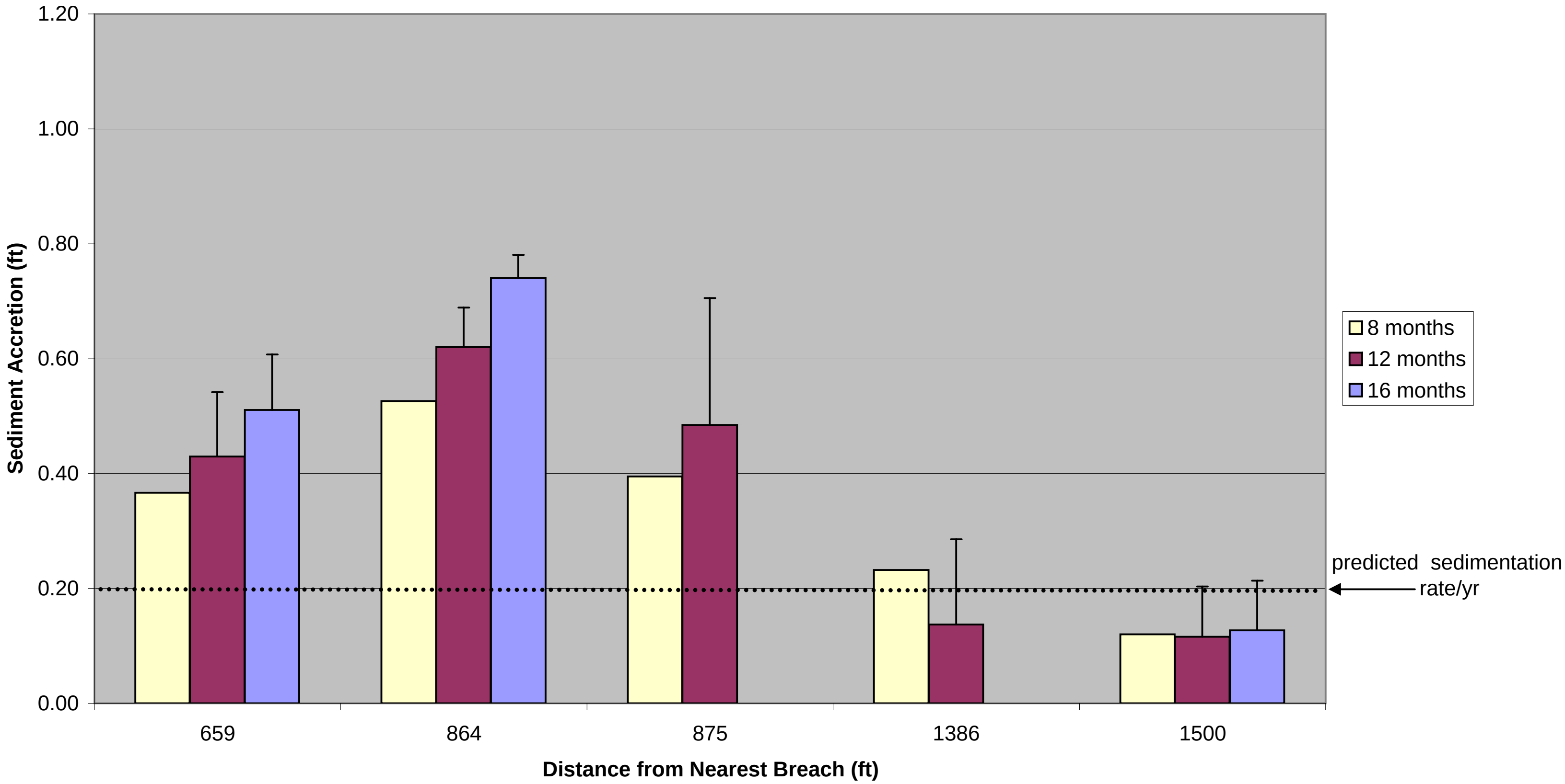
Santa Clara Valley Water District

Figure 7 - Pond A19 Sediment Accretion 8, 12 & 16 Months Post-Breach Based on Depth Probe Data



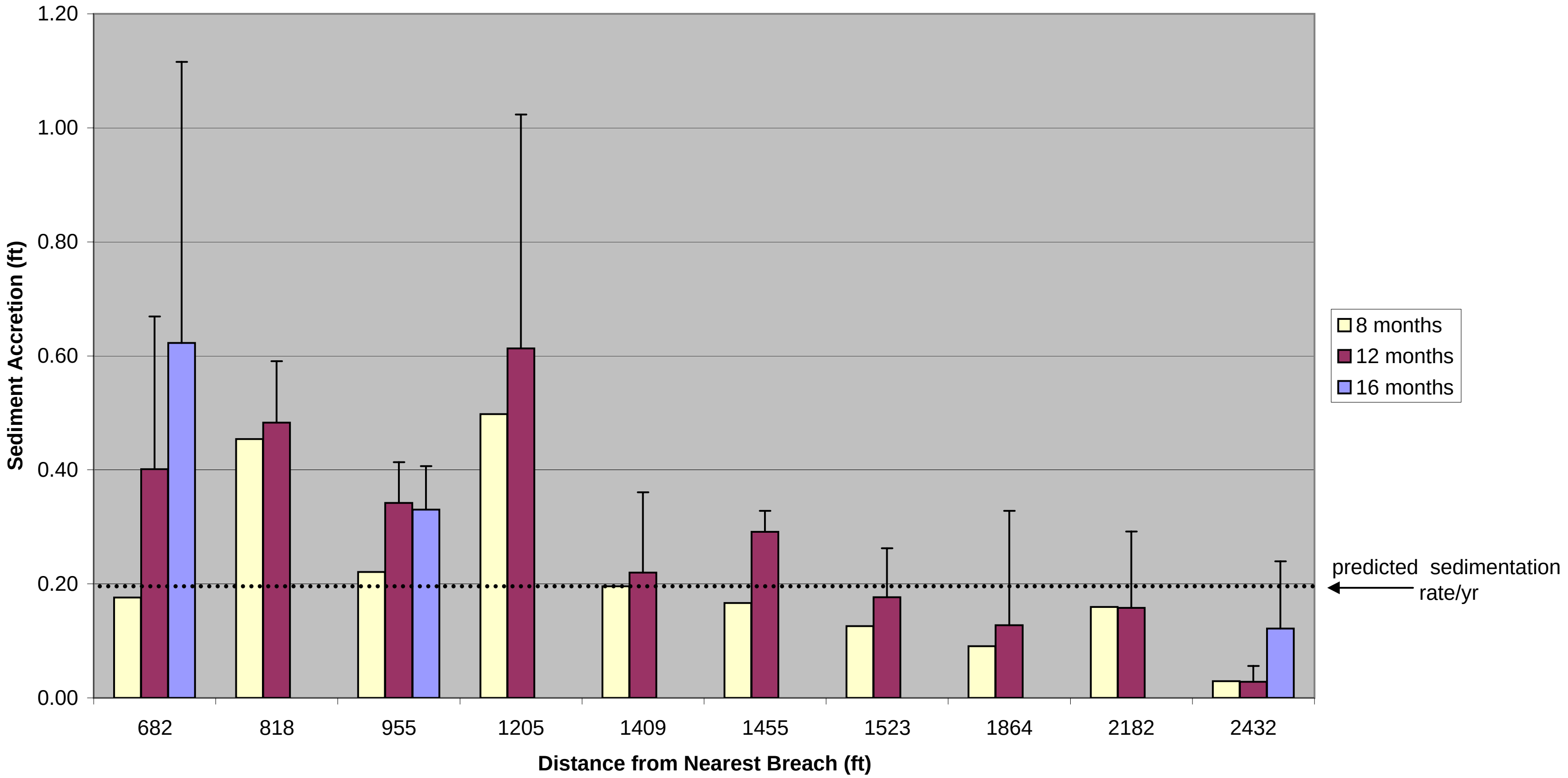
Note:
8 month data is an average of 3 depth probes.
12 and 16 month data is an average of 8 depth probes.
Error bars represent the maximum values recorded at the 12 and 16 month measurements.

