2013 Annual Self-Monitoring Report
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Prepared for:

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Table of Contents

List of Appendices

Introduction

The South Bay Salt Pond Restoration Project (Project) 2013 Annual Self-Monitoring Report (Report) has been prepared to provide: 1) an update of the Project's 2013 accomplishments; 2) information on on-going operations of the Alviso and Ravenswood Ponds; 3) results of the 2014 studies conducted at Pond A8 and SF2; 4) results of fisheries monitoring and studies; and 5) an update on Phase II planning efforts.

In previous years, this annual report has focused on water quality monitoring results and has been submitted to the California Regional Water Quality Control Board (Water Board) to comply with the Self-Monitoring Program (SMP) as described in the Final Order (No. R2-2008-0078). This is the third year the report will also be submitted to NOAA's National Marine Fisheries Service (NMFS) because we have included additional fisheries monitoring conducted as part of the Science Program's Applied Studies, which are intended to fill the most important gaps in our knowledge about South San Francisco Bay (South Bay) ecosystem

It is anticipated that both water quality and fisheries information will help the Water Board and NMFS: 1) understand the status of the Project; 2) provide feedback and guidance to the Project Management Team on current and future applied studies and monitoring; and 3) assist in identifying emerging key uncertainties and management decisions required to keep the Project on track toward its restoration objectives as we approach Phase II.

2013 Project Accomplishments

Tidal Marsh Restoration

- Save The Bay launched a new vegetation restoration effort at four acres in Eden Landing. Over two years, staff and volunteers will plant about 10,000 native shrubs to create transitional habitat along our developing tidal marsh at former Pond E9.
- Sediment has been accreting to create mudflat and carving channels at Alviso Pond A17 that was breached on October 31, 2012.

Enhanced Ponds

- The Project built 16 new islands for nesting birds at 240-acre Pond A16 in Alviso. We also redesigned the pond and added a fish screen so we can keep water levels optimal for shorebirds while protecting threatened fish. The end of this construction means Phase 1 is complete for both Alviso and Ravenswood Pond Complexes.
- Workers at Eden Landing carved mud and installed pipes, nearing completion on a suite of ponds designed to provide a menu of saline options for shorebirds.

Public Access

Alviso Pond A16 now boasts a platform for viewing and a set of new interpretive signs. Workers also reconfigured the Mallard Slough loop trail to make way for wetlands. Nearby Pond A17 has interpretive features at the end of that trail, and both areas have bike racks.

<u>Flood Protection</u>
The Project cannot breach many more additional levees at Alviso to create tidal marsh until flood protection levees are erected. The Congressionally authorized South San Francisco Bay Shoreline Study, a partnership of the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, State Coastal Conservancy and the Santa Clara Valley Water District, is analyzing Alviso-area flood risk management options, as well as ecosystem restoration scenarios. In 2013, work continued on a Corps-directed environmental analysis of tentatively selected Alviso-area levee alignments and new habitat restoration.

<u>Science and Adaptive Management</u>
Studies have indicated that seasonally opening ponds with a history of mercury contamination may be creating conditions that increase mercury levels in water and fish. The results have prompted managers to seek regulatory approval to keep Pond A8, a pond with mercury-tainted sediments, open year-round in order to benefit wildlife.

Leopard sharks have responded well to our recent breaches by gorging on increased populations of fish, crabs, and other species inside the ponds.

2013 Science Symposium highlights:

- The number of waterbirds at the Project has doubled since 2003, from less than 100,000 to more than 200,000 in 2012.
- Studies of the endangered western snowy plover found that predation is the leading cause of nest failure. Placing oyster shells on dry ponds, where the birds nest, may reduce predation by camouflaging eggs and chicks.
- Managers and engineers are starting to use information gathered by scientists on pond features such as island configuration and quantity, and water depth and salinity, that are most attractive to nesting, resting, and feeding birds to optimize use by a wide variety of bird species.
- After our 2010 breach at Pond A6 where a large colony of nesting California gulls typically nested, about half of the birds moved to ponds just to the east.

<u>Progress Towards Our 3 Goals</u>
Goal 1: Restore & Enhance Habitat
<u>3,040 Acres of Habitat Restored</u>
To date, we have opened 3,040 acres of former industrial salt ponds to the Bay to recreate wetlands. We are now planning our second phase of restoration work, which could include restoring thousands of additional acres to salt marsh. Our initial goal is to restore half of our land, 7,500 acres, to tidal marsh, with the other 50% in managed ponds.

<u>Doubled Enhanced Pond Acres</u>
With our completed pond construction work Pond A16 in Alviso, the Project now has 477 acres of ponds that have been enhanced for wildlife use. Project goals call for achieving 1,600 acres.

Goal 2: Provide Public Access

Alviso: New Spots to View and Learn Created

The Project's public access vision: establish an interrelated trail system; provide viewing and interpretation opportunities; create small watercraft launch points; and allow for waterfowl hunting. The project to date has created 2.9 trail miles. In 2013, we erected a viewing platform and new interpretive signs at Pond A16 in Alviso.

Goal 3: Provide Flood Risk Management

Flood Protection Progress Maintained

A goal of the Project is to provide for flood risk management, maintaining or improving existing flood protection levels. Project managers are committed to ensuring that flood hazards to adjacent communities and infrastructure do not increase as a result of the restoration. Tidal marsh restoration completed to date will increase scour and existing channels, thereby increasing flood flow capacity. Tidal marsh restoration in flood-critical parts of the Project area will not occur until inboard flood protection is established. In 2013, planning for new levees near Alviso continued.

2013 Pond Operations

Pond System A2W

The objectives for the Alviso Pond A2W system is to maintain circulation through ponds A1 and A2W while maintaining discharge salinities to the Bay at less than 40 parts per thousand (ppt) and meet the other water quality requirements in the Water Board’s Waste Discharge Permit. Through trial and error, the gates will need to be adjusted to find equilibrium of water in-flow and discharge to account for evaporation during the summer. The back portions of the Ponds A1 and Pond A2W will need to be monitored closely when warmer weather patterns occur. The 2014 Operation Plan for Pond A2W is included in Appendix A.

Pond System A3W

The objectives for the Alviso Pond A3W system are to: 1) maintain circulation through ponds AB1, AB2, A2E, and A3W while maintaining discharge salinities to Guadalupe Slough at less than 40 ppt and meet the other water quality requirements in the Water Board’s Waste Discharge Permit; 2) maintain pond A3N as a seasonal pond; and 3) maintain water surface levels lower in winter to reduce potential overtopping of A3W levee adjacent to Moffett Field. Water levels in Pond AB1 and Pond AB2 of Pond A3W system may be temporarily lowered during the summer to improve shorebird nesting and foraging habitat. The 2014 Operation Plan for Pond A3W is included in Appendix B and a discussion of Pond A3W applied study is included in Sustainability of Managed Ponds below.

Pond System A8

The Phase I action at Alviso Pond A8 is one of the initial actions for implementation under the Project. Pond A8 is identified as tidal habitat in the long-term programmatic restoration of the Project. The Pond A8 system will be operated to maintain muted tidal circulation through ponds A5, A7, A8N and A8S while maintaining discharge salinities to the Bay at less than 40 ppt and meet the other water quality requirements in the Water Board’s Waste Discharge Permit. Ongoing mercury and migrating salmonids studies continue. The 2014 Operation Plan for Pond A8 is included in Appendix C.

Pond System A14

The objectives of the Alviso Pond A14 systems are to: 1) maintain circulation through ponds A9, A10, A11 and A14, while maintaining discharge salinities to Coyote Creek at less than 40 ppt and meet the other water quality requirements in the Water Board's Waste Discharge Permit; 2) maintain pond A12, A13 and A15 as batch ponds - operating batch ponds at a higher salinity (80 – 120 ppt) during summer to favor brine shrimp; 3) minimize entrainment of salmonids by limiting inflows during winter; and 4) maintain water surface levels lower in winter to reduce potential overtopping. During the winter, Pond A9 and Pond A14 intakes will not be open due to possible fish entrainment. The 2014 Operation Plan for Pond A14 is included in Appendix D.

Pond System SF2

Ravenswood Pond SF2 is another Phase I action that was completed in 2010 to enhance 240 acres of managed pond habitat. A 155-acre pond was created with 30 nesting islands for nesting and resting shorebirds and shallow water habitat for foraging shorebirds. In addition, 85 acres of habitat was preserved for nesting western snowy plovers. Pond SF2 includes three management cells; the eastern and middle cell will be managed pond habitat and the western-most cell will be managed seasonal wetland. Water control structures will be used both to manage water levels and flows into and out of Pond SF2 from the Bay, and between cells, for shorebird foraging habitat and to meet water quality objectives. Another component of Pond SF2 created 0.7 mile of trail between the pond and the Bay and two new viewing platforms near the Dumbarton Bridge. The 2014 Operation Plan for Pond SF2 is included in Appendix E.

Pond System A16

Alviso Pond A16-A17 was the final Phase I action that was completed in 2012. Construction of Ponds A16-A17 allows Pond A17 to become tidal marsh with uninhibited hydraulic connection to Coyote Creek (and therefore South Bay) and Pond A16 would become a managed pond that would include nesting islands for birds and shallow water habitat for shorebird foraging. Public access and recreation are also included as part of the Pond A16-A17 project. The 2014 Operation Plan for Pond A16 is included in Appendix F.

Sustainability of Managed Ponds

Maintaining dissolved oxygen (DO) levels in the Alviso Ponds while meeting water quality objectives and Final Order requirements has been a significant management challenge for the Service during operation of the ponds. Over the last several years, the Service in conjunction with the California Regional Water Quality Control Board (RWQCB) developed and implemented a number of BMPs in an attempt to improve DO levels in the ponds (baffles, solar aerators, timing of discharge, etc.). Some of these BMPs appeared to be temporarily effective in either raising DO levels within ponds or minimizing the impacts of low pond DO to the receiving waters. However, the Service no longer considers these BMP's to be practical or effective on a long-term basis. Based on previous lessons learned, the Service has been operating the ponds as continuous flow-through systems to try and reduce the water resident time as much as possible, while supporting species that use these ponds (e.g., migratory, wintering, and nesting birds).

Pond A3W

In 2013, we received the final *Internal Nutrient Sources and Dissolved Nutrient Distributions in Alviso Pond A3W, California* (USGS report by Topping, et al.) which can be located at: (http://www.southbayrestoration.org/documents/technical/Kuwabara_Pond%20A3W_of2013-1128_text.pdf). Within the Alviso Salt Pond complex, pore-water profilers were deployed in triplicate at two contrasting sites in Pond A3W ("Inlet", near the inflow, and "Deep", near the middle of the pond). Deployments were conducted in 2010 and 2012 during the summer algal-growth season. Specifically, three deployments, each about 7 weeks apart, were undertaken each summer. This study provides the first measurements of the diffusive flux of nutrients across the interface between the pond bed sediments and water column (that is, benthic nutrient flux). These benthic fluxes are crucial to pond restoration efforts because they typically represent a major (if not the greatest) source of nutrients to the water column.

For soluble reactive phosphorus (SRP, the most biologically available form in solution), benthic flux was positive both years (that is, out of the sediment into the water column), with the exception of the August 2010 deployment, which exhibited nearly negligible but negative flux. There was much greater temporal variability in SRP flux in the pond than reported for the lower estuary.

For dissolved ammonia, benthic flux was consistently positive on all six sampling trips, and similar to SRP, the fluxes at Deep were consistently greater than those at Inlet. Dissolved ammonia fluxes reported for South San Francisco Bay fall in between these values. Once again, greater variability for benthic fluxes determined in the pond was observed relative to adjacent South San Francisco Bay. Dissolved nitrate fluxes were consistently negligible in the pond.

Silica fluxes are often used to represent sediment-forming processes that biogeochemically cycle silica (an important algal macronutrient) between biological and inorganic phases. For South San Francisco Bay, those values are consistently positive. In Pond A3W, dissolved-silica fluxes were much higher at Deep than at Inlet, similar to the spatially variability observed for SRP and dissolved ammonia. An elevated silica flux can stimulate diatom production and subsequent eutrophication effects. Variability in these silica fluxes is consistent with season patterns in pond primary productivity.

To complement these benthic-flux studies, a diurnal study of nutrient flux into and out of the pond was measured during neap and spring tides to provide comparative estimates for nutrients that originated outside the pond and enter via advective flux through water control structures. Benthic flux of nitrogen species, averaged over all sites and dates, was about 80,000 kilograms per year (kg/yr), well above the adjective flux range of -50 to 1,500 kg/yr. By contrast, the average benthic flux of orthophosphate was about 12,000 kg/yr, well below the advective flux range of 21,500 to 30,000 kg/yr. So for ammonia, nitrate, and silica in the water column, the primary source in the ponds was the reservoir of nutrients contained in the sediments; for soluble reactive phosphorus, the dominant source is coming in on the tide and is the pond is a net sink.

So in summary nutrients (N, P, Si) show consistent flux from sediment to the water column during the summer algal growing season. These nutrient fluxes are greater and more variable inside the ponds than observed in South San Francisco Bay. These data indicate that the reservoir of nutrients in the pond sediments is an important, and at times the most important, source of nutrients that stimulate phytoplankton growth in the water column, and it is hypothesized to be the most important step at the base of the food web for trophic transfer of nutrients and biomagnifying solutes like mercury.

It is likely that long-term improvements in water quality within the pond will eventually lead to decreases in contaminant pore-water gradients. However, such decreases are expected to lag in both time and magnitude relative to any surface water regulatory improvements. This is because the decades-long accumulation of solutes with the sediments will continue to generate a benthic flux until either the solutes diffuse completely into the water column or new sediment lacking the solutes settles sufficiently to diminish the gradient at the sediment-water interface.

USGS provided suggestions for management options that could be taken to help mitigate the dissolved-oxygen (DO) depletion. Managers could mechanically aerate waters at the pond outflow during low-DO summer periods so that advective transport through the pond could be maximized without compromising receiving water quality. Similarly, if flows can be managed according to diurnal patterns, it would be useful to maximize flow during the day (that is, high DO periods), while also mechanically aerating the pond water column at the inflow and outflow during the night. Inflow water can also be baffled to create turbulence near the inflow, outflow, or both to increase atmospheric oxygen diffusion (that is, increased surface area and mixing). The Service has previously implemented these measures and it was determined that they would not be viable for long-term use. The Service will continue to work with the Water Board and scientists to optimize the management of Pond A3W to reach water quality standards.