Figure 8 - Pond A20 Sediment Accretion 8, 12 & 16 Months Post-Breach Based on Depth Probe Data

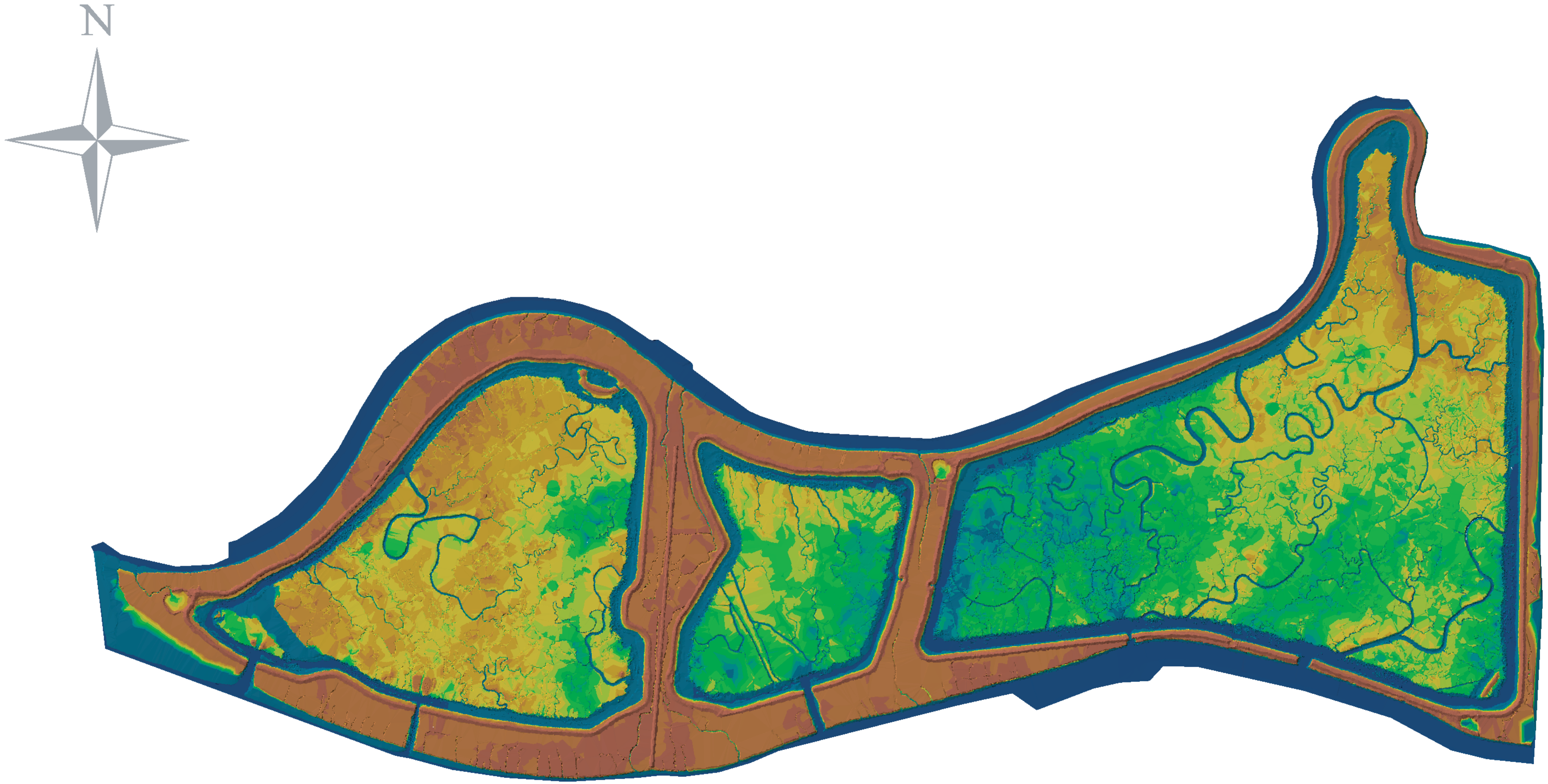


Note:
8 month data is an average of 3 depth probes.
12 and 16 month data is an average of 8 depth probes.
Error bars represent the maximum values recorded at the 12 and 16 month measurements.

Figure 9 - Pond A21 Sediment Accretion 8, 12 & 16 Months Post-Breach
Based on Depth Probe Data



Note:
8 month data is an average of 3 depth probes.
12 and 16 month data is an average of 8 depth probes.
Error bars represent the maximum values recorded at the 12 and 16 month measurements.



Elevation Range

8.004 - 14.415	4.75 - 5
6 - 8	4.5 - 4.75
5.75 - 6	4.251 - 4.5
5.5 - 5.75	4.001 - 4.25
5.251 - 5.5	0.007 - 4
5 - 5.25	-1.285 - 0

Data is based on the Photogrammetry model

1,750 875 0 1,750 Feet

Figure provided by the Santa Clara Valley Water District

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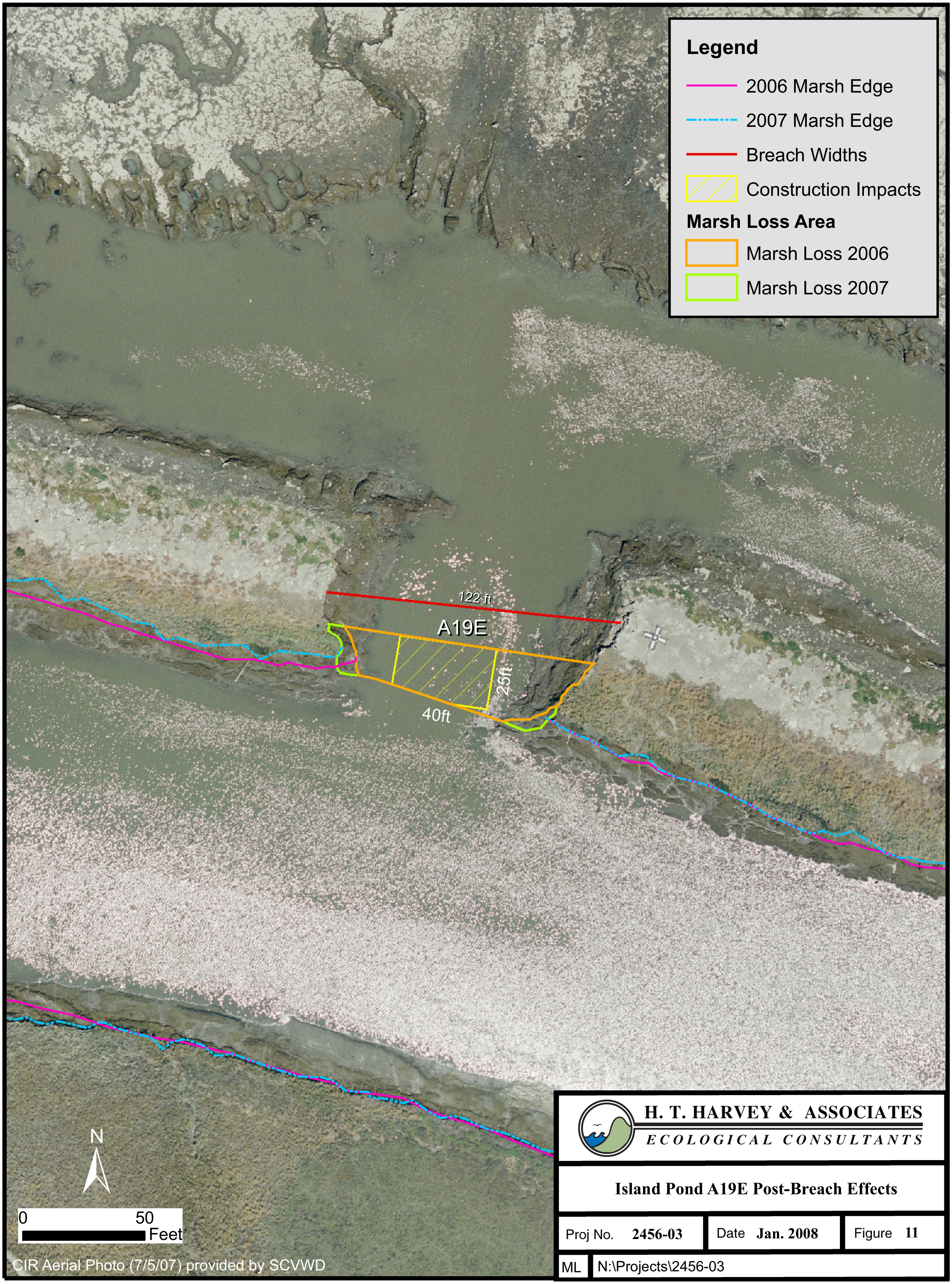
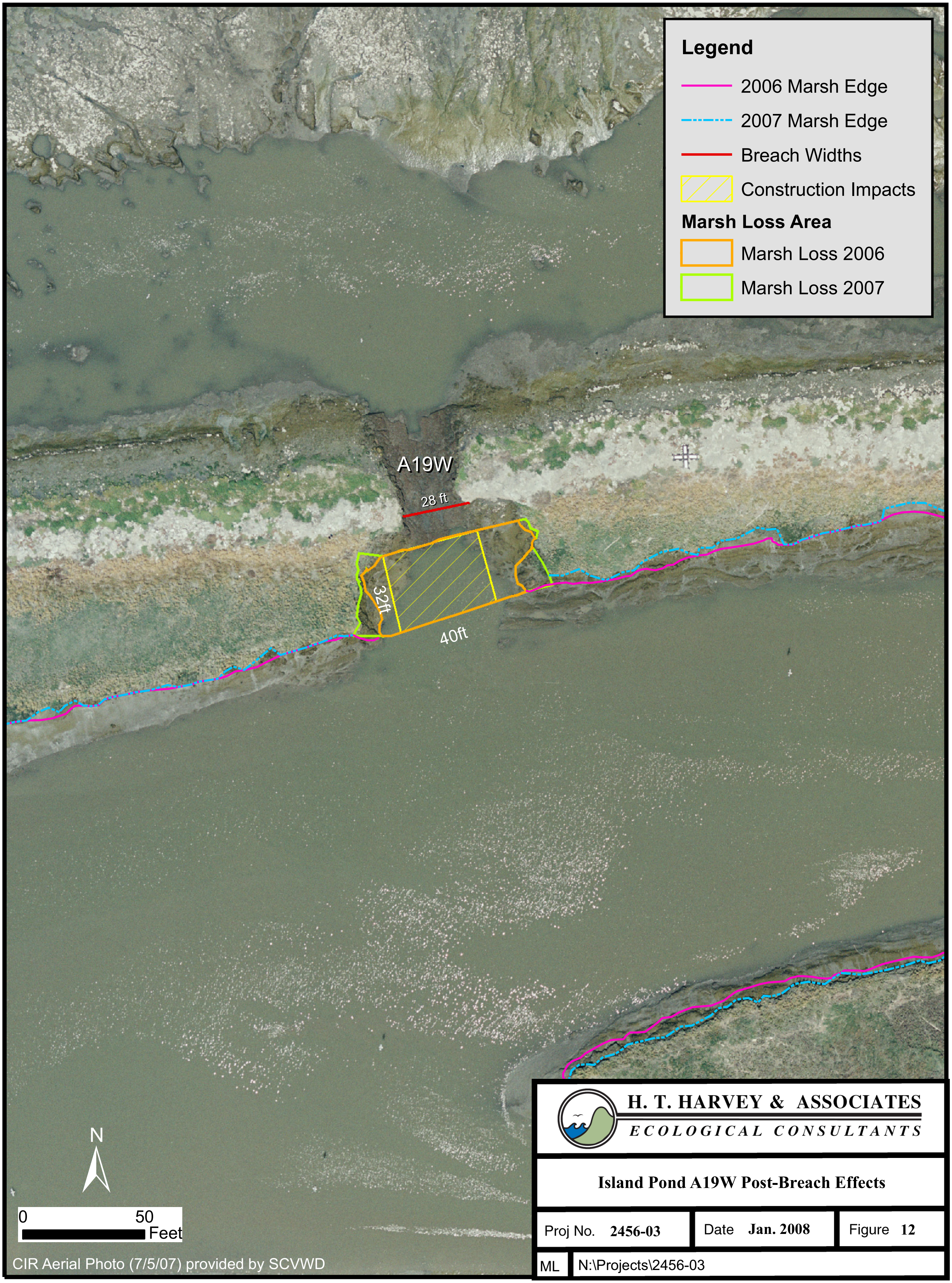
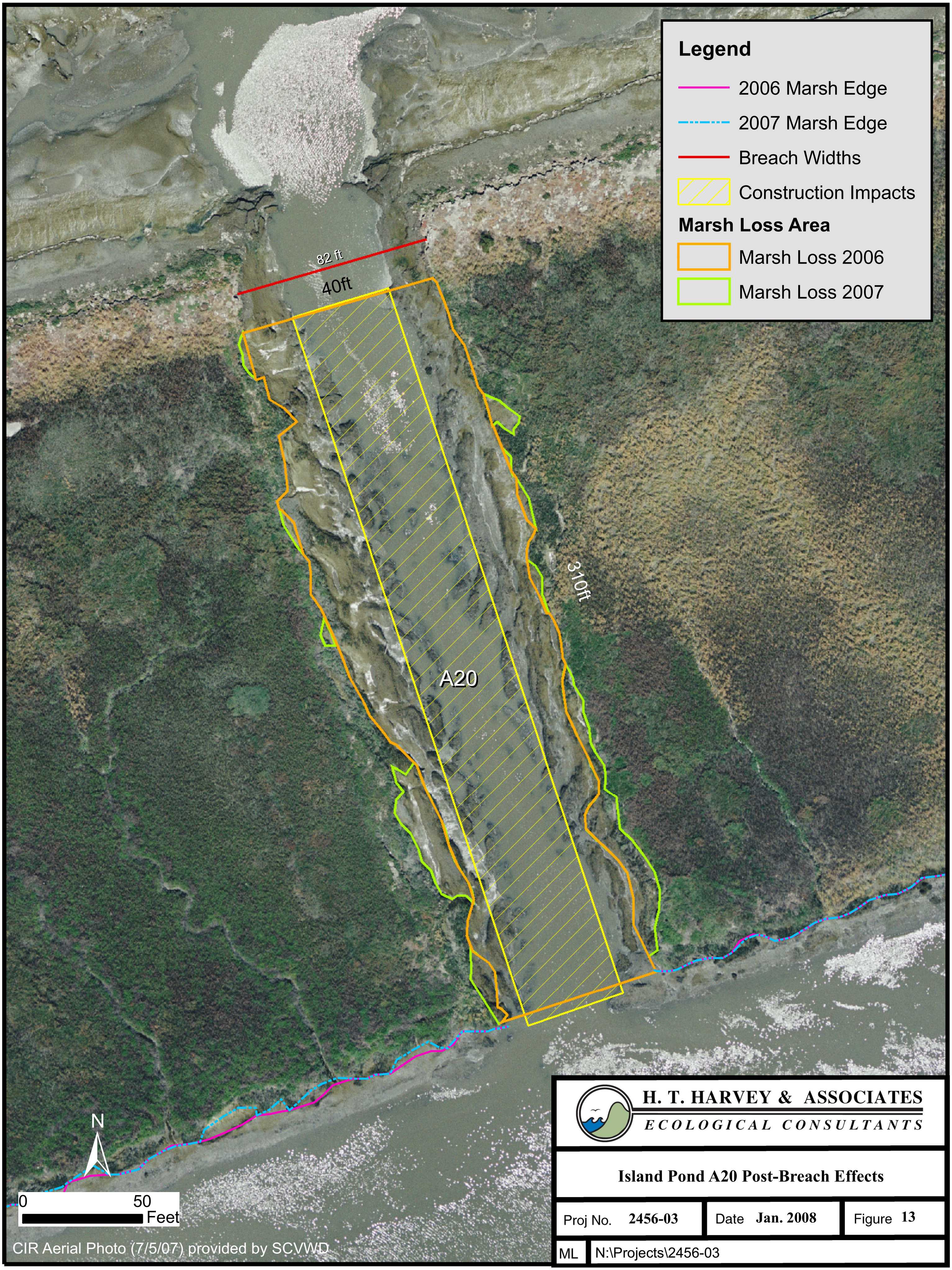
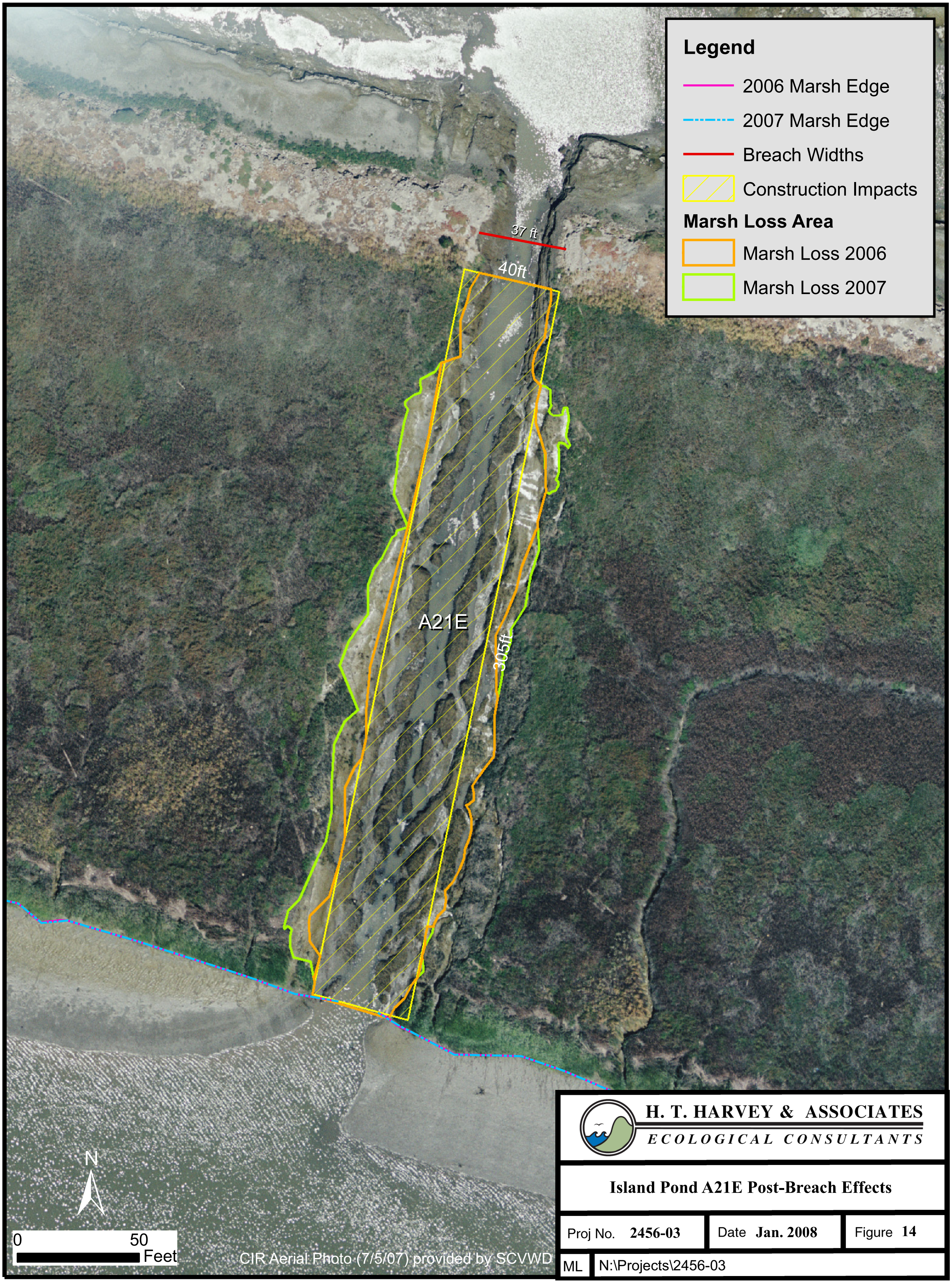
July 2007 Elevations at the Island Ponds