Studies and Observations Associated with Phase I Actions

Pond A8

<u>2013 Summary Update on Pond A8 Mercury Studies</u>

To investigate whether opening the Pond A8 notch results in scour of sediments in Alviso Slough, and the resulting remobilization of mercury (Hg) that is buried in the sediments, bathymetric studies of Alviso Slough (Bruce Jaffe USGS), along with deep cores sediment samples analyzed for mercury (Mark Marvin DiPasquale, USGS) were conducted during 2010 through 2012. Results indicate that sediment erosion within Alviso Slough was limited with the initial (June 2011) opening of 1 gate (5’ out of 40’) of the Pond A8 notch, with most of the erosion occurring near (and associated with) the Pond A6 breaches. Preliminary results from the 2012 studies indicates the same trend of limited erosion of Alviso Slough sediment near the Pond A8 notch with the opening of three gates (15’ of 40’) in June 2012, with most of the erosion still occurring near the Pond A6 breaches. The most recent estimates, based on the preliminary 2012 results, indicate that from 10.8 – 12.9 kg of Hg in sediments were remobilized since 2010, with the majority of Hg remobilized around the Pond A6 breaches. This is significantly less than earlier estimates of 66 kg Hg at predicted for a 20’ notch opening at Pond A8. This earlier estimate did not consider the breaching of Pond A6. Bathymetric surveys continued in 2013 to document whether additional scour has occurred in Alviso Slough. We are still awaiting the results of the 2013 bathymetric surveys from USGS for this area.

To investigate the effect of the restoration of Pond A5/A7/A8 and the opening of the Pond A8 notch in June 2011, Josh Ackerman, Mark Marvin Di-Pasquale, Collin Eagles-Smith (of USGS) and Darell Slotton (UC Davis) conducted Hg biogeochemisty and bioaccumulation studies in Pond A8 and Alviso Slough during 2010 (before restoration actions) and 2011 (during and after restoration actions). Samples included water, sediment, 3 fish species (threespine stickleback, longjaw mudsucker, and Mississippi silverside); and 2 bird species (Forster's tern, and American avocet). Initially, these studies were set up to be a before/after design, with the "after" samples collected in 2011 intended to be after all the construction activities were completed. Because of delays, construction activities inside the Ponds A5/A7/A8 were going on through the start of 2011 nesting activities, and birds continued to nest after the Pond A8 notch was opened on June 1, 2011 (5' opening).

The final report for The South Bay Mercury Project is completed as can be found at: http://www.southbayrestoration.org/documents/technical/Mercury%20OFR%20Report%20May28_2013_Final%20Annual%20Report%202012.pdf. The results indicate that, in 2011, fish in the A5/A7/A8 Pond Complex had higher Hg levels, as compared to fish from reference ponds during 2010 (pre-notch opening). Fish within the A5/A7/A8 Pond Complex exhibited an increase in Hg tissue concentration between 2010 and 2011, prior to the June 1, 2011 notch opening, relative to reference ponds. Models indicate these increases were very strongly related to restoration construction activities during the Fall 2010 / Winter 2010-2011 period. Once the notch was opened to 5' in June 2011, Hg in fish decreased noticeably (to below 2010 levels) in the A5/A7/A8 Pond Complex during the remainder of 2011. The decrease in fish mercury concentrations within the A5/A7/A8 Pond Complex after the opening of the notch appeared to be linked to a change in methylmercury (MeHg) availability at the base of the food web, associated with dramatic changes in water chemistry, suspended particulate composition, and Hg partitioning between particulates and the dissolved phase. By the end of the study, fish tissue Hg concentrations, though lower than observed in 2010, remained elevated in the Pond A5/A7/A8 Complex compared to the reference ponds.

Fish-eating birds, like terns, take up Hg in the fish they eat, and that Hg is transferred to the egg prior to egg-laying. Terns were already very high in Hg, with 90% of eggs being over the reproductive toxicity threshold in 2010, prior to any restoration activity. Tern egg Hg concentrations increased 67-78% in Ponds A7 and A8 between 2010 and 2011. In 2011, tern nesting started prior to the notch opening, so egg levels likely reflect perturbations from construction activities. These are very large increases in Hg, and it is estimated that 100% of the terns exceeded reproductive toxicity levels during 2011. Avocet eggs had slight increases from 4-15% from 2010 to 2011, but this was a minor statistical increase compared to reference ponds.

Fish in Alviso Slough also experienced changes in tissue Hg concentration coincident with the opening of the A8 notch on June 1, 2011. There were 4 sample locations in Alviso Slough – one just upstream of the notch, one at the notch, one downstream midway down the slough, one downstream at the slough mouth (near Pond A6) . By the end of the study in October of 2011, there was no change in Alviso Slough fish mercury levels for either Mississippi silverside or threespine stickleback compared to 2010; however slough fish Hg concentrations increased in Hg after the notch was opened on June 1 until between August and October when the Hg concentration decreased. The increase in Hg after the notch opening was more pronounced at the locations closest to the notch than at downstream locations. Thus, the increase in Hg in slough fish was short-lived, and mostly seen in upstream fish. The increase seems to be linked to changes in water chemistry and MeHg availability to the base of the food web, and not to sediment scour directly.

There were no observed changes in sediment Hg chemistry in either Alviso Slough or Pond A5/A7/A8. In the water samples, dissolved MeHg in the Pond A5/7/8 complex decreased significantly in 2011 compared to 2010 after the notch opening, which was due to a combination of simple dilution and a shift in partitioning between the dissolved and particulate phases (the material that is suspended in the water). MeHg is the form of mercury that is most readily moved up the foodweb. The transfer of MeHg from the dissolved phase and onto suspended particles increased from 2010 to 2011, and was associated with a decrease in both salinity and dissolved organic carbon. The composition of the suspended particles also changed after the notch opening with a higher proportion of terrestrial and/or marsh plant particulates evident during 2011 (which is reasonable to expect since water from the surrounding bay and marshes was pouring into Pond A5/7/8). Phytoplankton concentrations (an indicator of algae and other small organisms) also increased modestly in the A5/A7/A8 Pond complex in 2011, compared to 2010. But the higher proportion of terrestrial particulates and the partitioning of MeHg onto particulates appeared to result in MeHg becoming less bioavailable to fish after the initial notch opening, resulting in the observed decrease in fish Hg concentration within the Pond A5/7/8 after the notch was opened. In upper Alviso Slough, there was a significant shift in MeHg partitioning towards the dissolved phase between 2010 and 2011, which was coincident with the short lived increase in slough fish Hg concentrations in this region of the slough. Thus, the changes in MeHg between dissolved and particulate phases observed between 2010 and 2011 were in opposite directions for the A5/A7/A8 complex and Alviso Slough. The water chemistry results help explain the short-lived increases in fish Hg concentrations in Alviso Slough after the notch was opened, while there was a decrease in fish Hg concentrations within Pond A5/7/8 after the notch was opened.

In summary, Hg in pond fish increased in Pond A5/A7/A8 due to the construction activities, then decreased after the opening of the Pond A8 notch. The terns feeding on the fish laid eggs that had substantially higher Hg after the restoration activities than before. However, another bird species, the avocet, had little change in Hg levels after the restoration activities or compared to reference areas. The researchers were somewhat encouraged that the pond fish Hg decreased after the June 1 notch opening. And although slough fish increased in Hg at first, by October the concentrations were down to levels seen before the restoration activities. In both pond fish and slough fish, the decrease in Hg happened within a few months of opening the notch. Tern eggs remained high in Hg because eggs represent an aggregate of Hg in the environment, so one nesting season would not show a decreased response as quickly as did the fish. An EPA grant to continue monitoring Hg in birds and slough fish was awarded for 2013. We are still awaiting the results of the 2013 bathymetric surveys for this area.

The increase in Hg seen in tern eggs and fish could be related to the construction activities, where a perturbation in a system can increase Hg in biota for a period of time before going back down. Researchers think that opening and closing the notch every 6 months may be continually perturbing the system, thereby exacerbating MeHg production. They hypothesize that opening the notch year round would be better than frequent opening and closing, and might also benefit nesting birds which require stable water levels during the nesting season. They also suggest that opening the A8 Notch more than 15' (out of a maximum of 40') may not be prudent until we better understand the effects of opening on Hg bioaccumulation more fully; and that it may be better to let the system equilibrate more slowly. The second best option would be to open the notch earlier so that the bird nests are not flooded, but to have flow-through so that the conditions believed to enhance methylation of Hg are minimized. Since Pond A8 was completed in 2010, three tide gates in the Pond A8 notch have been opened as of 2012. As a result of this study, we are working with NMFS to alter Pond A8 operations to modify the operational regime for a 2014 applied study.

Pond A16

For 2013, the Service committed to conducting sampling at Pond A16 for Water Board compliance with Continuous Circulation Monitoring (CCM) water quality standards (salinity <44 ppt, 10th percentile DO >3.3 mg/L, pH 6.5-8.5). One datasonde was to be placed at the discharge of Pond A16 to monitor continuously from July 1 through September 30, 2013. Due to lack of staff resources and complications obtaining datasonde equipment, the CCM did not occur in 2013. The Service continued to conduct weekly site visits to Pond A16 to record pond and intake readings for depth and salinity, make visual pond observations to locate potential algae buildup or signs of avian botulism, as well as inspect water control structures and levees as part of our regular levee maintenance program.

Pond SF2

For 2013, the Service committed to conducting sampling at Pond SF2 for Water Board compliance with Continuous Circulation Monitoring (CCM) water quality standards (salinity <44 ppt, 10th percentile DO >3.3 mg/L, pH 6.5-8.5). One datasonde was to be placed at the discharge of Pond SF2 to monitor continuously from July 1 through September 30, 2013. Due to lack of staff resources and complications obtaining datasonde equipment, the CCM did not occur in 2013. The Service continued to conduct weekly site visits to Pond SF2 to record pond and intake readings for depth and salinity, make visual pond observations to locate potential algae buildup or signs of avian botulism, as well as inspect water control structures and levees as part of our regular levee maintenance program.

As part of Hobbs 2013 applied fish study, he looked at Pond SF2 to document fish and invertebrate species use in restored tidal ponds, muted ponds and adjacent sloughs and assess the basic health and condition of fish in restored salt ponds. Hobbs noted that because of the limited tidal range within the pond, very little vegetation has recruited within the pond complex. Pond SF2 is adjacent to a fringing salt marsh dominated by pickleweend and gumplant (*Grindelia*). The fringing marsh is between 100-m and 30-m wide and has several 2^{nd} and 3^{rd} order creeklets (small, typically dendritic tidal channels) draining it. The channel that connects the water control structures to the adjacent bay cuts through the marsh and is about 20-m wide and 60-m long. Because of the limited tidal flow, there is poor channel definition within the pond itself, but the remnant borrow ditch is present. In 2013, Pond SF2 was sampled with baited minnow traps, beach seines and gillnets bi-monthly through June. Sampling ceased due to low catch and significant sedimentation. Anecdotal data on pond depths from 2010 to 2013 suggest the pond has accreted approximately 6-ft of sediment in the ditch on the bayside of pond SF2 where the sampling sites were located. In 2010, this channel was approximately 10-ft deep based on depth measurements using oars from a 14-ft Jon boat. In 2013, it was possible to walk from the levee to the islands across this formerly deep channel. The beach seine site at the northeast corner adjacent to the Cargill brine pond had almost completely filled with sediment to the point that they could no longer pull a seine. Because the SF2 pond depths became too shallow to effectively sample and they stopped sampling SF2 in June. Preliminary results indicate that Pond SF2 at times had high abundance of fishes including Top Smelt and Leopard Sharks. However the muted tide and high turbidity of the bay waters has resulted in the pond accreting sediment and the once deep borrow ditch has now filled significantly. In addition, water quality conditions in the summer months can become inhospitable to fish with dissolved oxygen concentrations at or near the 2-mg/L level at which most species cannot survive long periods of time.

Fisheries Monitoring

Monitoring the Response of Fish Communities to Salt Pond Restoration
Dr. James A. Hobbs released a draft *Monitoring the Response of Fish Communities to Salt Pond Restoration: 2013 Annual Report*. The final report will be posted on the Project website at: http://www.southbayrestoration.org/documents/technical/ once it has been finalized.

In summary, the restoration of solar evaporation ponds to full tidal actionsupported a diverse assemblage of fish and macro-invertebrate and where functionally equivalent to the adjacent slough habitats. The tidal ponds provide spawning and nursery habitat for many important species including, Pacific Herring, Northern Anchovy and Longfin Smelt, historically important pelagic species that were key components of the San Francisco Bay Estuary food web. Northern Anchovy are the most abundant species of fish in the estuary and following the invasion of the overbite clam (Potamocorbula amurensis) underwent a significant decline in biomass. Moreover the Longfin Smelt is a state listed threatened species, and has undergone a dramatic decline in abundance, potentially warranting uplisting of the species to endangered status. Pacific Herring are the last commercially harvested species in San Francisco Bay and too have undergone significant declines. The addition of several thousand acres of former solar evaporation pond habitat to the estuary will result in increases in the abundance of these species; however, quantifying the overall abundance of these species is beyond the scope of this study as they occur in habitats outside the restoration areas. Tidal ponds have also provided novel habitats for piscivorous sport fish and created new recreational opportunities for sport fishers in Lower South Bay.

While the muted ponds did support many species of fish and invertebrates, they had more non-native species, exhibited frequent low dissolved oxygen events, and are accreting sediment at a rate that will eventually change these habitats to tidal marsh, a state not intended with the initial design of the muted ponds. Given the construction costs of the muted ponds and the problems they are creating, the muted pond design hasbeen extremely problamaitc..

Reported Fish Kills

No major fish kills were observed during 2013 that were associated with pond operations or Phase I restoration ponds. However, in 2013, the Service found 6 dead Chinook salmon and 12 live salmon in pond A16. These fish were located inside the Pond A16 as well as inside the fish screen (intake) holding area.. Through coordination with NMFS and Dr. James Hobbs, we believe these fish are entering the pond through the discharge and we are working with NMFS to determine how to resolve this problem. We will continue to coordinate with NMFS in 2014 on this issue.

Phase II Planning

In 2010, the Project Management Team members participated in a design charrette using specific criteria to create a set of proposed actions that would make up the Project's Phase II of restoration, enhancement, public access and flood protection projects. During 2010-12, the proposed actions were refined with input from Project stakeholders and a Notice of Intent/Notice of Preparation to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/R) was released in October 2013. These actions are generally described below, but are subject to change depending on the outcome of the CEQA and NEPA analyses currently underway. The Public Draft EIS/R should be available during the summer of 2014 and our goal is to have a Final EIS/R out late this year or early 2015. The Project anticipates coordinating a regulatory meeting to occur in May 2014. A subset of the Phase II actions are described below:

<u>Southern Eden Landing</u>

For the area of ponds between Old Alameda Creek and the Alameda Creek Flood Control Channel (referred to as "Southern Eden Landing"), the proposed Phase II actions are phased tidal wetland restoration integrated with flood protection measures deemed preferred alternatives by Alameda County Flood Control District, and with public access that links with existing and planned Bay Trail and Water Trail segments. The landowner (CDFW) and the local flood control partner (ACFCD) will need to collaborate to achieve a design that: 1) will be functionally integrated with flood protection measures that will preclude FEMA's mapping of landward areas as being subject to coastal flooding; 2) restores full tidal action to the ponds with adequate fish and wildlife passage; 3) increases public access to these areas, including the completion of the Bay Trail spine; and 4) provides necessary access for maintenance and repair of the flood protection measures for up to 5 years after completion of construction.