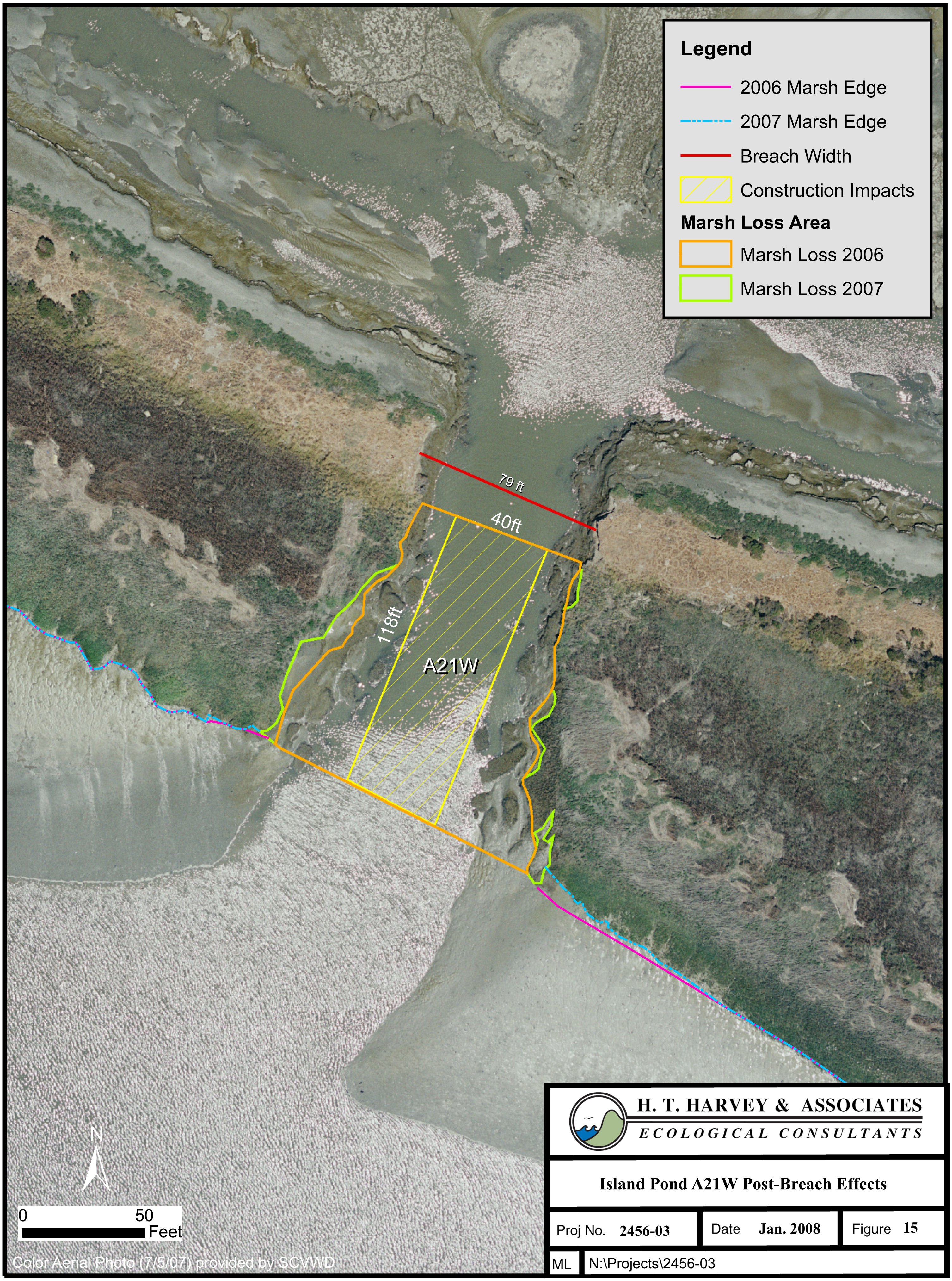
Proj No. 2456-03	Date Jan. 2008	Figure 10
ML	G:\Active Projects\2456, Marsh Development Projection for Island Ponds\	


Legend
2006 Marsh Edge
2007 Marsh Edge
Breach Widths
Construction Impacts
Marsh Loss Area
Marsh Loss 2006
Marsh Loss 2007
122 ft
A19E
25ft
40ft
N
0
50
Feet
CIR Aerial Photo (7/5/07) provided by SCVWD
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
Island Pond A19E Post-Breach Effects
Proj No. 2456-03
Date Jan. 2008
Figure 11
ML
N:\Projects\2456-03


Legend
2006 Marsh Edge
2007 Marsh Edge
Breach Widths
Construction Impacts
Marsh Loss Area
Marsh Loss 2006
Marsh Loss 2007
A19W
28 ft
32ft
40ft
N
0 50
Feet
CIR Aerial Photo (7/5/07) provided by SCVWD
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
Island Pond A19W Post-Breach Effects
Proj No. 2456-03
Date Jan. 2008
Figure 12
ML
N:\Projects\2456-03


Legend
2006 Marsh Edge
2007 Marsh Edge
Breach Widths
Construction Impacts
Marsh Loss Area
Marsh Loss 2006
Marsh Loss 2007
82 ft
40ft
310ft
A20
N
0
50
Feet
CIR Aerial Photo (7/5/07) provided by SCVWD
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
Island Pond A20 Post-Breach Effects
Proj No. 2456-03
Date Jan. 2008
Figure 13
ML
N:\Projects\2456-03


Legend
2006 Marsh Edge
2007 Marsh Edge
Breach Widths
Construction Impacts
Marsh Loss Area
Marsh Loss 2006
Marsh Loss 2007
37 ft
40ft
A21E
305ft
N
0
50
Feet
CIR Aerial Photo (7/5/07) provided by SCVWD
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
Island Pond A21E Post-Breach Effects
Proj No. 2456-03
Date Jan. 2008
Figure 14
ML
N:\Projects\2456-03


Legend
2006 Marsh Edge
2007 Marsh Edge
Breach Width
Construction Impacts
Marsh Loss Area
Marsh Loss 2006
Marsh Loss 2007
79 ft
40ft
118ft
A21W
N
0
50
Feet
Color Aerial Photo (7/5/07) provided by SCVWD
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
Island Pond A21W Post-Breach Effects
Proj No. 2456-03
Date Jan. 2008
Figure 15
ML
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APPENDIX. A.
REFUGE MONITORING

APPENDIX A

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

San Francisco Bay NWR Monitoring Requirements for Island Ponds Tidal Wetland Restoration Year 2

Summary of Tasks

During Year Two (Y2) 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 Y2 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. While aerial photography has not shown an increase in the channel width from Y1 to Y2, the depth of the channels most likely is increasing.

Task 5.2.4: During Y2 of native vegetation development monitoring in the Island Ponds, a very limited amount of new vegetation was observed inside the Ponds. There was some pickleweed seen, especially along the pond side levee.

Task 5.2.6: No invasive plant species were found to be in the Island Ponds for Y1 or Y2, except for two previously identified patches of invasive Spartina on the outer fringe of Pond A21 which are being treated.

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 indicated positive results.

Task 5.3.6: Monitoring of the Island Ponds for water quality showed 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. The Regional Water Quality Control Board does not require further water quality analysis for the Island Ponds.

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."

Island Pond channels were unchanged from 2006. Many channel areas in the 2007 aerial photos were measured using GIS software, and the 2006 GIS-generated channels were overlaid on the 2007 photos for comparison. No notable differences were seen between the 2006 and 2007 channel morphologies. If anything, there is less water in the channels in the 2007 imagery, probably because photos were taken at a lower tide. However, the channel contours themselves were unchanged. Table 1 provides a baseline to show channel networking in the Island Ponds.

Table 1: Channel Networking in Island Ponds

Year	Pond	Pond Acreage	Total Channel Acreage	Percent Pond as Channel
2006	A19	265	8.74	3.30
	A20	63	0.85	1.35
	A21	147	3.02	2.05
2007	A19	265	8.74	3.30
	A20	63	0.85	1.35
	A21	147	3.02	2.05

Figures 1 – 3 show the same channel networking evolution for Y2 monitoring in the Island Ponds using GIS generated channels from last year overlaid on the 2007 photos.

Figure 1: Channel Networking in Pond A19 during 2007.

Figure 2: Channel Networking in Pond A20 during 2007.

Figure 3: Channel Networking in Pond A21 during 2007

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 because 99% of the total area was 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 Y2 of native vegetation development monitoring in the Island Ponds, a very limited amount of new vegetation was observed inside the Ponds. There was some pickleweed seen, especially along the pond side levee. However, there was not enough vegetation to accurately map, as the patches were very small. It is likely that there will be sufficient vegetation next year to identify and map from the aerial photographs. Ground monitoring is not required until there are at least 30 acres of vegetation, which is likely several years from now.

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)."

On July 31, 2007 the San Francisco Estuary Invasive Spartina Project (ISP) treated 2 patches of invasive Spartina along the south-western outboard levee of Pond A21 (west of the A21 west breach) using a helicopter "spray-ball". Additionally, on October 2, 2007 the ISP and SCVWD surveyed for invasive Spartina along Coyote Creek and within the Island Ponds. Several genetic samples were taken during this survey. Other than the two patches that were treated in July 2007, no new invasive patches were identified in the October survey and all genetic samples came back native including the samples from within the ponds (Lisa Porcella, SCVWD, *personal quote)*. A survey of Mud Slough was performed in November 2007 by the ISP; the genetic results from this sampling effort are still pending at this time. While there are invasive species such as *Lepidium latifolium* (perennial peppergrass) atop the levees and within the outboard marshes, no invasive species were found inside the Island Ponds during Y2.

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 30 acres of native vegetation develop. During Y2, 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 Y2, there is no suitable habitat available for the SMHM.

"**C) Waterfowl and shorebird species –** USGS has been counting waterbirds at the Island Ponds monthly since October 2002 (with the exception of September 2005) and will continue to do so for five years after the first breach. 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 (Table 2, Figure 4). 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 substantial increase in dabbling ducks can be likely attributed to the introduction of tidal action and the subsequent creation of shallow foraging areas for this guild. There has also been a slight increase in shorebird use of the ponds and a more dramatic increase in the use of the ponds by gulls (Figure 4). California gulls make up 61% of all of the gulls identified during surveys: they are using the Island Ponds as a roosting site as the ponds are adjacent to landfills where gulls forage. Tables 3-10 document the monthly totals of waterbird use at the Island Ponds during high and low tide surveys from December 2006 to November 2007.

Low tide surveys that began after the breach occurred have document upwards of 10,000 small shorebirds on pond A19 in July 2006 (Tables 9 and 10). Because most shorebirds forage on exposed mudflats during low tide, high tide surveys generally record shorebirds using the ponds for roosting. High numbers during low tide surveys indicate that the Island Ponds are being used as foraging habitat.

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 to tidal ponds with increased foraging potential for many waterbirds

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."

Results of these samples from Y1 showed no abnormal readings. Since no adverse water quality impacts were detected due to the breaching of the Island Ponds the RWQCB [Regional Water Quality Control Board] did not require sampling for future years.

Figure 4. Average numbers of waterbirds counted during high tide surveys, pre- and post-breach at the Island Ponds.