<u>Alviso Ponds (A1, A2W, Charleston Slough)</u>

The overall goal for Phase II in this area is to restore tidal wetlands in Ponds A1 and A2W, increase public access opportunities, and create upland transition habitat. Phase II designs in Ponds A1 and A2W will include an option that evaluates the possibility of including Charleston Slough in the restoration. However, Charleston Slough is the property of Mountain View, and Mountain View has existing mitigation requirements and other high priority uses for that pond. The goals of this project would be to jointly meet the habitat goals of both the Project and the original Charleston Slough project in a way that is more cost-effective without compromising the existing critical uses of the site.

Ravenswood Ponds (R3, R4, R5, S5)

The overall goal for Phase II in this area is to restore Pond R4 to tidal wetlands, create managed pond habitat in Ponds R5/S5, improve trail linkages, and create upland transition habitat. Redwood City originally approached the Project Management Team members to discuss options to utilize Ponds R5/S5 as flood storage during annual rain events to alleviate an existing flooding issue along Bayfront Canal.

Beneficial Reuse of Dredged Material

In a related project, the beneficial reuse of dredged material for habitat restoration and enhancement in the Phase II ponds is being investigated. Planning for reuse of this material will be included in the Phase II EIS/EIR. More information on Phase II planning and how to participate is located on the Project's website:
http://www.southbayrestoration.org/planning/phase2/.

2014 Monitoring and Applied Studies

- A continuous monitoring device will be installed at the discharge of Ponds A3W, SF2, and A16
- Visual observations at all ponds will continue in 2014
- The SBSPRP Science Program is discussing more applied studies (fish, mercury, etc.) for 2014
- The Service and other members of the SBSPRP Project Management Team would like to meet with the Water Board to discuss 2014 and future years

APPENDIX A
2014 ALVISO POND A2W OPERATION PLAN

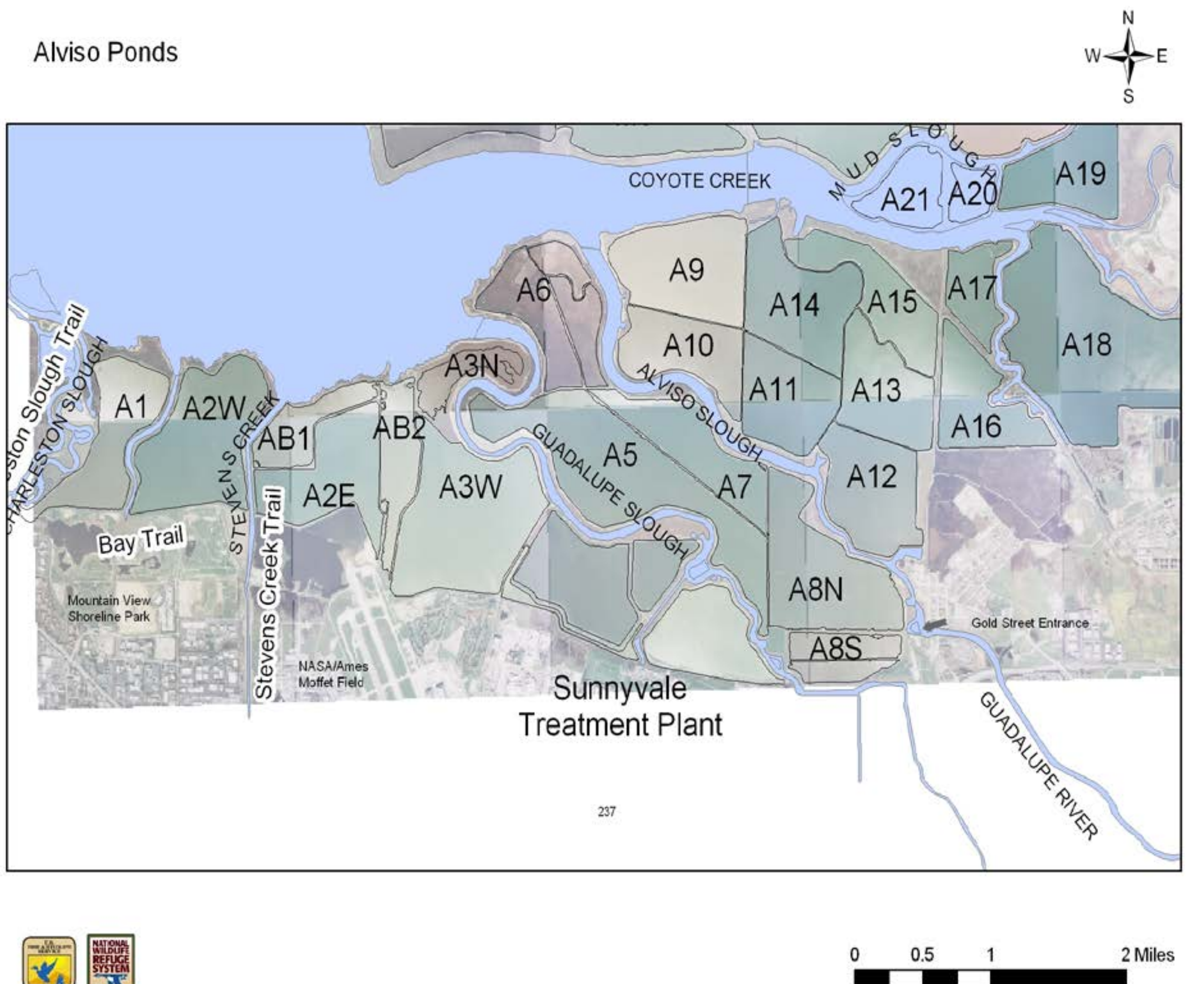
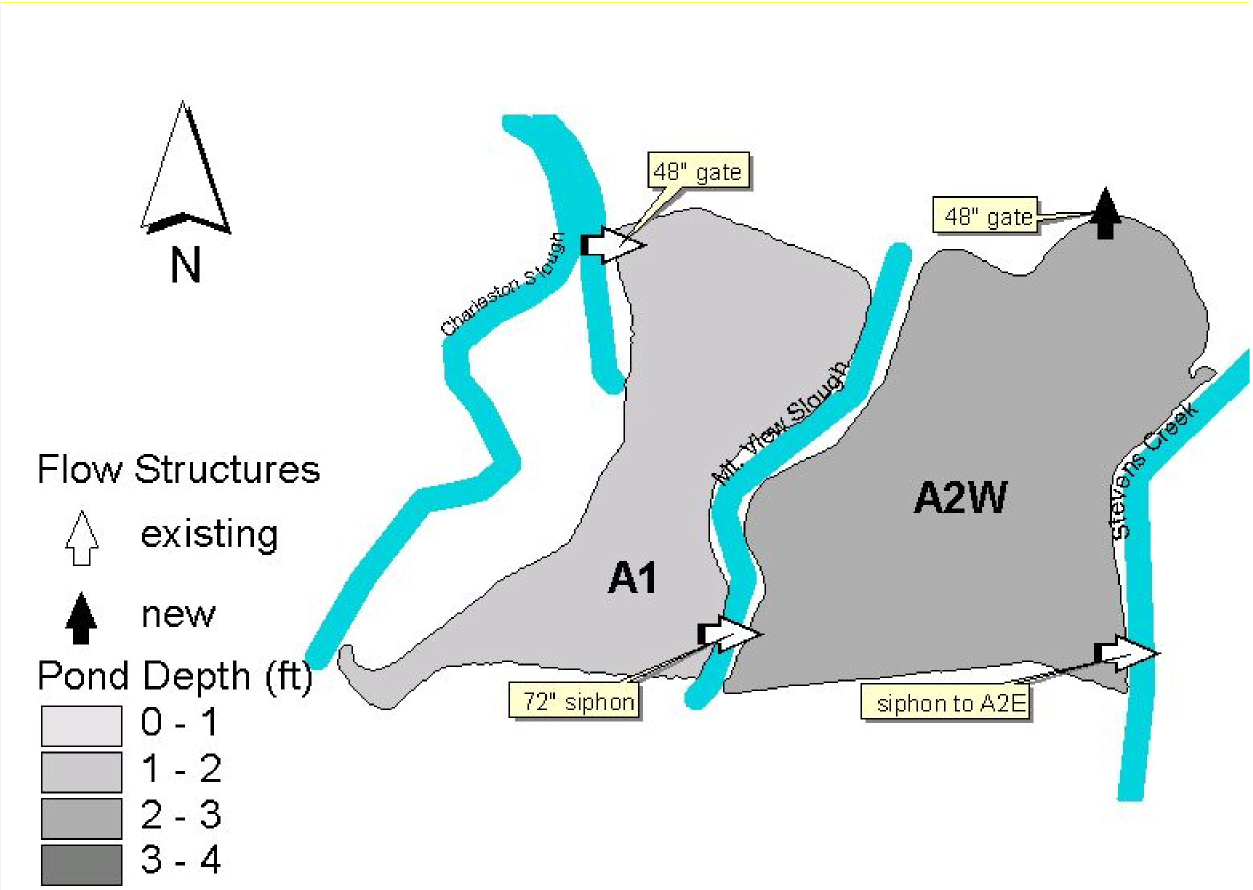


Table of Contents



Objectives

Maintain full tidal circulation through ponds A1 and A2W while maintaining discharge salinities to the Bay at less than 40 ppt. This program will also include monitoring for avian botulism, and potential for inorganic mobilization.

Structures

The A2W system includes the following structures needed for water circulation in the ponds:

- Existing 48” gate intake at A1 from lower Charleston Slough
- New NGVD gauge at A1
- Existing 72” siphon under Mountain View Slough between A1 and A2W
- Existing staff gauge (no datum) at A1
- New 48” gate outlet structure with 24’ weir box at A2W to the Bay
- New NGVD gauge at A2W
- Note that existing siphon to A2E should be closed

System Description

The intake for the A2W system is located at the northwest end of pond A1 and includes one 48” gate from lower Charleston Slough near the Bay. The system outlet is located at the north end of pond A2W, with one 48” gate to the Bay. The flow through the system proceeds from the intake at A1 though the 72” siphon under Mountain View Slough to A2W. An existing siphon under Stevens Creek to Pond A2E was used for salt pond operations. It should remain closed for normal operations, though it is available for unforeseen circumstances.

Operations of the A2W system should require little active management of gate openings to maintain appropriate flows. Summer and winter operations are described below to indicate predicted operating levels during the dry and wet seasons. The system will discharge when the tide is below 3.6 ft. MLLW.

Summer Operation

The summer operation is intended to provide circulation flow to make up for evaporation during the summer season. The average total circulation inflow is approximately 19 cfs, or 38 acre-feet/day, with an outlet flow of about 14 cfs (28 acre-feet/day). The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A1	277	-1.8	-0.4	2.0
A2W	429	-2.4	-0.5	NA

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A1 intakes	50	19
A2W	100	48
Weir	-1.2 ft NGVD	6 boards

Water Level Control

The water level in A2W is the primary control for the pond system. The outlet at A2W includes both a control gate and control weir. Either may be used to limit flow through the system. The system flow is limited by the outlet capacity. Normal operation would have the outlet gates fully open, and the weir set at elevation -1.2 ft NGVD, approximately 0.7 feet below the normal water level. The normal water level in A2W should be at -0.5 ft NGVD in summer. The level may vary by 0.2 due to the influence of weak and strong tides.

The A1 intake gate can be adjusted to control the overall flow though the system. The maximum water level in either A1 or A2W should generally be less than 1.2 ft NGVD. This is to maintain freeboard on the internal levees, limit wind wave erosion, and to preserve existing islands within the system used by nesting birds.

Design Water Level Ranges

Pond	Design Water Level Elev. (ft, NGVD)	Maximum Water Elev. (ft, NGVD)	Maximum Water Level (ft, Staff Gage)	Minimum Water Elev. (ft, NGVD)	Minimum Water Level (ft, Staff Gage)
A1	-0.4	1.2	3.6	-0.6	1.8
A2W	-0.5	1.1	NA	-0.7	NA

There is no existing staff gage in pond A2W. Therefore, there is no record of existing minimums and maximums. Based on system hydraulics, pond A2W would typically be about 0.1 feet below pond A1.

100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
A1	-0.4	-0.7	1.7
A2W	-0.5	NA	NA

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems.

Salinity Control

The summer salinity in the system will increase from the intake at A1 to the outlet at A2W, due to evaporation within the system. The design maximum salinity for the discharge at A2W is 40 ppt. The intake flow at A1 should be increased when the salinity in A2W is close to 35 ppt. If the gate at A1 is fully open, the flow can be increased by lowering the weir elevation at the A2W outlet structure. Increased flow will increase the water level in A2W. Water levels above elevation 1.1 ft NGVD should be avoided as they may increase wave erosion of the levees.

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. San Francisco Bay Bird Observatory conducts weekly surveys to find sick, dead or injured birds with any signs of an avian botulism outbreak. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

The winter operation is intended to provide less circulation flow than the summer operation. Evaporation is normally minimal during the winter. The winter operation is intended to limit large inflows during storm tide periods and to allow rain water to drain from the system.

The average total circulation inflow is approximately 9 cfs, or 18 acre-feet/day, with an outlet flow of about 9 cfs (18 acre-feet/day). The winter operation period would normally extend from November through April. The proposed gate settings are intended to limit the intake flow, and flow within the system.

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A1	277	-1.8	-0.6	1.8
A2W	429	-2.4	-0.6	NA

Winter Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A1 intakes	30	12
A2W	100	48
Weir	-1.2 ft NGVD	6 boards

Water Level Control

The water level in A2W is the primary control for the pond system. The system flow is limited by the both the intake and outlet capacities. Normal winter operation would have the intake gate partially open to reduce inflow during extreme storm tides. Water levels in the ponds are controlled by the outlet weir setting. The normal winter water level in A2W should be at -0.6 ft

NGVD, approximately 0.6 ft above the outlet weir. The pond water level may vary by 0.2 ft due to the influence of weak and strong tides, and over 0.5 ft due to storms

During winter operations, the water levels should not fall below the outlet weir elevation. If the elevation does decrease in April, it may be necessary to begin summer operation in April instead of May.

During winter operations, if the water levels exceed approximately 1.2 ft NGVD, the A1 intake should be closed to allow the excess water to drain. Note that without rainfall or inflow, it will take approximately 3 weeks to drain 1.0 ft from the ponds.

Salinity Control

The winter salinity in the system may decrease from the intake at A1 to the outlet at A2W, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease to as low as 11 ppt.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings. The monitoring parameters are listed below.

Weekly Monitoring Program

Location	Parameter
A1 intakes	Salinity
A1	Depth, Salinity, Observations
A2W	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees.

APPENDIX B
2014 ALVISO POND A3W OPERATION PLAN

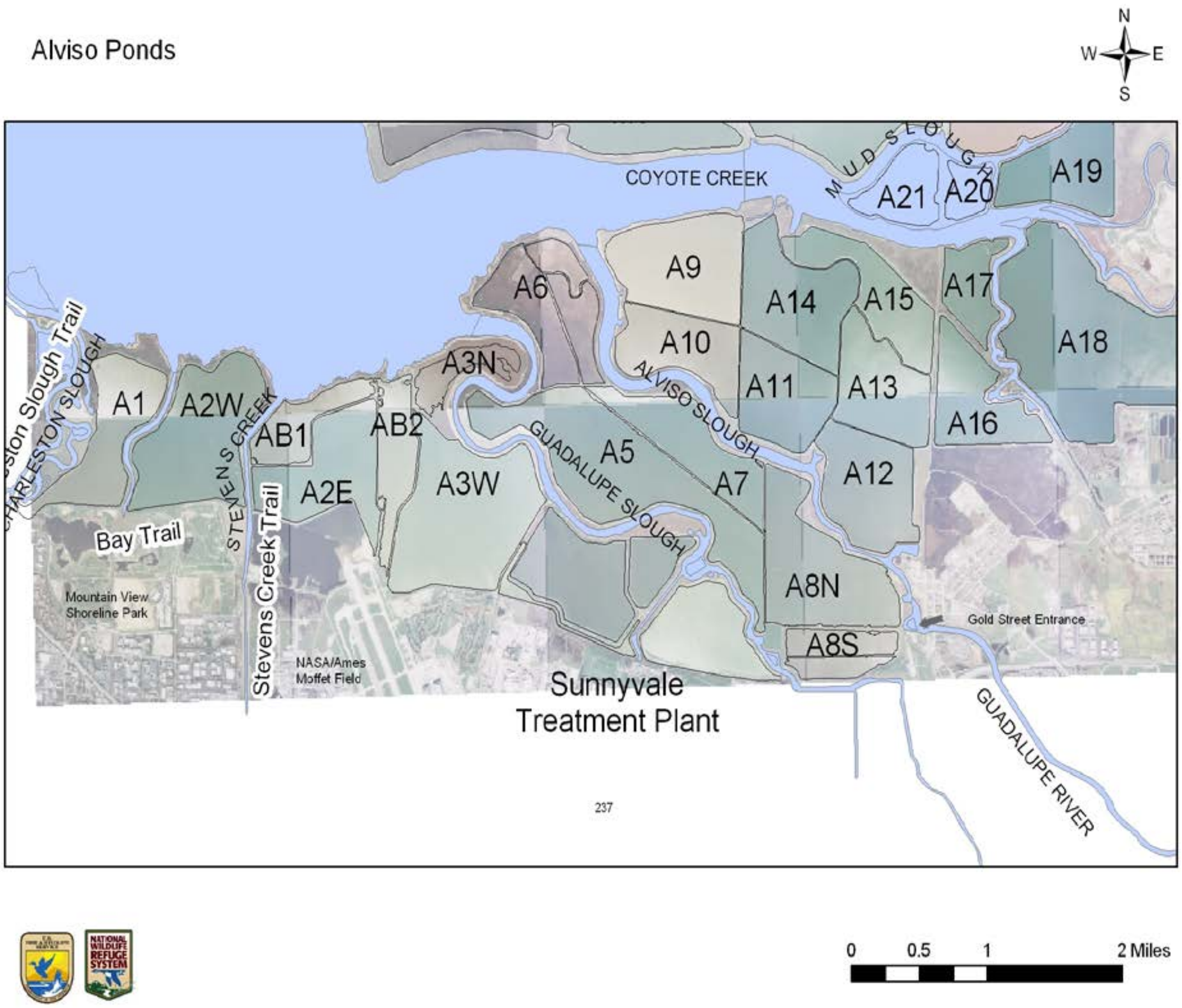
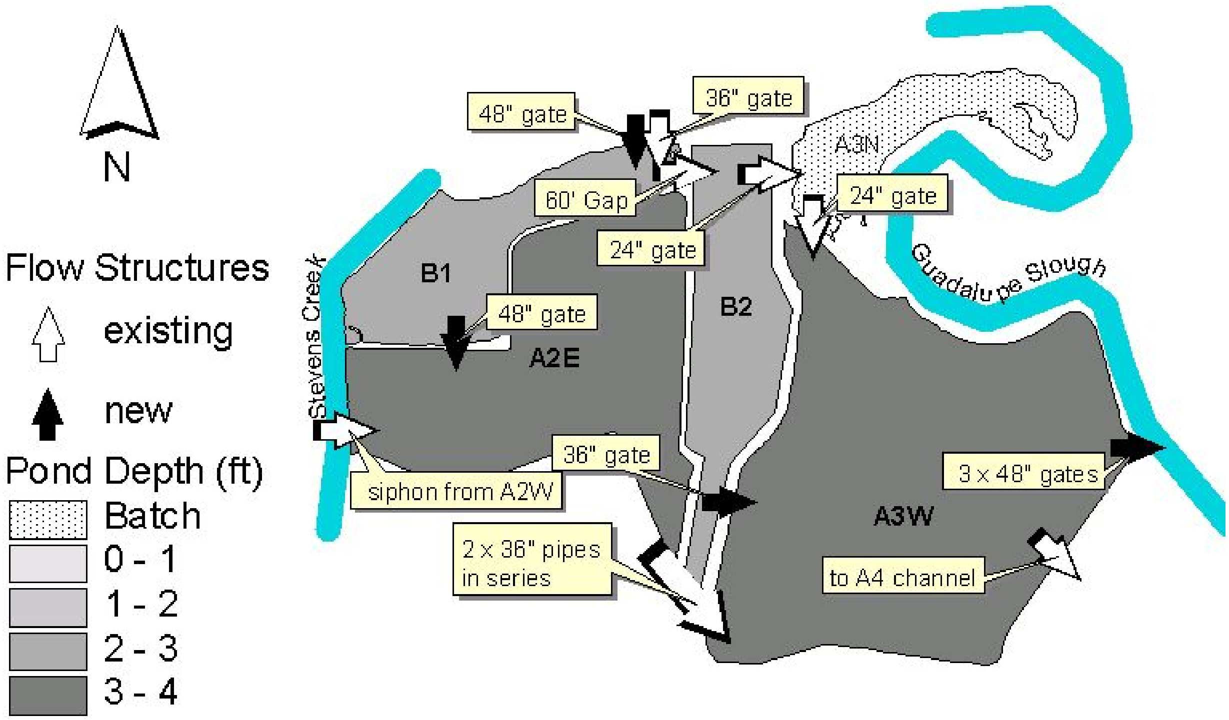


Table of Contents



Objectives

1. Maintain full tidal circulation through ponds B1, B2, A2E, and A3W while maintaining discharge salinities to Guadalupe Slough at less than 40 parts per thousand (ppt) and meet the other water quality requirements in the Water Board's Waste Discharge Permit. This program will also include monitoring for avian botulism, and potential for inorganic mobilization.

2. Maintain pond A3N as a seasonal pond. If results of wildlife population monitoring indicate the need, operate pond A3N as a batch pond (i.e., at higher salinities).

3. Maintain water surface levels lower in winter to reduce potential overtopping of A3W levee adjacent to Moffett Field.

Structures

The A3W system includes the following structures needed for water circulation in the ponds:

- Existing 36" gate intake structure from the Bay at B1

- New 48” gate intake from the Bay at B1
- New 48” gate between B1 and A2E
- Existing 2x36” pipes in series between A2E and A3W (no gates).
- New 36” gate between B2 and A3W
- Existing gap between B1 and B2
- Existing 24” gate between B2 and A3N
- Existing 24” gate between A3N and A3W
- New 3x48” gate outlet at A3W to Guadalupe Slough. Two are outlet only, and one allows both inflow and outflow, no weir.
- Existing staff gauges at all ponds and new NGVD gauges at all ponds
- Existing siphon from A2W is closed, but available if needed

System Description

The intake for the A3W system is located at the northeast end of pond B1 and includes one 48” gate and one 36” gate from the bay. The system outlet is located at the eastern end of pond A3W, with three 48” gates into Guadalupe Slough. The normal flow through the system follows two parallel routes. One route is from B1 to A2E and then to A3W. The second route is from B1 to B2 and then to A3W. Flow through the two routes is controlled by gates from B1 to A2E, and from B2 to A3W. There is an uncontrolled gap between ponds B1 and B2. Due to the size of pond A2E, the majority of the flow should be through A2E, with only minimal circulation flow through B2. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow would occur at high tide, and all outflows would occur when the tide is below 3.1 ft. MLLW.

Pond A3N is a seasonal pond. Therefore, for the ISP period, the pond will be drained, and left to partially fill with rain water during the winter and to evaporate completely during the summer. However, if wildlife population monitoring during this period indicates the need for additional higher salinity habitats or if mercury monitoring indicates an increase in methylation due to reduction in water levels, Pond A3N could be operated as a batch pond.

Summer Operation

The summer operation is intended to provide circulation flow to make up for evaporation during the summer season. The average total circulation inflow is approximately 35 cfs, or 70 acre-feet/day. The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
B1	142	-0.8	0.4	1.3
B2	170	-0.6	0.4	1.3
A2E	310	-3.1	-0.5	3.0
A3W	560	-3.2	-1.4	2.1
A3N	163	-1.4	NA	NA

* Pond B1 and B2 will be operated at lower water levels on an experimental basis in an attempt to improve shorebird nesting and foraging habitat. If water quality or operations are jeopardized from lower water levels in Ponds B1 or B2, the system will be reverted back to normal operating levels.

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
B1 west intake	100	36
B1 east intake	90	39
B1 – A2E	38	14
A2E – A3W	NA	NA
B2 – A3W	41	12
A3W outlets	100	48
A3W intake	0	0
B2 – A3N	0	0
A3N – A3W	0	0

Water Level Control

The water level in A3W is the primary control for the pond system. The system flow is limited by the outlet capacity. Normal operation would have the outlet gates fully open. Water levels are controlled by the intake gate settings. The normal water level in A3W should be at -1.4 ft NGVD (2.1 ft gage). The level may vary by 0.2 due to the influence of weak and strong tides.

The flow through B2 to A3W is only required to maintain circulation through B2. This circulation prevents local stagnant areas which may create areas of higher salinity or algal blooms. The gate can be set to a standard opening and would not require frequent adjustment.

The flow through A2E is controlled by the gates from B1 to A2E. The partial gate opening is to maintain the water level differences between A2E and B1. Again, the setting should not require frequent adjustment. There are no gates on the culverts between A2E and A3W, therefore the water levels in those two ponds should be similar.

The B1 intake gates should be adjusted to control the overall flow through the system. The water levels in B1 (and therefore B2) will change due to the change in inflow. The maximum water level should be less than 1.6 ft NGVD (2.5 ft gage). This is to maintain freeboard on the internal levees and limit wind wave erosion.

Water levels in Pond AB1 and Pond AB2 of Pond A3W system will be lowered during the summer to improve shorebird nesting and foraging habitat

Design Water Level Ranges

Pond	Design Water Level Elev. (ft, NGVD)	Maximum Water Elev. (ft, NGVD)	Maximum Water Level (ft, Staff Gage)	Minimum Water Elev. (ft, NGVD)	Minimum Water Level (ft, Staff Gage)
B1	0.4	1.6	2.5	-0.2	0.7
B2	0.4	1.6	2.5	-0.2	0.7
A2E	-0.5	-0.2	3.3	-2.0	1.5
A3W	-1.4	-0.2	3.3	-2.0	1.5
A3N	NA	NA	2.6	NA	NA

100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
B1	0.4	-0.8	0.1
B2	0.4	-0.8	0.1
A2E	-0.5	-2.2	1.3
A3W	-1.4	-2.7	0.8
A3N	NA	NA	NA

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems.

Salinity Control

The summer salinity in the system will increase from the intake at B1 to the outlet at A3W, due to evaporation within the system. The design maximum salinity for the discharge at A3W is 40 ppt. The intake flow at B1 should be increased when the salinity in A3W is close to 35 ppt. Increased flow will increase the water level in A3W. Water levels in pond A3W above elevation -0.2 ft NGVD (3.3 ft gauge) should be avoided as they may increase wave erosion of the levees.

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. San Francisco Bay Bird Observatory conducts weekly surveys to find sick, dead or injured birds with any signs of an avian botulism outbreak. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

The winter operation is intended to provide less circulation flow than the summer operation. Evaporation is normally minimal during the winter. The winter operation is intended to limit large inflows during storm tide periods and to allow rain water to drain from the system.

The average total circulation inflow is approximately 16 cfs, or 32 acre-feet/day, with an average outflow of approximately 18 cfs (36 acre-feet per day). The winter operation period would normally extend from November through April. The proposed gate settings are intended to limit the intake flow, and flow within the system.

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
B1	142	-0.8	0.9	1.8
B2	170	-0.6	0.9	1.8
A2E	310	-3.1	-1.8	1.7
A3W	560	-3.2	-1.8	1.7
A3N	163	-1.4	NA	NA

Winter Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
B1 west intake	34	10
B1 east intake	25	10
B1 – A2E	16	6
A2E – A3W	NA	NA
B2 – A3W	21	6
A3W outlets	100	48
A3W intake	0	0
B2 – A3N	0	0
A3N – A3W	0	0

Water Level Control

The water level in A3W is the primary control for the pond system. The system flow is limited by the outlet capacity. Normal winter operation would have the A3W outlet gates fully open. Water levels are controlled by the intake gate settings. The normal water level in A3W should be near -1.8 ft NGVD (1.7 ft gage). The level may vary by 0.2 due to the influence of weak and strong tides, storm tides, and rainfall inflows.

The water levels in A3W are important to prevent levee overtopping. The south levee separates the pond from the Moffit Field drainage ditch. The levee is low, and subject to erosion with high water levels. If the water level in A3W exceeds -0.6 ft NGVD (2.9 ft gage), the intake gate openings at B1 should be reduced or closed. The internal gates from B1 and B2 would also require adjustment. If the water level in A3W exceeds -0.2 ft NGVD (3.3 ft gauge), the intake gates and all internal gates should be closed until the water level in A3W is back to normal. This may take one to two weeks depending on the weather. The water levels in the upper ponds (B1, B2, and A2E) may increase due to rainfall during this period, but are less sensitive to higher water levels. The historic high elevation in pond A3W has been -0.2 ft NGVD (3.3 ft gauge).

Whenever possible, the system intake at B1 should be closed in anticipation of heavy winter rains and high tides. When the system intake gates are closed, the internal gates from B1 to A2E and from B2 to A3W should also be closed to keep water in the upper ponds (B1 and B2).

There is no gate between A2E and A3W. During winter operations with reduced flows through the system, the A2E water level will be similar to the A3W water level. During the summer, the higher flows will establish approximately 0.9 ft difference due to the head loss through the two pipes in series which connect the ponds.