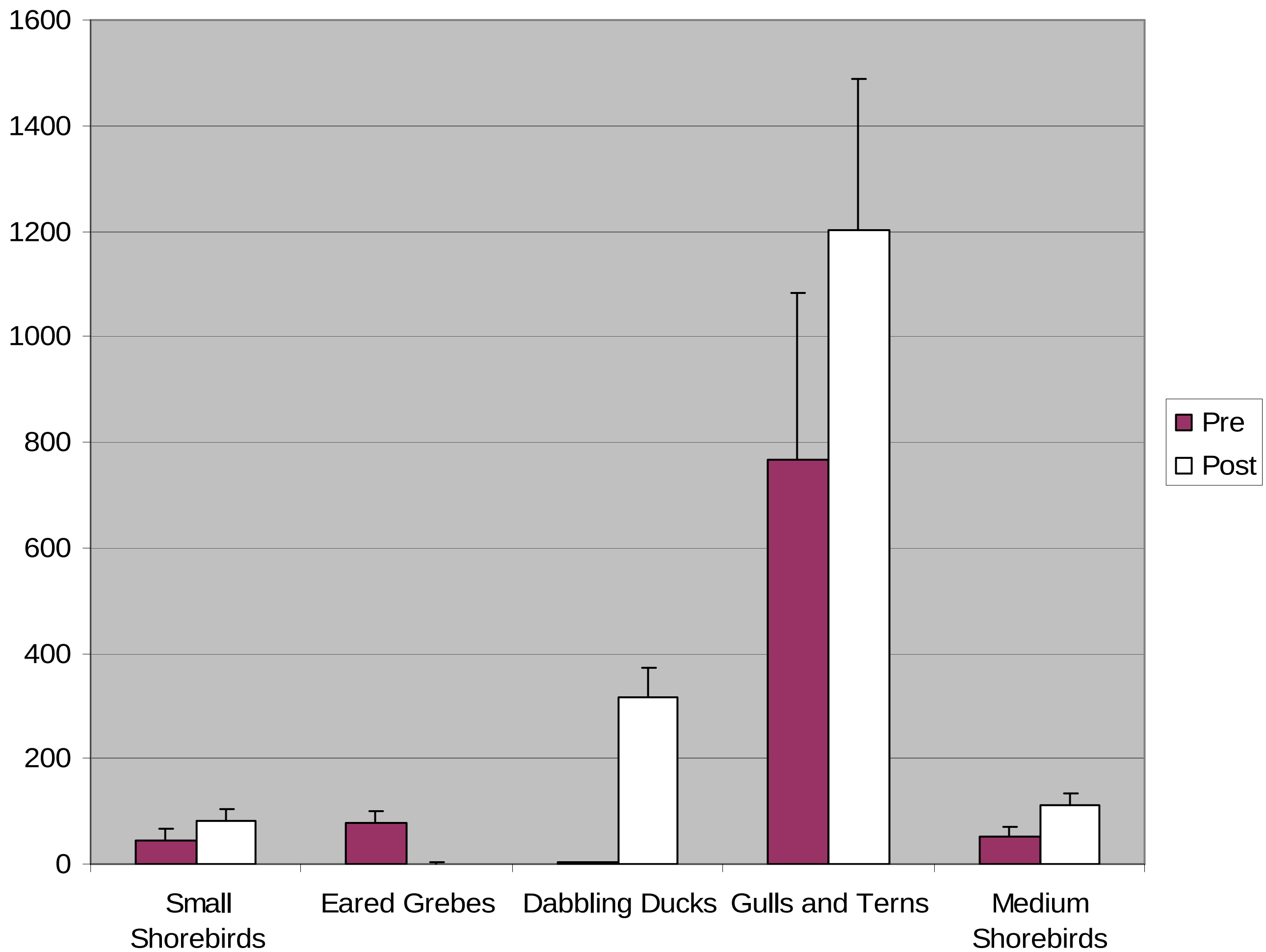

Table 2: Yearly Totals of Waterbird-Use in Island Ponds

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[1]	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 - Dec 2006[2]	High	All	2,632	162	375	376	52	65,145	172	2,478	0	4,075
Jan - Nov 2007[3]	High	All	15751	482	1	175	221	29071	97	3987	0	2548
Apr – Nov 2006	Low	All	1,078	18	0	351	36	55,631	203	2,140	0	17,279
Jan – Nov 2007	Low	All	3603	39	0	32	156	32126	98	3447	0	1726

1: Surveys not conducted year round, data is not included in Table 1.

2: Breach occurred in March 2006

3: Does not include December 2007 data

Table 3: 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 4: 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
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 5: 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
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 6: 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
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 7: 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
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 8: Monthly Totals of Waterbird-Use at High Tide in Island Ponds During 2007

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
Dec-06	High	A19	372	2	0	4	0	671	20	181	0	133
Dec-06	High	A20	274	75	0	0	0	48	4	429	0	31
Dec-06	High	A21	857	8	0	6	0	31	2	147	0	194
Jan-07	High	A19	272	0	0	7	0	2162	3	71	0	93
Jan-07	High	A20	490	19	0	0	0	270	0	44	0	0
Jan-07	High	A21	1347	26	0	4	3	820	0	218	0	37
Feb-07	High	A19	295	4	0	14	36	5450	0	75	0	0
Feb-07	High	A20	283	3	0	2	8	438	0	231	0	0
Feb-07	High	A21	1430	84	0	3	42	1247	1	17	0	0
Mar-07	High	A19	387	7	0	5	17	415	5	3	0	0
Mar-07	High	A20	785	6	0	0	0	8	0	23	0	0
Mar-07	High	A21	1283	0	0	1	18	1082	3	310	0	0
Apr-07	High	A19	413	16	0	2	23	169	4	7	0	350
Apr-07	High	A20	363	33	0	0	1	13	0	73	0	18
Apr-07	High	A21	413	32	0	9	4	251	9	374	0	1075
May-07	High	A19	56	0	0	19	26	113	11	106	0	0
May-07	High	A20	20	0	0	0	22	124	0	152	0	0
May-07	High	A21	71	1	0	0	7	298	2	360	0	0
Jun-07	High	A19	4	0	0	0	0	30	0	122	0	0
Jun-07	High	A20	6	1	0	1	0	71	2	13	0	0
Jun-07	High	A21	2	0	0	1	0	5911	17	306	0	49
Jul-07	High	A20	11	0	0	2	0	4	2	60	0	21
Jul-07	High	A21	12	0	0	3	0	128	3	673	0	14
Aug-07	High	A19	91	0	0	46	0	4583	10	82	0	0
Aug-07	High	A20	7	0	0	5	0	2	4	193	0	303
Aug-07	High	A21	72	0	0	2	14	78	1	82	0	503
Sep-07	High	A19	484	4	0	17	0	3451	8	0	0	0
Sep-07	High	A20	284	0	0	0	0	463	0	0	0	0
Sep-07	High	A21	1172	0	0	15	0	319	5	110	0	0
Oct-07	High	A19	353	148	0	4	0	367	0	0	0	0
Oct-07	High	A20	304	0	0	1	0	5	0	5	0	0
Oct-07	High	A21	1007	0	0	7	0	80	3	169	0	85
Nov-07	High	A19	1447	39	0	0	0	321	2	0	0	0
Nov-07	High	A20	1392	12	0	1	0	71	0	108	0	0
Nov-07	High	A21	1195	47	1	4	0	327	2	0	0	0
		Totals for Year	*17254*	*567*	*1*	*185*	*221*	*29821*	*123*	*4744*	*0*	*2906*

Table 9: 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
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 10: Monthly Totals of Waterbird-Use at Low Tide in Island Ponds During 2007

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
Dec-06	Low	A19	136	0	0	4	0	98	6	261	0	247
Dec-06	Low	A20	124	0	0	1	0	7	6	289	0	41
Dec-06	Low	A21	163	1	0	1	0	787	6	299	0	316
Jan-07	Low	A19	166	1	0	0	45	1177	7	51	0	48
Jan-07	Low	A20	54	0	0	0	0	0	1	33	0	75
Jan-07	Low	A21	578	12	0	0	2	1040	2	123	0	561
Feb-07	Low	A19	143	1	0	0	48	10822	1	7	0	0
Feb-07	Low	A20	10	0	0	0	10	281	1	4	0	0
Feb-07	Low	A21	105	25	0	0	17	2255	3	7	0	0
Mar-07	Low	A19	8	0	0	0	0	955	1	0	0	2
Mar-07	Low	A20	123	0	0	0	11	490	6	0	0	0
Mar-07	Low	A21	11	0	0	0	11	915	4	1	0	0
Apr-07	Low	A19	22	0	0	0	12	0	1	1	0	12
Apr-07	Low	A20	4	0	0	0	0	0	2	1	0	6
Apr-07	Low	A21	6	0	0	0	0	1	1	1	0	3
May-07	Low	A19	4	0	0	0	0	3	6	40	0	0
May-07	Low	A20	0	0	0	0	0	457	8	91	0	0
May-07	Low	A21	10	0	0	0	0	7	4	27	0	0
Jun-07	Low	A19	4	0	0	0	0	153	9	79	0	10
Jun-07	Low	A20	2	0	0	0	0	2	6	10	0	0
Jun-07	Low	A21	0	0	0	0	0	675	3	14	0	0
Jul-07	Low	A19	0	0	0	0	0	913	1	272	0	0
Jul-07	Low	A20	0	0	0	0	0	0	0	0	0	245
Jul-07	Low	A21	16	0	0	1	0	270	2	521	0	59
Aug-07	Low	A19	9	0	0	1	0	1305	10	288	0	18
Aug-07	Low	A20	1	0	0	1	0	2	0	12	0	17
Aug-07	Low	A21	28	0	0	0	0	130	3	131	0	152
Sep-07	Low	A19	408	0	0	29	0	3480	2	208	0	268
Sep-07	Low	A20	143	0	0	0	0	82	2	152	0	39
Sep-07	Low	A21	241	0	0	0	0	167	7	393	0	161
Oct-07	Low	A19	541	0	0	0	0	604	1	279	0	25
Oct-07	Low	A20	121	0	0	0	0	1324	1	9	0	14
Oct-07	Low	A21	116	0	0	0	0	316	2	86	0	0
Nov-07	Low	A19	225	0	0	0	0	1266	1	585	0	0
Nov-07	Low	A20	45	0	0	0	0	2412	0	5	0	11
Nov-07	Low	A21	459	0	0	0	0	622	0	16	0	0
	Totals for Year		*4026*	*40*	*0*	*38*	*156*	*33018*	*116*	*4296*	*0*	*2330*