Salinity Control

The winter salinity in the system may decrease from the intake at B1 to the outlet at A3W, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease to as low as 10 ppt.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings listed below.

Weekly Monitoring Program

Location	Parameter
B1 intakes	Salinity
B1	Depth, Salinity, Observations
B2	Depth, Salinity, Observations
A2E	Depth, Salinity, Observations
A3W	Depth, Salinity, Observations
A3N	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees.

APPENDIX C
2014 ALVISO POND A8 OPERATION PLAN

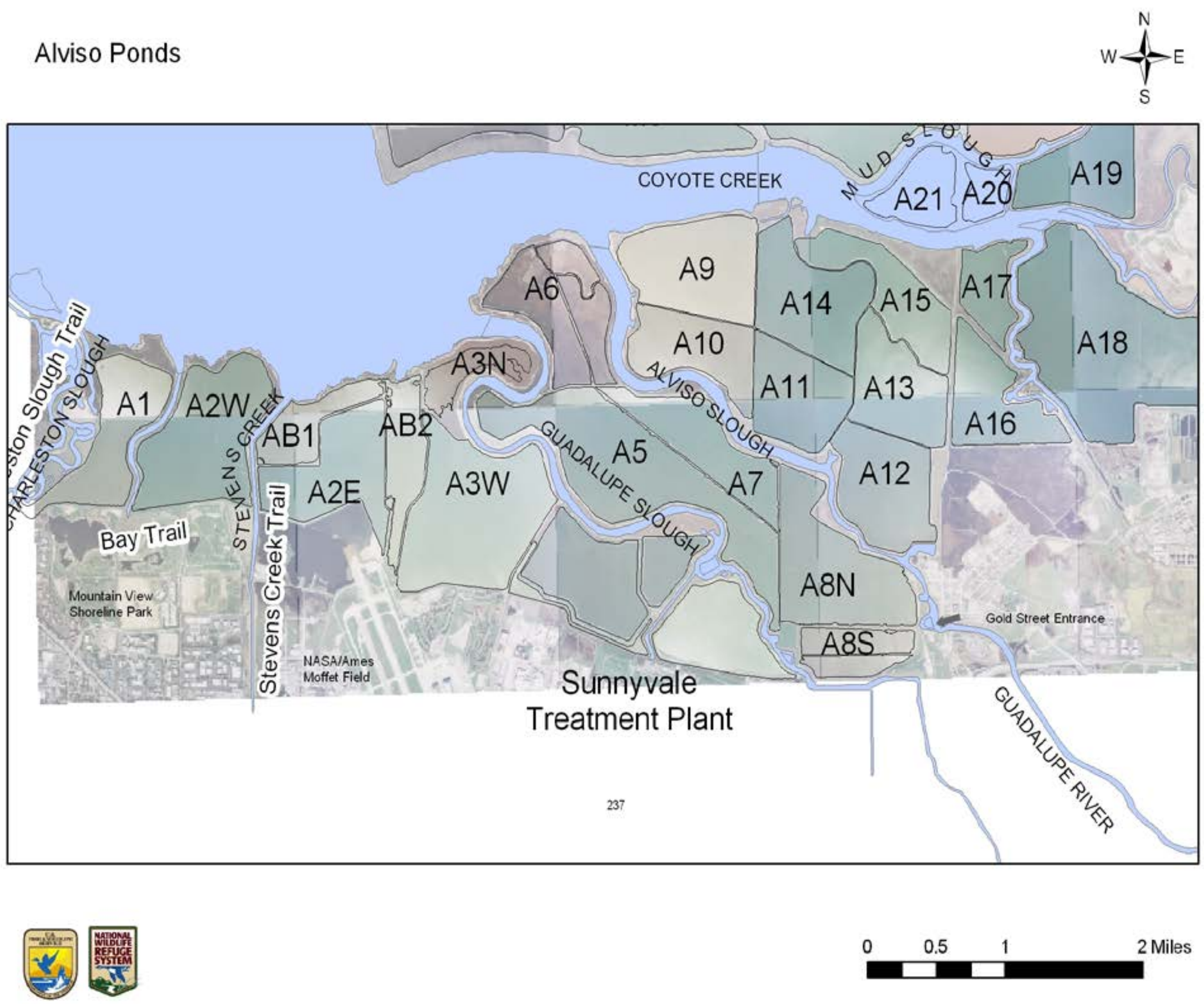
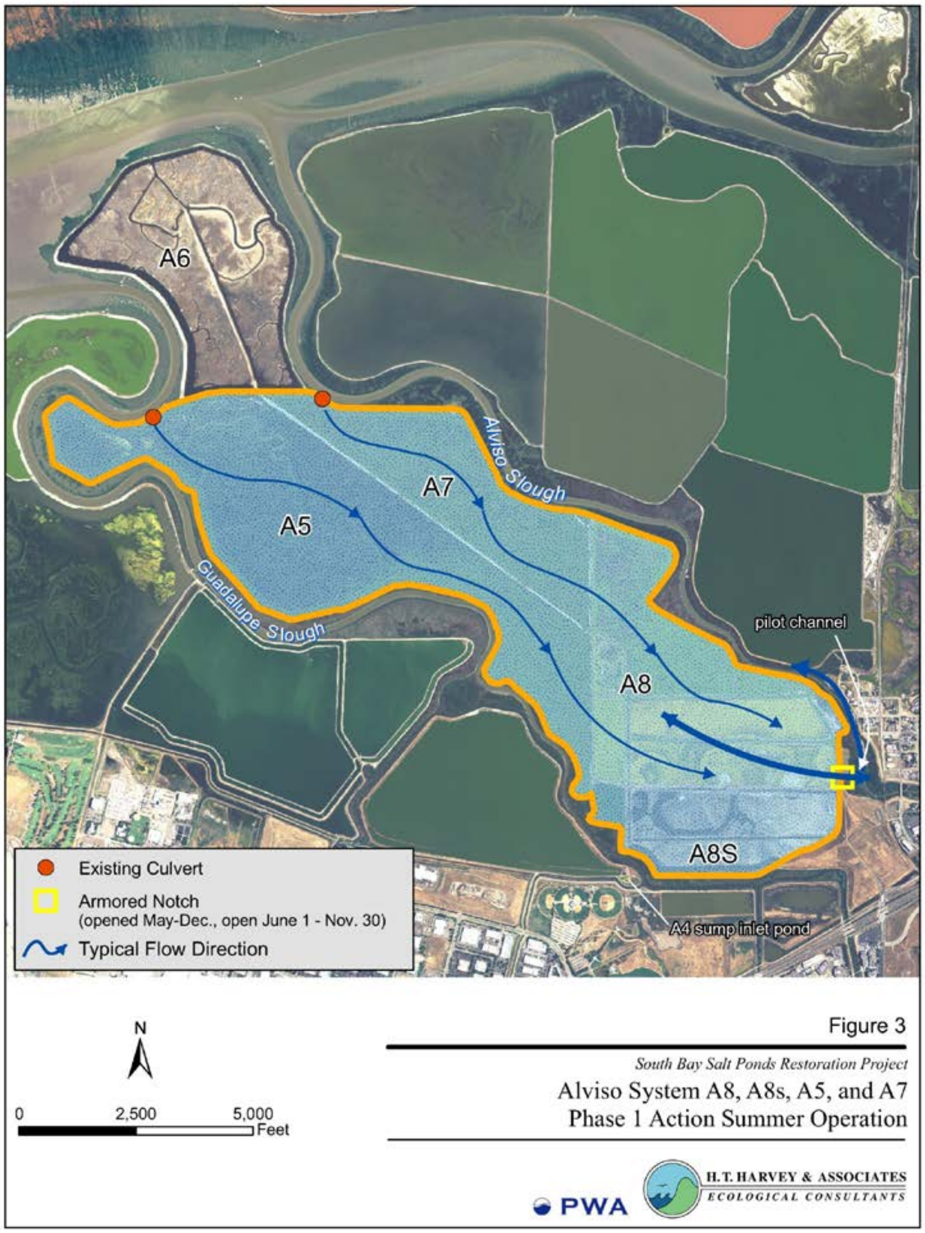


Table of Contents



Map provided by Philip Williams and Associates (PWA)

Goals

The Phase 1 action at Pond A8 is one of the initial actions for implementation under the larger South Bay Salt Pond (SBSP) Restoration Project. Pond A8 is identified as tidal habitat in the long-term programmatic restoration of the SBSP Restoration Project, which would contribute to achieving the overarching project goal of restoring wetland habitat while providing for flood management and wildlife-oriented public access and recreation (U.S. Fish and Wildlife Service et al. 2007). The Pond A8 system will be operated to maintain muted tidal circulation through ponds A5, A7, A8N and A8S while maintaining discharge salinities to the Bay at less than 40 ppt.

Structures

The A8 system includes the following structures needed for water circulation in the ponds:

- Existing 2x48" gate intake at A5 from Guadalupe Slough.
- Existing 2x48" gate inlet with two 24' weir boxes at A7 from Alviso Slough.
- Existing staff gages in ponds; Existing NGVD gages at A5 and A7 structures (see Figure 2).
- Existing 36" gate between A7 and A8N.
- Existing siphon between A4 to A5 will generally be closed; this siphon is pump driven rather than gravity fed.
- New 40-foot armored notch with multiple bays that can be opened and closed independently.

Figure 2: Water Level Gauge Locations

Weir Structure
A portion of the levee adjacent to Pond A8 was reconfigured as part of the Lower Guadalupe River Flood Protection Project (LGRFPP) to act as an overflow weir and take advantage of the off-line storage provided by the Pond A8 system. The LGRFPP was constructed by the Santa Clara Valley Water District (SCVWD) on the Guadalupe River/Alviso Slough between Highway 101 and Alviso Marina County Park. The 1,000-ft long overflow weir at Pond A8 allows high flood flows to exit Alviso Slough when water levels reach approximately 10.5 ft NAVD88. Due to the relatively low elevation of interior pond levees, flood water stored in Pond A8 would spill into Pond A8S (at 2.5 ft NAVD88), Pond A5 (at 3.25 ft NAVD88), Pond A7 (4.0 ft NAVD88), and eventually Pond A6 (at 10.0 ft NAVD88), (PWA et al. 2008).

A4 Siphon
The SCVWD may request to pump water from Pond A4 into Pond A5. At that time, SCVWD will provide monitoring data from Ponds A3W, A4 and A5 twice weekly, in accordance with the Pond A4 Water Management Operations Plan (December 2005) to assure that A8 discharges will remain below RWQCB permit limits. The Fish and Wildlife Service (USFWS) may also desire to pump water from Pond A4 into Pond A5 and may request SCVWD to do so. Operations of the A4 siphon will be consistent with the A4 MOU agreement between SCVWD and USFWS which was established in 2005.

Notch / Bridge Structure
The armored notch provides a muted-tidal connection between Pond A8 and upper Alviso Slough. Earth excavated to construct the notch has been placed within Pond A8 and covered by clean sediment. The notch width is adjustable up to approximately 40 ft. The depth of the notch (invert at 0.5 ft NAVD88) is approximately one foot above the average bed elevation (-0.5 ft NAVD88). The size of this structure was to maximize the volume of water exchanged between the slough and the pond while controlling water levels within the pond. The notch consists of multiple 'bays' that can be opened and closed independently. This allows for adjustments to the amount of tidal exchange between Pond A8 and Alviso Slough based on monitoring data. Initially, the notch is to be operated with only one bay open. Additional bays may be opened if monitoring data confirm that slough widening does not threaten downstream levees, in particular the levees along the east side of Alviso Slough (perimeter levees to Ponds A11 and A12). Flow through the notch occurs during both flood and ebb tides. Concrete armoring is to prevent unintentional widening and/or deepening of the notch. Vehicle access over the notch for maintenance of the overflow weir and management of flashboards is provided by a bridge that spans the 40-ft notch. The FWS at its own expense operates and maintains the notch, bridge, and access levees and insures that the notch remains fully functional. As part of the preventive maintenance, the FWS performs weekly monitoring for the notch, bridge, channels, weir boards, and access levees to document areas for repair. FWS staff will be monitoring for erosion, cracks, missing or defective pieces, vandalism, or any normal and/or abnormal wear that was not part of the original construction. Once these repair items have been identified, FWS staff will inform Refuge Manager of repairs needed to keep these improvements in fully functioning condition.

System Description

The Pond A8 project consists of a variety of elements that allow for a muted-tidal connection from adjacent slough to Ponds A8, A5 and A7. The notch can be closed if there is evidence of adverse environmental impact. Water exchange through this connection is limited and the tidal range within the ponds is muted. With a fully open notch, water level fluctuations in the ponds over a tidal cycle were predicted to be small (0.5 to 1 ft) compared to the range of tidal change in Alviso Slough (over 8 ft). Initially, water level fluctuations in the ponds are predicted to be less as the notch is to be only partially open. Water levels in Pond A8 were predicted to exceed elevations of internal levees, spill into adjacent Ponds A8S, A5 and A7 and modify the existing hydrologic regime in these ponds as well. Water levels were predicted to fluctuate over the tidal cycle evenly across the area of all the ponds, and depths vary due to differences in bed elevations. Depths were predicted to exceed those at which the ponds were managed under the ISP (<1 foot). Typical summer water levels are shown in Table 1.

A notch with multiple bays adds operational flexibility, and the operation of the notch is informed by on-going monitoring activities. Initially, the notch will be operated with one (5 ft) bay open during the dry season (summer and fall) in order to avoid excessive channel widening and possible erosion of perimeter levees along Alviso Slough and the former salt ponds (e.g., the A12 levee at the A8 'Bulge'). Depending on the actual channel widening observed and the amount of fringing marsh remaining, the notch width may gradually be increased up to its full 40-ft width. If monitoring indicates a substantial risk to the structural integrity of perimeter pond levees, additional channel scour could be halted by reducing the restored tidal prism. Closing one or more of the multiple bays provides this flexibility.

Table 1. Summer Pond Water Levels

Pond	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A5	-0.9	1.4	2.9
A7	-0.8	1.4	2.8
A8N	-3.6	1.4	NA
A8S	-3.5	1.4	NA

The intakes for the A8 system are located at the northwest end of pond A5 (two 48-inch gated culverts from lower Guadalupe Slough and at the northeast end of pond A7 (two 48-inch gated culverts from Alviso Slough. The discharge point is located at the east end of Pond A8 with a 40 foot notch which has adjustable independent bays that allows flood and ebb flow. In normal operations, the flow through the system starts at the intakes of A5 and A7, and then muted tidal at the notch in Pond A8. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow occurs at high tide, and all outflows occurs when the tide is below 8.12 ft. MLLW. The standard summer operation gate settings are shown in Table 2.

Table 2. Summer Gate Settings

Gate	Setting (% open)	# of gates and size
A5 intakes	100	2 X 48"
A7 intakes	100	2 X 48"
Notch	1 bay of boards to begin	1 of 8 bays

Water Level Control

The water level in A8 is the primary control for the pond system. The-40 foot notch at Pond A8 includes multiple bays that can be adjusted to reach desired pond depth. The intake gate settings or notch may be used to limit flow through the system. The system flow is limited by the outlet capacity. Normal operation is to have the intake gates fully open, and the initial notch setting is to have one bay fully open. The normal water level in A8 will normally be at 1.4 ft NGVD in summer (see Table 3). The level may vary by 0.2 feet due to the influence of weak and strong tides.

The A5 and A7 intake gates can be adjusted to control the overall flow through the system. The maximum water level in A5, A7, and A8 is to be less than 1.6 ft NGVD. This is to maintain freeboard on the external levees, limit wind wave erosion, and to preserve remnant lengths of islands within the system occupied by nesting birds. If future monitoring efforts result in re-evaluating the maximum level, the FWS will verbally consult with the SCVWD to determine appropriate water levels. Additionally, the extent of tidal exchange needs to be adjustable such than corrective actions can be taken if needed to avoid increases in flood hazards to the community of Alviso.

Table 3. Design Water Level Ranges

Pond	Design Water Level Elev. (ft, NGVD)	Maximum Water Elev. (ft, NGVD)	Maximum Water Level (ft, Staff Gage)	Minimum Water Elev. (ft, NGVD)	Minimum Water Level (ft, Staff Gage)
A5	1.4	1.6	3.1	0.9	2.2
A7	1.4	1.6	3.0	0.9	2.1
A8	1.4	1.6	NA	0.9	NA

Table 4. 100 Percent Coverage Water Level

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
A5	1.4	0.2	1.4
A7	1.4	0.2	1.4
A8	1.4	-2.5	NA

Table 4 shows the water elevation needed to cover the pond bottom. The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems.

Channel Erosion along Alviso Slough

Restoration of muted tidal action at Pond A8 is expected to deepen and widen the channel along the upper (landward) portion of Alviso Slough due to substantial increases in the slough tidal prism. The magnitude of tidal current velocities and associated slough scour would be related to the size of the notch opening, with less deepening and widening occurring with fewer open bays. These potential changes would increase the ability of the slough channel to convey flood flows and lower water levels associated with large rainfall-runoff events on the Guadalupe River. However, restoration of muted tides in Ponds A8, A7 and A5 during the rainy season would also reduce the amount of flood storage provided by these ponds and possibly result in higher maximum water elevations along Guadalupe Slough. Pond A8 would provide an opportunity to assess the changing flood conveyance along Alviso Slough and determine if flood hazards are decreased over both the short- and long-term. Monitoring data of slough scour and tidal regime would provide the necessary information to examine changes to baseline flood hazards. If it is determined that changes in channel conveyance always compensate for losses of flood storage, seasonal management of the Phase 1 notch could be modified.

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulinum* along water bodies. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of. Historically, Ponds A5 and A7 were susceptible to botulism outbreaks due to a shallow water depth and pond dynamics. At A8, the raised waters levels within the system should reduce potential botulism outbreaks.

Winter Operation

The notch is closed during winter months (December – May) to prevent entrapment of migrating salmonids. During these winter months, Pond A8 system is operated by closing the inlets at A5 and A7 and allowing them to discharge only until waters levels within Ponds A5 and A7 are at or below 0.6 NGVD. The gate between A7 and A8 is also opened to lower water levels in A8. Once the winter operation target level is reached at Pond A5, both A5 and A7 is operated as muted tidal as part of the FWS permit requirements stated in National Marine Fisheries Service (NMFS) biological opinion (NMFS et al. 2009). Table 5 shows the target water levels for winter operation. During winter operations, if the water levels exceed approximately 0.6 ft NGVD, the

A5 intake will be closed to allow the excess water to drain. Note that without pumping, rainfall or inflow, it will take approximately 3 weeks to drain 1.0 ft from the ponds. If water levels exceed the capacity of Pond A8, SCVWD will use pumps to remove excess water at various locations stated in the Pond A8 Floodwater Evacuation Plan (2006). With the pumping described in the 2006 plan, the pond should be returned to the beginning winter operations water level within 40 days.

Winter operation provides less circulation flow than the summer operation. Evaporation is normally minimal during the winter. Winter operation is to limit large inflows during storm tide periods to allow rain water to drain from the system, and maintain flood storage for the Guadalupe River. The Pond A8 system (Ponds A5, A6, A7, and A8) currently provides flood overflow storage and conveyance of Guadalupe River/Alviso Slough flows via the Pond A8 overflow weir along Alviso Slough. The Phase 1 action must maintain or improve current levels of flood protection. This includes avoiding unintentional breaching of downstream perimeter levees due to channel widening. Table 6 shows the winter gate settings which are based on visual observations of water elevations that provide enough water in the ponds to prevent mud flats from occurring, and not yet too high to overtop internal levees.

Table 5. Winter Pond Water Levels

Pond	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A5	-0.9	0.6	1.8
A7	-0.8	0.6	NA
A8N	-3.6	NA	NA
A8S	-3.5		

Table 6. Winter Gate Settings

Gate	Setting (% open)	# of gates and size
A5	100	2 X 48”
A7	100	2 X 48”
A8 Notch	Closed	Closed

Monitoring

The system monitoring requires weekly site visits to record pond and intake readings. The monitoring parameters are listed below in Table 7.

Table 7. Weekly Monitoring by Refuge staff

Location	Parameter
A5	Depth, Observations
A7	Depth, Observations
A8	Depth, Salinity, Observations

The weekly monitoring program includes visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees.

Mercury

Sediments in some parts of Pond A8, particularly in and along Alviso Slough, contain elevated levels of mercury contamination. Re-mobilization of mercury-contaminated sediments into the water column, either directly (e.g., during excavation of pilot channels) or indirectly (through increased sediment scour after the pond is opened to tidal action), could result in adverse effects on South Bay biota.

South Baylands Mercury Project started in 2006 to assess the risks associated with restoring pond A8 to tidal action and to collect baseline data prior to breaching. This study established baseline mercury levels in the sediment, water column, and various sentinel species (song sparrows, brine flies, long jawed mud suckers, silver sides, stickleback, killi fish, and yellow fin gobies); bioavailability of inorganic mercury in sediments; mercury methylation across salinity gradients in managed ponds, marshes, and other habitat types. These baseline data may be influenced by direction and/or future requirements imposed by regulatory agencies (including the RWQCB), as well as findings from other applied studies or scientific research. These baseline data will be used to inform management decisions to further minimize mercury exposure. Specifically, exceeding beyond the baseline levels will be cause for changing management of the armored notch.

Future mercury monitoring projects will be developed to advance the understanding of uncertainties faced by the project. If the change in operation of the pond by opening the notch results in a negative effect on the local environment, the notch may be operated differently or closed following the process described in the Memorandum of Agreement between FWS and the SCVWD. Alternatively, if there is not a negative effect or the benefits of tidal restoration appear to outweigh any negative effect, the FWS will consider beginning the planning process for full tidal restoration of Pond A8.

Alviso Slough Channel Scour and Effects on Downstream Levees

The SCVWD will monitor scour effects in Alviso Slough, as specified in the Memorandum of Agreement between FWS and the SCVWD. Monitoring will consist of taking cross-sections at two points in the slough annually to assess potential impacts to the FWS-owned levee bordering Pond A12 and the District-owned levee upstream (see Figure 2). The purpose for these inspections is to determine if operations of the notch have produced undesired scour or other undesired conditions, as described below. The District will provide results of its monitoring in an annual report to the FWS. If undesired scour of either levee occurs or other undesired condition is observed, the FWS will close the notch and promptly notify all the members of the SBSP Restoration Project Management Team (PMT), in writing. A meeting of the PMT will be convened to discuss and determine Adaptive Management actions as soon as possible to determine the appropriate course of action regarding the operation of the Armored Notch (e.g., changing Armored Notch operation).

As part of the regular monitoring conducted by FWS, FWS staff will visually inspect the levees downstream of the armored notch. Any of the following is considered to be an undesired condition:

1. Sloughing, scarps, or bulges in the levee slope
2. Ruts, rills, and erosion on the levee slope.
3. Cracks - transverse, longitudinal, or diagonal crack anywhere on the levee
4. Seepage- water emerging on slope, at toe, or beyond the toe of the levee
5. Sinkholes and/or animal burrows anywhere on the levee

Fish Entrapment and 2014 Operation Changes

Operation of the Pond A8 notch was initiated on June 1, 2011. However, because of the high mercury concentrations in the sediment from the historic upstream mining activities (both within the ponds, and buried in the sediments of Alviso Slough), the project is proceeding cautiously. In 2011, only 1 gate was opened, while 2012 and 2013, a total of 3 gates were opened each year. To prevent the possible entrainment of steelhead into the pond complex, the gates remain closed during the salmonid migration period from December 1st to June 1st of each year. During this initial period of opening, the project has been working with several researchers from USGS and UC Davis to assess the effect of these actions on mercury remobilization, methylation, and its effect on biota. The preliminary results indicate these periodic perturbations (opening and closing of the notch) may be worsening the mercury effects, and they have proposed that we either: 1) open the gates earlier so that we can ameliorate the local effects observed on nesting terns and fish, or preferably, 2) leave the gates open all year.

<u>2014 Applied Study</u>

The existing operations at the Pond A8 Complex are to open gates at the armored notch on June 1st and close the gates on Dec 1st each year. Number of gates opened can be progressively increased each year pending no adverse impacts from mercury or scour. To assist in the development of this applied study, the SBSP Restoration Project had ESA-PWA conduct a modeling exercise to look at the flow split between the river and the notch opening under a variety of flow regimes during the period between December 1 and May 31. These results were provided to NMFS in the summer of 2013. Additional coordination with NMFS in November and December 2013 resulted in the applied study plan presented below.

We are proposing the following modified operational regime during the applied study:
Open 3 gates as early as Feb 15th 2014, and keep them open until June 1, 2014. After June 1, 2014, and through December 1, 2015, the project may open additional gates up to the full 8 pending the physical and biosentinel results of the mercury studies and the steelhead entrainment results. Future course of action beyond Dec 1st 2015 to be decided in coordination with NMFS after the results of two seasons (spring of 2014 and spring 2015) have been analyzed. The two other water control structures in the complex will be operated as follows: A5 (1 gate closed, 1 gate intake only), A7 (1 gate closed, 1 gate open for bi-directional flow). Below is a synopsis of the steelhead smolt component of the applied study in support of the
proposed change in operations:

PURPOSE OF STUDY: Determine Steelhead Entrainment and Escapement in the Ponds A8, A7 &A5 in the Alviso Marsh Complex.

OBJECTIVES:

1. Determine if RFID (Radio Frequency Identification) antennae arrays with PIT (passive integrated transponder) tags could be used to detect PIT tagged steelhead outmigration from the Guadalupe River.
2. Determine potential entrainment rates of PIT tagged steelhead from the Guadalupe River, into Pond A8 through the water control structure on Alviso Slough, with three bays open to bi-directional flow beginning February 15, 2014.
3. Determine subsequent potential ability of PIT tagged steelhead to volitionally exit the Pond A8 Complex.

To address the questions regarding potential entrainment and escapement of steelhead smolts in Pond A8, our lead researcher Dr. James Hobbs of UC Davis, with assistance from biologists with NMFS and the Santa Clara Valley Water District (SCVWD), tagged wild juvenile steelhead in a size range consistent with smolting and migrating to the ocean this spring (90-230-mm SL) in the Guadalupe River with half-duplex PIT tags. To detect these PIT tagged out-migrating smolts from the Guadalupe River into Alviso Slough, we will have an RFID antenna located in the lower reach of the Guadalupe River above tidal influence.

Fish detected passing this location will be considered to have smolted and migrated out of the Guadalupe River. To detect smolt entrainment into the Pond A8 complex, additional RFID antennas will be placed: a) on the three bays of the “armored notch” of Pond A8, b) on the water control structure on Pond A5, where Guadalupe Slough water is exchanged with the pond, and c) on the A7 water control structure, where water from Alviso Slough is exchanged with the pond on both flood and ebb tides. These three structures are the only locations where water from the slough can enter or exit the pond complex. If additional bays at the armored notch are opened during the spring of 2015, additional RFID antennas will be installed to detected tagged fish passing through these structures.

PROGESS: In December 2013, Dr. Hobbs successfully tagged 25 fish in the size range consistent with the sizes likely to undergo smolting and out-migration this spring. Of the 25 fish tagged to date, 10 were captured then tagged and released in a 100-m stretch adjacent to Coleman Avenue, and 15 fish were captured then tagged and released in downtown San Jose next to St. John Park. With assistance from SCVWD biologists, Dr. Hobbs will continue to tag up to an additional 75 juvenile steelhead in January & February 2014 at locations in the lower reaches of the Guadalupe River. Upon completion of the final report for the 2014 study, Dr. Hobbs will meet with Gary Stern of NOAA Fisheries, Greg Brown of the Army Corp of Engineers, John Bourgeois Executive Project Manager, Laura Valoppi lead Scientist for the South Bay Salt Pond Restoration Project, and Eric Mruz of the U.S. Fish and Wildlife Service to discuss results and potential plans for a 2015 study plan. Results from 2014 will be used to create a study plan for 2015. Work in 2015 will be contingent upon collaboration with the Santa Clara Valley Water District and additional funding for Dr. Hobbs. If the 2015 study is not funded the gates will be fully closed for the period between February 1, 2015 through June 1, 2015 as outlined in the biological opinion.

LOGISTICS: The original study outline in the 2009 biological opinion for the study included the use of acoustic technology rather than RFID technology. This is primarily due to the size of fish, and the vulnerability of Steelhead to acoustic tags. RFID technology uses a much smaller tag (PIT-tag) that is less harmful to juvenile salmonids. In addition acoustic technology is much more expensive than RFID. We are working with the Santa Clara Valley Water District and NOAA Fisheries to purchase and install the RFID antennas and associated equipment and will be installing them on the Pond A8 notch, and on the A5 and A7 notches as described above. The study proposal originally thought that an upstream array could be placed on the Gold Street Bridge to detect when smolt are out-migrating; however that proved to be impossible technically so instead we are planning on installing an RFID station at a location to be determined upstream of tidal influence. The exact location of this station will be identified by the end of January. The site location will need to balance the trade-off of the difficulties accessing a station located in a remote location where vandalism or theft is less likely versus a location with easy access but higher foot traffic and potential for vandalisms and theft issue. If the RFID antenna arrays are not deployed and fully operational at all pond locations (Pond A8 notch, Pond A5 water control structure, and Pond A7 water control structure) by February 15, 2014, the Pond A8 gates will remained fully closed until such time as all arrays are operational, or June 1, 2014 whichever occurs first. Dr. Hobbs has been is working with local non-profit watershed stewards, The Santa Clara Valley Watershed Coalition regarding the project and they have expressed interest in the project and will be discussing purchasing an additional RFID station to be placed in the Guadalupe River to aid in the determination of outmigration of smolts. In addition the coalition is organizing citizen volunteers to patrol the station(s) in the Guadalupe River to protect against vandalism and/or theft. The volunteers would also be available to retrieve the RFID station in the event of a high flow event to prevent the stations from being washed out. In addition the Santa Clara Valley Water District has volunteered an intern to aid in installation and maintenance of the stream antenna. Other challenges to this study include routine maintenance of the stations. To assure maximum detection efficiency, battery power will need to be charged and exchanged as frequently as possible, which may be on a daily basis. We would appreciate any assistance that NMFS staff can provide to Dr. Hobbs in setup or maintenance of this system during the study.