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APPENDIX B.
PHOTOGRAPHS

APPENDIX B-1.
RAILROAD BRIDGE SCOUR PHOTOGRAPH COMPARISONS

APPENDIX B-1.
RAILROAD BRIDGE SCOUR PHOTOGRAPH COMPARISON
NOVEMBER 2006 & 2007

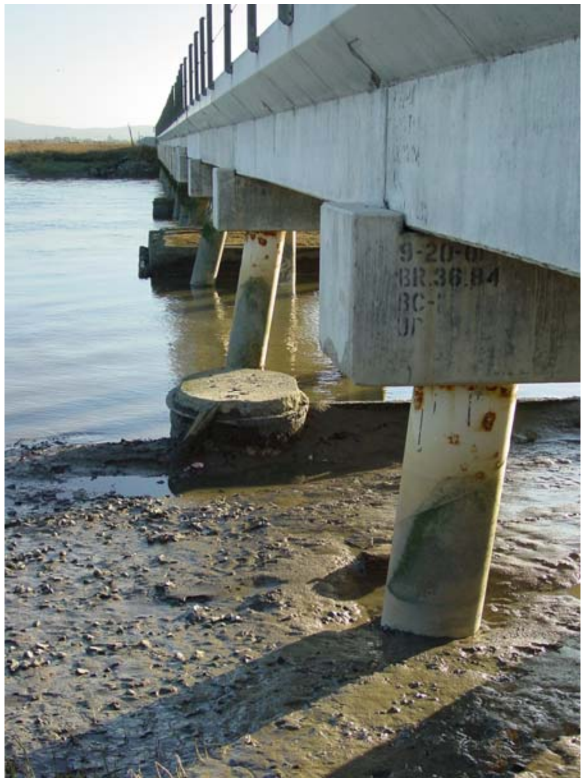


Photo 1. East Side of Bridge Looking South. Pile 1N-C in foreground – November 29, 2006

Photo 2. East Side of Bridge Looking South. Pile 1N-C in foreground – November 21, 2007

Photo 3. West Side of Bridge Looking South. Pile 1N-A in foreground – November 29, 2006

Photo 4. West Side of Bridge Looking South. Pile 1N-A in foreground – November 21, 2007

Photo 5. West Side of Bridge Looking North. Pile 1S-A in foreground – November 29, 2006

Photo 6. West Side of Bridge Looking North. Pile 1S-A in foreground– November 21, 2007

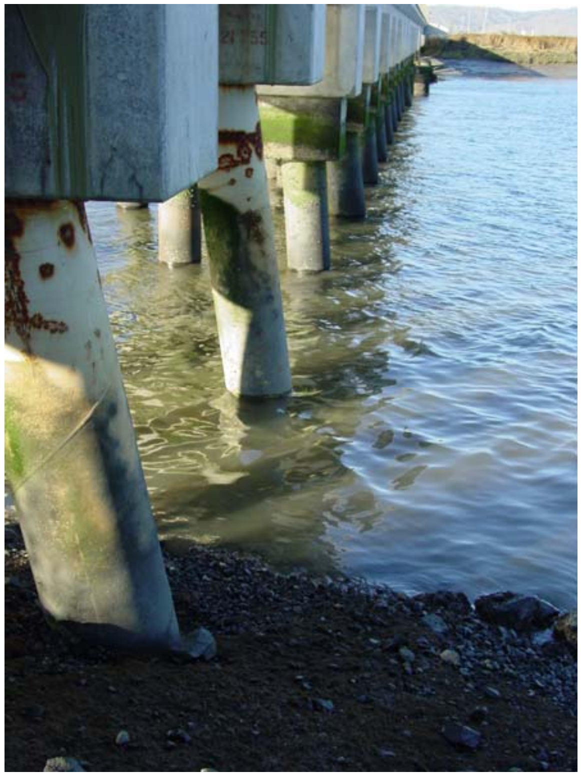


Photo 7. East Side of Bridge Looking North. Pile 1S-C in foreground – November 29, 2006

Photo 8. East Side of Bridge Looking North. Pile 1S-C in foreground – November 21, 2007

Photo 9. Close-up of pile 1S-A – November 29, 2006

Photo 10. Close-up of pile 1S-A – November 21, 2007

Photo 11. Close-up of piles 1S-C (foreground), 1S-B (centre), and 1S-A – November 29, 2006

Photo 12. Close-up of piles 1S-C (foreground), 1S-B (centre), and 1S-A – November 21, 2007

Photo 13. Close-up of pile 1S-C – November 21, 2007

Photo 14. Close-up of pile 1N-A (looking west) – November 29, 2006

Photo 15. Close-up of pile 1N-A (looking east) – November 21, 2007

Photo 16. Close-up of pile 1N-B (looking east) – November 29, 2006

Photo 17. Close-up of pile 1N-B (looking east) – November 21, 2007

Photo 18. Close-up of pile 1N-B (looking west) – November 29, 2006

Photo 19. Close-up of pile 1N-B (looking west) – November 21, 2007

Photo 20. Close-up of pile 1N-C – November 29, 2006

Photo 21. Close-up of pile 1N-C – November 21, 2007

APPENDIX B-2.
RAIL LEVEE PHOTOGRAPHS

APPENDIX B-2
RAIL LEVEE PHOTOGRAPHS
2006 VS. 2007

Photo 1. Pond A21 Levee near Rail Levee, view looking north - July 13, 2006.

Photo 2. Same location as above – May 18, 2007.

Photo 3. Pond A21 Levee near Rail Levee, view looking south – July 13, 2006.

Photo 4. Same location as above – May 18, 2007.

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

Photo 6. Same location as above – May 18, 2007.

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

Photo 8. Same location as above – May 18, 2007.

Photo 9. Pond A20 Levee near Rail Levee – July 13, 2007.

Photo 10. Same location as above – May 18, 2007.

Photo 11. Pond A20 Levee near Rail Levee, view looking south – July 13, 2006.

Photo 12. Same location as above – May 18, 2007.

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

Photo 14. Same location as above – May 18, 2007.

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

Photo 16. Same location as above – May 18, 2007.

APPENDIX B-3.
TOWN OF DRAWBRIDGE PHOTOGRAPHS

APPENDIX B-3.

TOWN OF DRAWBRIDGE PHOTOGRAPHS

Possible Deterioration Threats

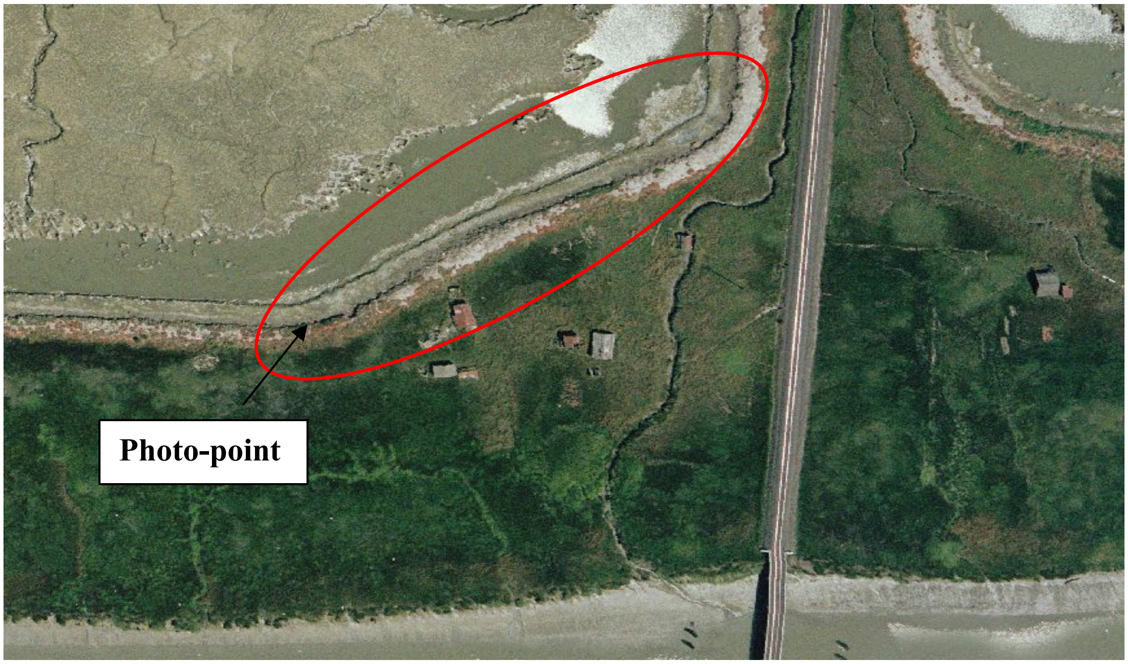


Photo 1. Aerial view of railroad and Town of Drawbridge. The red circle (southeast levee of Pond A21) depicts the area which is eroding.