REPORTING: RFID data will be reported as the number of fish detected, the individual tag identification, along with data on release date and location, from each antenna array from February 15 to June 1 or when no fish are detected out-migrating and slough water temperatures are above 24 °C. The ratio of detected fish at the upstream location to total fish tagged will be used to determine the proportion of fish tagged that successfully “out-migrated” from the Guadalupe River. Fish detected at the Pond A8 antennas in a direction determined as moving into the pond will be considered “entrained” and fish determined moving out of the pond and not detected again will be considered as successfully “escaped”. Fish detected as moving into Pond A8 and not detected escaping prior to May 15th will be considered mortalities. The success of escapement of Pond A8 will be reported as the ratio of fish entering the Pond A8 Complex to fish successfully exiting Pond A8. Since it is not possible to place RFID antennae in the slough downstream from the pond complex in Alviso Slough due to its width and depth, we will rely on published survival data for Napa River Steelhead (60% survival from acoustic tagged fish released in the upper Napa River and detected at the Golden Gate Bridge) to assess the success of fish escaping Pond A8 (Sandstrom et al. 2013). As part of ongoing restoration monitoring, bottom trawling and seining will occur in Alviso Slough and any steelhead encountered will be examined for PIT tag and recorded. Water quality monitoring of temperature, salinity, conductivity and dissolved oxygen will coincide with ongoing monthly fish monitoring at two stations in Alviso Slough (upstream Alviso adjacent to the armored notch of pond A8 and downstream adjacent to the A6 breach), and inside pond A8 near the armored notch. In addition, a continuous water quality station will be established inside pond A8 near the notch, which will record the same water quality variables every 30 minutes for the duration of the steelhead study. Daily average streamflow in the Guadalupe River will be monitored using the USGS streamflow station in the Guadalupe River (Guadalupe River at Highway 101; number 109 USGS 11169205).

The lead researcher will provide updates on study progress via electronic communication weekly once the antennae are in place. Any study plan modifications will be discussed via conference call with the project lead researcher, SBSPR lead scientist and executive project manager, and NMFS staff. A draft report for the 2014 results will be produced and distributed by to the project lead researcher to NMFS staff by July 1, 2014 for comments and revisions. A final report will be provided by September 1, 2014.

Dr. Hobbs has contacted several groups in the area including the Santa Clara County Creeks Coalition, students at San Jose State University, and USFWS reserve stewards to assist volunteers in monitoring the deployed equipment to guard against theft and or vandalism. It appears that we will have to exchange charged batteries out at a much greater frequency that we had originally anticipated due to the salinities in the study area. We would appreciate if you know of any additional volunteer assistance that might be provided to assist with maintenance of the equipment. We have worked very hard to gather the funding to start this study this year, and have exhausted our resources. If you are aware of any funding opportunities we would greatly appreciate it, in particular if smolt do not move this year and we have to continue the monitoring in 2015 we will have additional expenses.

Flood Storage Capacity

The Pond A8 system (Ponds A5, A6, A7, and A8) currently provides flood overflow storage and conveyance of Guadalupe River/Alviso Slough flows via the Pond A8 overflow weir along Alviso Slough. The Phase 1 action must maintain or improve current levels of flood protection. It is predicted by Phillip Williams and Associates (PWA) that the water surface elevation will decrease with the notch fully open. If future studies such as Mercury, channel scour, and fish entrapment prove to show no unacceptable risks, the notch can be operated fully open year round. Until the notch is fully open year round, winter operations (refer to winter operations 3.5) will be followed to maintain existing flood storage capacity.

Figure 3. Monitoring locations of Alviso Slough for erosion

APPENDIX D
2014 ALVISO POND A14 OPERATION PLAN

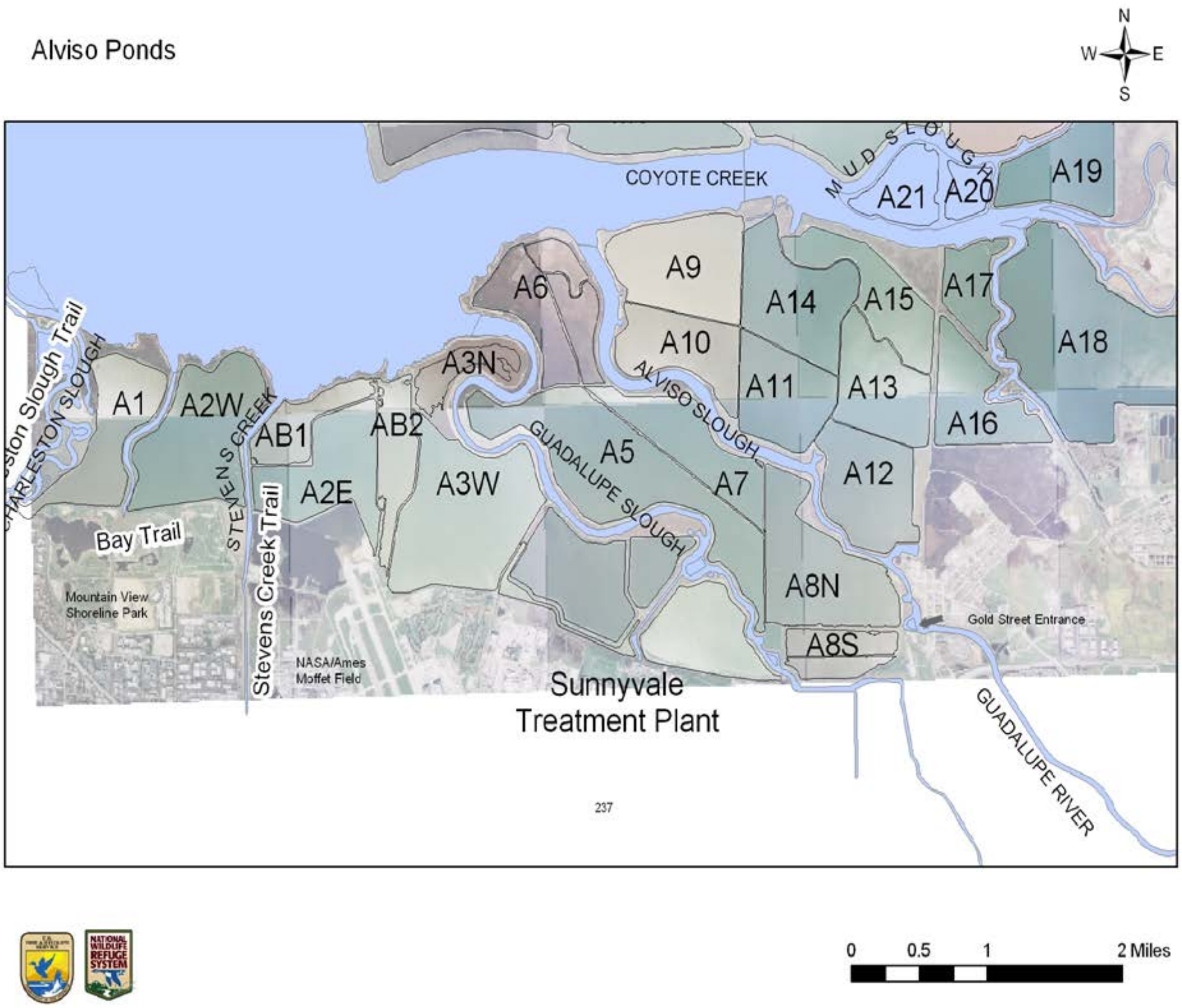
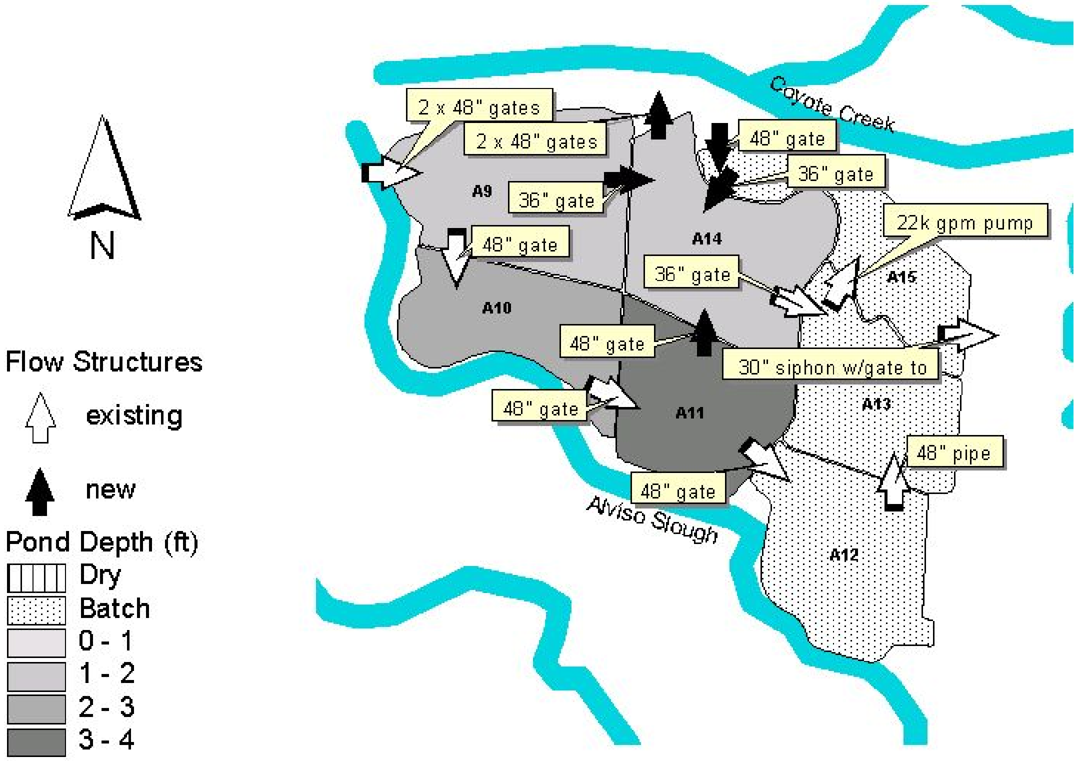


Table of Contents



Goals

1. Maintain full tidal circulation through ponds A9, A10, A11 and A14, while maintaining discharge salinities to Coyote Creek at less than 40 parts per thousand (ppt). This program will also include monitoring for avian botulism, and potential for inorganic mobilization.

2. Maintain pond A12, A13 and A15 as batch ponds. Operate batch ponds at a higher salinity (80 – 120 ppt) during summer to favor brine shrimp.

3. Minimize entrainment of salmonids by limiting inflows during winter.

4. Maintain water surface levels lower in winter to reduce potential overtopping.

Structures

The A14 system includes the following structures needed for water circulation in the ponds:

- Existing 2 x 48" gate intake at A9 from Alviso Slough
- Existing 48" gate between A9 and A10
- New 48" gate between A9 and A14
- Existing 48" gate between A10 and A11
- New 48" gate between A11 and A14
- Existing 48" gate between A11 and A12
- Existing 48" gate between A12 and A13
- Existing 36" gate between A14 and A13
- Existing siphon from A15 to A16
- Existing 36" gate between A15 and A14
- Existing 22,000 gpm pump from A13 to A15
- New 48" gate intake at A15 from Coyote Creek
- New 2 x 48" gate outlet at A14 into Coyote Creek
- Existing staff gages at all ponds and new NGVD gages at all pond

System Description

The intake for the A14 system is located at the northwest end of pond A9 and includes two 48" gates from Alviso slough near the Bay. The system outlet is located at the northerly end of A14, with two 48" gates into Coyote Creek. The normal flow through the system proceeds from the intake at A9, then flow through A10 and A11 to the outlet at A14. Because of the flap gates and the relative elevation of the tides and pond levels, all gravity intake flow would occur at high tide, and all outflows would occur when the tide is below 6.2 ft. MLLW.

Ponds A12, A13, and A15 will be operated as batch ponds to control the individual pond volumes and salinities.

Operations of the A14 system should require little active management of gate openings to maintain appropriate circulation flows. Summer and winter operations are described below to indicate predicted operating levels during the dry and wet seasons.

Summer Operation

The summer operation is intended to provide circulation flow to make up for evaporation during the summer season. The average total circulation inflow is approximately 38 cfs, or 17,000 gpm. The summer operation would normally extend from May through October.

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A9	385	-0.2	2.0	3.3
A10	249	-0.8	1.8	3.0
A11	263	-1.8	1.3	2.5
A14	341	-0.0	0.9	2.3
A12	309	-2.0	1.2	2.5
A13	269	-1.1	1.1	2.6
A15	249	0.7	2.8	4.1

Summer Gate Settings

Gate	Setting (% open)	Setting (in, gate open)
A9 north intake	100	48
A9 south intake	100	48
A9 – A10	100	48
A10 – A11	100	48
A11 – A14	100	48
A14 west outlet	100	48
A14 east outlet	100	48
A9 – A14	0	0
A11 – A12	0	0
A12 – A13	0	0
A13 – A15	0	0
A14 – A13	0	0
A15 – A14	0	0
A15 intake	0	0
A14 weir	0.0 ft NGVD	

Water Level Control

The water level in A14 is the primary control for the pond system. The system flow is limited by the inlet capacity at A9. Normal operation would have the outlet gates fully open. Water levels are controlled by the weir elevation at A14. The A14 weir should be at approximately 0.0 ft NGVD to maintain the summer water level in A14 at 0.9 ft NGVD (2.3ft gage). The level may vary by 0.2 due to the influence of weak and strong tides.

The route of flow through this system will be from A9 to A10 to A11 to A14. The partial gate opening is to maintain the water level differences between the ponds. Again, the setting should not require frequent adjustment.

The A9 intake gates should be adjusted to control the overall flow through the system. The water levels in A9 will change due to the change in inflow. The maximum water level should be less than 2.5 ft NGVD (3.8 ft gage). This is to maintain freeboard on the internal levees and limit wind wave erosion.