Photo 2. Levee erosion at Pond A21's southeast levee, view looking east – May 18, 2007.

Photo 3. Close up of eroded section of levee in the southeast corner of Pond A21, view looking west – August 10, 2006.

Photo 4. Same location as above – May 18, 2007.

Photo 5. Debris accumulated in the southeast corner of Pond A21. Debris is also visible on top of the levee – October 26, 2007.

APPENDIX B-4.
BREACH AND MARSH SCOUR PHOTOGRAPHS

APPENDIX B-4.
BREACH AND MARSH SCOUR PHOTOGRAPHS

Photo 1. View of A19W Breach. Note evident scour of marsh in foreground **-** July 24, 2007.

Photo 2. View of A19E Breach. Note evident scour of marsh in foreground – July 24, 2007.

Photo 3. Scour along fringing marsh, northern bank of Coyote Creek – July 24, 2007.

Photo 4. Scour along fringing marsh, southern bank of Coyote Creek – July 24, 2007.

Photo 5: Scour along fringing marsh, southern bank of Coyote Creek – July 24, 2007.

APPENDIX C.
SEDIMENTATION DATA

APPENDIX C

Summary of Sediment Accretion at the Island Ponds

Pond	Pin ID	Northing	Easting	Distance from Nearest Breach (feet)	8 Months Post-Breach Depth Probe Accretion (feet)	12 months Post-Breach Depth Probe Accretion (ft)	16 Months Post-Breach Depth Probe Accretion (ft)
A19	A1912	1994802	6137896	477	0.00	0.16	0.08
A19	A1913	1994943	6138503	545	0.25	0.35	
A19	A1914	1994981	6139508	886	0.21	0.22	
A19	A1915	1994441	6139937	1114	0.22	0.25	
A19	A1911	1994902	6136328	1136	0.09	0.12	
A19	A1909	1995850	6137503	1227	0.20	0.18	
A19	A1910	1995754	6136634	1364	0.30	0.22	
A19	A1908	1995661	6140093	1750	0.16	0.21	
A19	A1906	1996260	6138748	1795	0.17	0.23	
A19	A1907	1996306	6138209	1841	0.13	0.18	0.20
A19	A1905	1996246	6139614	1955	0.10	0.11	
A19	A1904	1996794	6139043	2364	0.06	0.15	0.16
A19	A1903	1997004	6140052	2841	0.04	0.05	
A19	A1902	1997533	6139359	3114	0.03	0.05	0.04
A19	A1901	1998378	6139462	4000	0.01	0.06	
A20	A2005	1994548	6134334	659	0.37	0.43	0.51
A20	A2004	1995023	6134585	864	0.53	0.62	0.74
A20	A2003	1995020	6135241	875	0.39	0.48	
A20	A2002	1995551	6135296	1386	0.23	0.14	
A20	A2001	1995675	6134580	1500	0.12	0.12	0.13
A21	A2109	1994879	6131048	682	0.18	0.40	0.62
A21	A2108	1994879	6131709	818	0.45	0.48	
A21	A2107	1994877	6132369	955	0.22	0.34	0.33
A21	A2110	1994221	6133040	1205	0.50	0.61	
A21	A2106	1994858	6133026	1409	0.20	0.22	
A21	A2105	1995539	6131707	1455	0.17	0.29	
A21	A2104	1995507	6132381	1523	0.13	0.18	
A21	A2103	1995533	6133027	1864	0.09	0.13	
A21	A2102	1996203	6132359	2182	0.16	0.16	
A21	A2101	1996190	6133043	2432	0.03	0.03	0.12

Note:

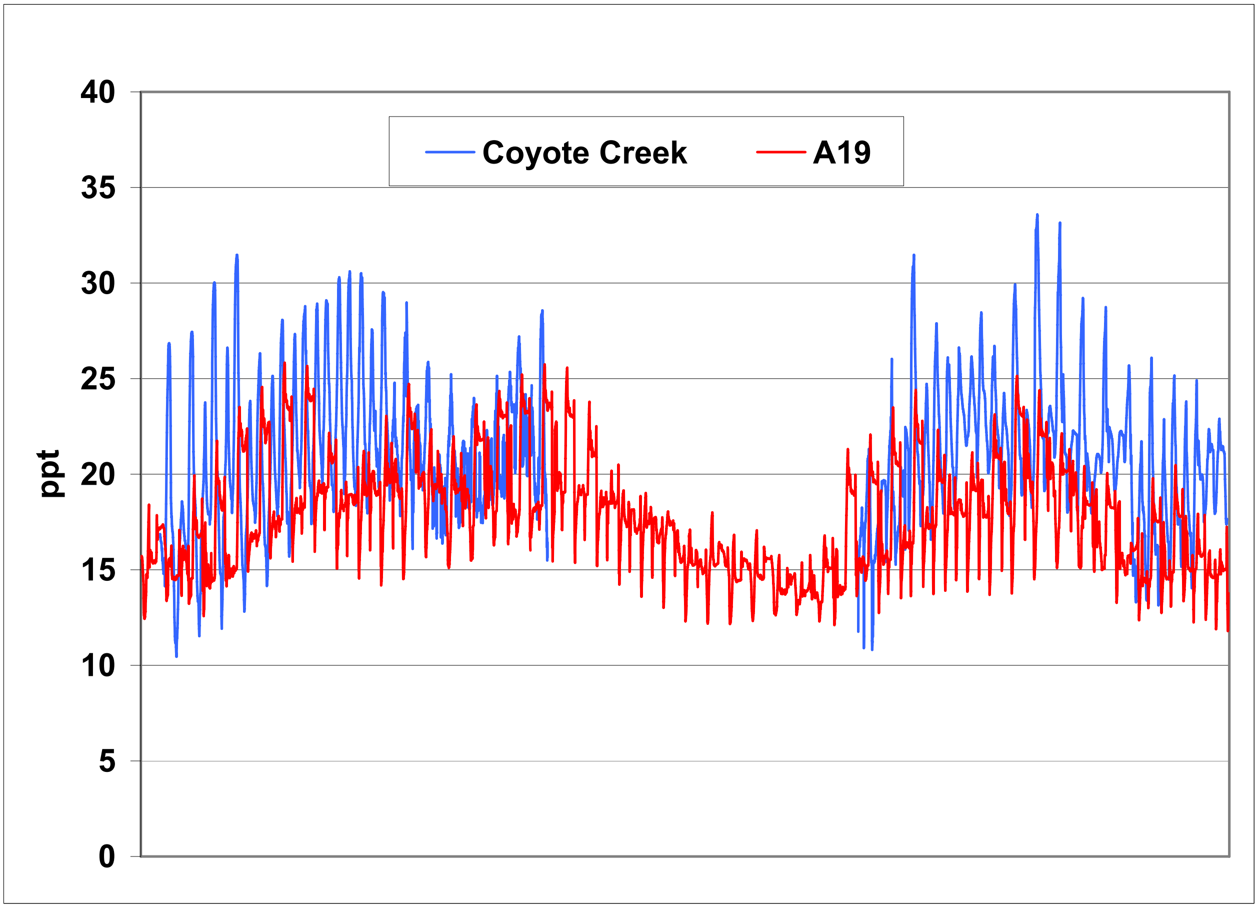
8 month data is an average of 3 depth probes.

12 and 16 month data is an average of 8 depth probes.

APPENDIX D.
SALINITY DATA: POND A19 AND COYOTE CREEK

APPENDIX D
SALINITY DATA: POND A19 AND COYOTE CREEK

Salinity data (ppt) from 24 July for 11 September 2007 for Pond A19 and Coyote Creek.



* No salinity data is available for Coyote Creek from 11-25 August due to biofouling of YSI datasonde.