<u>100 Percent Coverage Water Level</u>

Pond	Design Water Level Elev. (ft, NGVD)	100 % Coverage Water Elev. (ft, NGVD)	100 % Coverage Water Level (ft, Staff Gage)
A9	2.0	1.6	3.0
A10	1.8	-0.2	1.0
A11	1.3	-0.2	1.0
A14	0.9	0.8	2.2
A12	NA	-0.3	1.0
A13	NA	-0.3	1.2
A15	NA	0.7	2.0

The 100 percent coverage values represent the estimated water level which begins to expose part of the pond bottom area. Lower water levels would expose large areas of the pond bottom to drying and may cause odor problems. The 100 percent coverage water levels are intended for information purposes only. Operating the ponds at or near minimum depths will interfere with circulation through the ponds and may cause significant increases in pond salinity during the summer evaporation season.

Pond A14 has an estimated average bottom elevation at 0.0 ft NGVD, but portions of the pond bottom are at 0.8 ft NGVD, very near the design water level. The proposed A14 water level may need to be adjusted to maintain circulation through the pond.

Salinity Control

The summer salinity in the system will increase from the intake at A9 to the outlet at A14, due to evaporation within the system. The design maximum salinity for the discharge at A14 is 40 ppt. The intake flow at A9 should be increased when the salinity in A14 is close to 35 ppt. Increased flow may increase the water level in A14. The inflow at A9 is constrained by the tide level in Alviso Slough since the intake gates would be fully open. The inflow can be increased by partially opening the gate from A9 to A14 to lower the water level in A9 and increase the gravity inflow. This would increase the flow through A9 and A14, but reduce the flow through A10 and

A11. Water levels in pond A14 above elevation 2.0 ft NGVD (3.4 ft gage) should be avoided as they may increase wave erosion of the levees.

Batch Ponds A12, A13, and A15 summer salinity levels should be between 80 and 120 ppt, to provide habitat for brine shrimp and wildlife which feeds on brine shrimp. Salinity control for the batch ponds will require both inflows to replace evaporation losses, and outflows to reduce the salt mass in the ponds and create space for lower salinity inflows. Ponds A12 and A13 would operate as a single unit, with inflow from pond A11 and outflows to either A14 or A15. The water levels in A12 and A13 would generally be between the elevations in A11 (higher than A12) and A14 (lower than A13). Therefore inflows from A11 and outflows to A14 would be by gravity. Outflows from A13 can also be pumped to A15. Water can also be pumped from A13 to A14 if the water levels are low in A13. Pond A15 would operate as a separate batch pond at a higher elevation than A13 or A14. Inflows to A15 would be pumped from A13, or by gravity from Coyote Creek with the supplemental intake at A15. Outflows from A15 would be by gravity to either A14 or A16.

The batch pond operation will require the outflow of approximately 0.5 to 0.7 ft of water from the batch ponds each month. This represents approximately 25 percent of the pond volumes. Because the A14 and A17 system have no circulation inflows from Coyote Creek for dilution from December through April, the outflow would normally occur during the evaporation season. The preferred operation would be to maintain the pond salinities near 100 ppt as much as possible, with consistent small outflows during the month from A13 to A14 and from A15 to A16. These gates should only be open approximately 10 percent, depending on the pond water levels. The inflows would be on a batch basis to add approximately 0.5 ft to the batch ponds about every other week.

If the salinity levels are high in A14 or A16, it may be necessary to reduce or suspend outflows from the batch ponds and allow the batch pond salinity to increase until later in the season. The salinity in a batch pond will increase by approximately 10 ppt per month during the peak evaporation months. If the batch pond salinities are high at the end of the circulation season, it may be necessary to continue to operate the A16 system with reverse flow during the winter continue to dilute the batch pond outflows until a reasonable salinity level is reached to start the next evaporation season.

Avian botulism

Avian botulism outbreaks most typically occur in late summer/early fall when warm temperatures and an abundance of decaying organic matter (vegetation and invertebrates) combine to present ideal conditions for the anaerobic soil bacterium *Clostridium botulism* along water bodies. San Francisco Bay Bird Observatory conducts weekly surveys to find sick, dead or injured birds with any signs of an avian botulism outbreak. Monitoring of weather for long periods of hot, dry, windless days during late August and early September will trigger on the ground monitoring for any signs of botulism. FWS will be in contact with the adjacent landowners such as the San Jose and Sunnyvale Treatment plants to determine if botulism is occurring on their ponds. Additionally, if any bird carcasses in the ponds or nearby receiving waters are observed, they will be promptly collected and disposed of.

Winter Operation

During the winter season, the A9 intake will be closed to prevent entrainment of migrating salmonids. The winter operation period would normally extend from December through May 31. During the winter, rainfall would tend to increase the water levels in the ponds. The water levels in the ponds would be set by a weir at the outfall or adjustment of the control gates to avoid flooding of the existing internal levees or wave damage to the levees. The gates from A9, A10, and A11 will be partially open to allow rainfall to drain to A14. Excess water from rainfall would be drained from the system after larger storms and will require additional active management to adjust the interior control gates.

<u>Winter Gate Settings</u>

Gate	Setting (% open)	Setting (in, gate open)
A9 north intake	0	0
A9 south intake	0	0
A9 – A10	100	48
A10 – A11	100	48
A11 – A14	100	48
A14 west outlet	0	0
A14 east outlet	100	48
A9 – A14	0	0
A11 – A12	0	0
A12 – A13	0	0
A13 – A15	0	0
A14 – A13	0	0
A15 – A14	0	0
A15 intake	0	0

<u>Winter Pond Water Levels</u>

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gage)
A9	385	-0.2	1.5	2.8
A10	249	-0.8	1.5	2.7
A11	263	-1.8	1.4	2.6
A14	341	-0.0	1.3	2.7
A12	309	-2.0	1.4	2.7
A13	269	-1.1	1.2	2.7
A15	249	0.7	2.8	4.1

Salinity Control

The winter salinity in the system may decrease from the intake at A9 to the outlet at A14, due to rainfall inflows within the system, which may exceed winter evaporation. During very wet winters, the intake salinities and system salinities may decrease to as low as 11 ppt.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings, as well as to inspect water control structures, siphons and levees. The monitoring parameters are listed below.

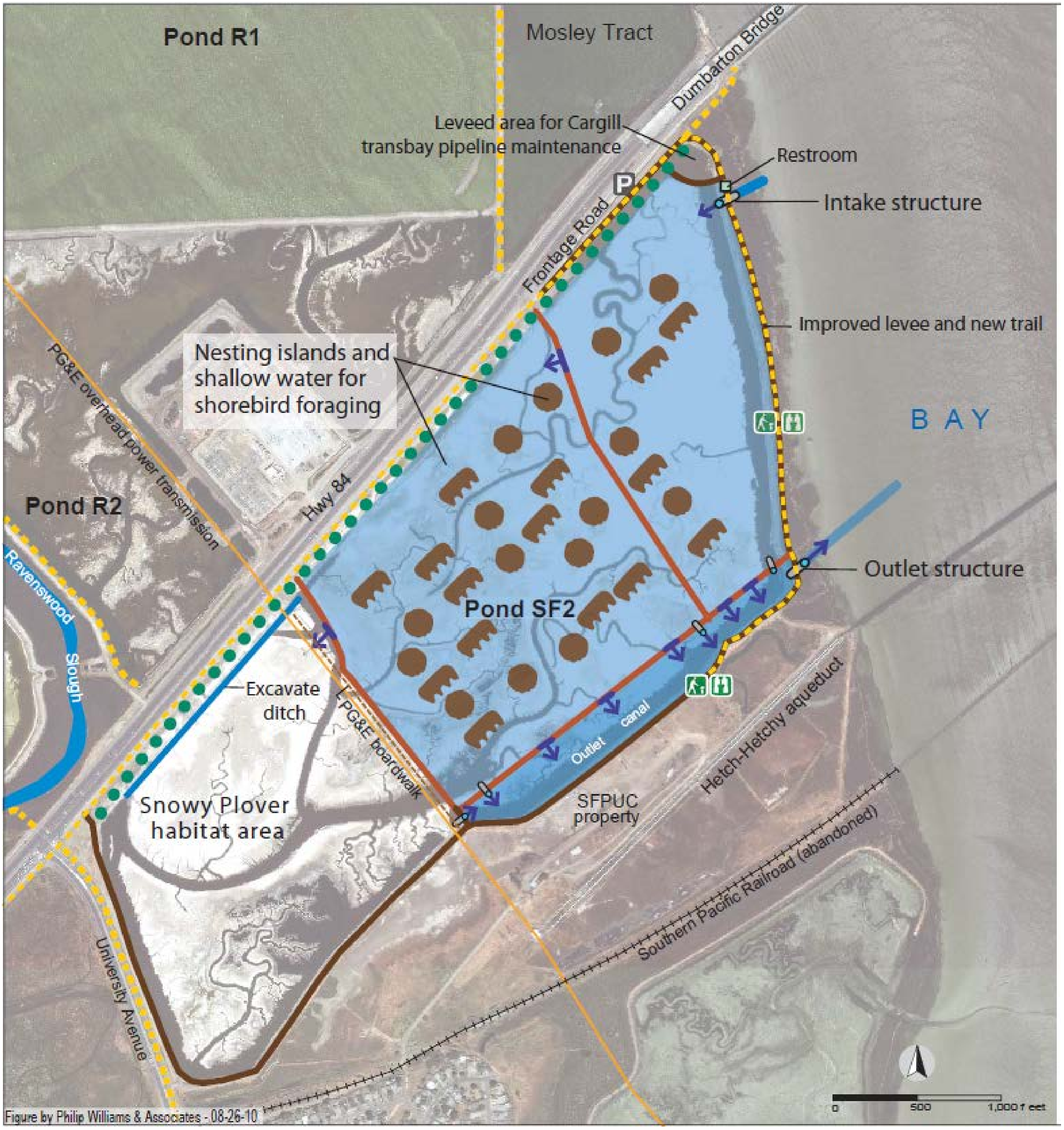
Weekly Monitoring Program

Location	Parameter
A9 intakes	Salinity
A10	Depth, Salinity, Observations
A11	Depth, Salinity, Observations
A14	Depth, Salinity, Observations
A12	Depth, Salinity, Observations
A13	Depth, Salinity, Observations
A15	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures, siphons and levees.

Appendix E
2014 Pond SF2 Operation Plan

Table of Contents



Map of SF2 System

Goals

The goals of Pond SF2 are to enhance 240 acres by creating a 155-acre managed pond with 30 nesting islands for nesting and resting shorebirds, and an 85-acre seasonal wetland for western snowy plovers. Pond SF2 includes three management cells; the eastern and middle cell will be managed pond habitat and the western-most cell will be managed seasonal wetland. Water control structures will be used both to manage water levels and flows into and out of Pond SF2 from the Bay, and between cells, for shorebird foraging habitat and to meet water quality objectives.

Structures

The SF2 system includes the following structures needed for water circulation in the ponds:

- New intake structure consisting of 5 new 4-foot intake culverts with combination slide/flap gates on each end of the culvert
- New outlet structure consisting of 6 new 4-foot outlet culverts, with combination slide/flap gates on both ends of each culvert
- Approximately 10,000 linear feet of earth berms were constructed to create three cells in Pond SF2
- Pilot channels were excavated to the Bay through the fringe marsh outboard of the new water control structures
- Approximately 400 linear feet of weirs
- Two new viewing platforms and benches
- Bathrooms and interpretive signage
- Exclusion fencing – around water control structures
- Approximately 1.2 miles of trash fence along Highway 84
- 0.7 of miles of ADA trail between Pond SF2 and the Bay

System Description

Water would flow into and out of Pond SF2 through new water control structures at the northern (cell #1) and southern ends (cell #4) of the bayfront levee between Pond SF2 and the Bay. Weirs with adjustable flashboard risers (flashboard weirs) will be used to control flow in and out of cells #2 and #3. Water would flow out of Pond SF2 during low tides through the outlet structure located in the southern portion (cell #4) of the bayfront levee. Within Pond SF2, flashboard riser weirs are installed to convey flow into and out of individual cells. The weirs would be located along the northwest edge of the pond and the southeast edge of the pond in portions of the deep

existing borrow ditch. The seasonal wetland area will have 1 intake and 1 outlet structure. The intake structure will consist of four 4-ft long flashboard weirs while the outlet structure will consist of 1 culvert with a flashboard weir box on the seasonal wetland area side and a tide gate on the outlet canal side (to prevent the outlet canal from flowing into the seasonal wetland area during high tides). In addition to the cell intake and outlet weir structures, 4 cell outlet culvert structures will be located where the berms cross deeper, historic channels and borrow ditches (giving a total of 5 of these structures including the seasonal wetland area outlet structure). These culvert structures are included to drain deeper water from these channels for periodic maintenance and as a water quality management approach. Water would be circulated through the cells in Pond SF2 at rates sufficient to meet water quality objectives. The water quality objectives for Pond SF2 would be to maintain adequate DO levels, salinity, and pH in the cells and at the outlet structure.

Summer Operation

The summer operation is intended to provide maximum circulation flow to compensate for evaporation during the summer season and improve water quality. Average summer inflow will be approximately 35 cfs and maximum summer inflow will be 365 cfs. From June 1 through January 31, the southern water control structure will be operated as a one-way outlet and the northern water control structure will be operated as a one-way intake. However, as we continue to learn how to manage Pond SF2 for optimal shorebird roosting and nesting habitat, we will manipulate the water levels in cell 1 by operating the intake as a two-way flow. With this option, Cells 2 and 4 would continue to operate as a one way continuous flow, but cell 1 would also be allowed to drain through the intakes at low tide and provide more mud flat areas within cell 1 which will provide more foraging habitat during high tides.

Operational Measures to protect Juvenile Salmon and Steelhead

Water Control Structure	Summer/Fall Operations	Winter/Spring Operations
SF2-1	No restrictions June 1 to Jan 31	Two-way flow or outlet only from Feb 1 to May 31
SF2-2	No restrictions June 1 to Jan 31	Two-way flow or outlet only from Feb 1 to May 31

Water Level Control

The water level in SF2 is designed to maintain shallow water which will provide extensive foraging habitat for the target species of shorebirds and waterfowl. Water levels are controlled by the outlet weirs located on cell 4.

Winter/Spring Operations

During the winter/spring season, both water control structures will be operated as “2-way” flow to create muted tidal conditions. The winter/spring operation period would normally extend from February through May. During the winter, rainfall would tend to increase the water levels in the ponds. Therefore, winter inflows are expected to be lower due to the presence of rainwater in the pond. If alternative management scenarios require either of the water control structures to be operated for one-way flow year-round, fish screens will be installed prior to their year-round use for one-way flow. The winter operation is intended to provide less circulation flow than the summer operation. Evaporation is normally minimal during the winter.

Monitoring

We will continue to take weekly depth and salinity readings in Pond SF2 during summer months. On our weekly checks, we will also visually look for changes within the pond such as algae blooms, stressed fish, mortality of fish, and insure levees and water control structures are in working condition.

APPENDIX F
2014 POND A16 AND A17 OPERATION PLAN

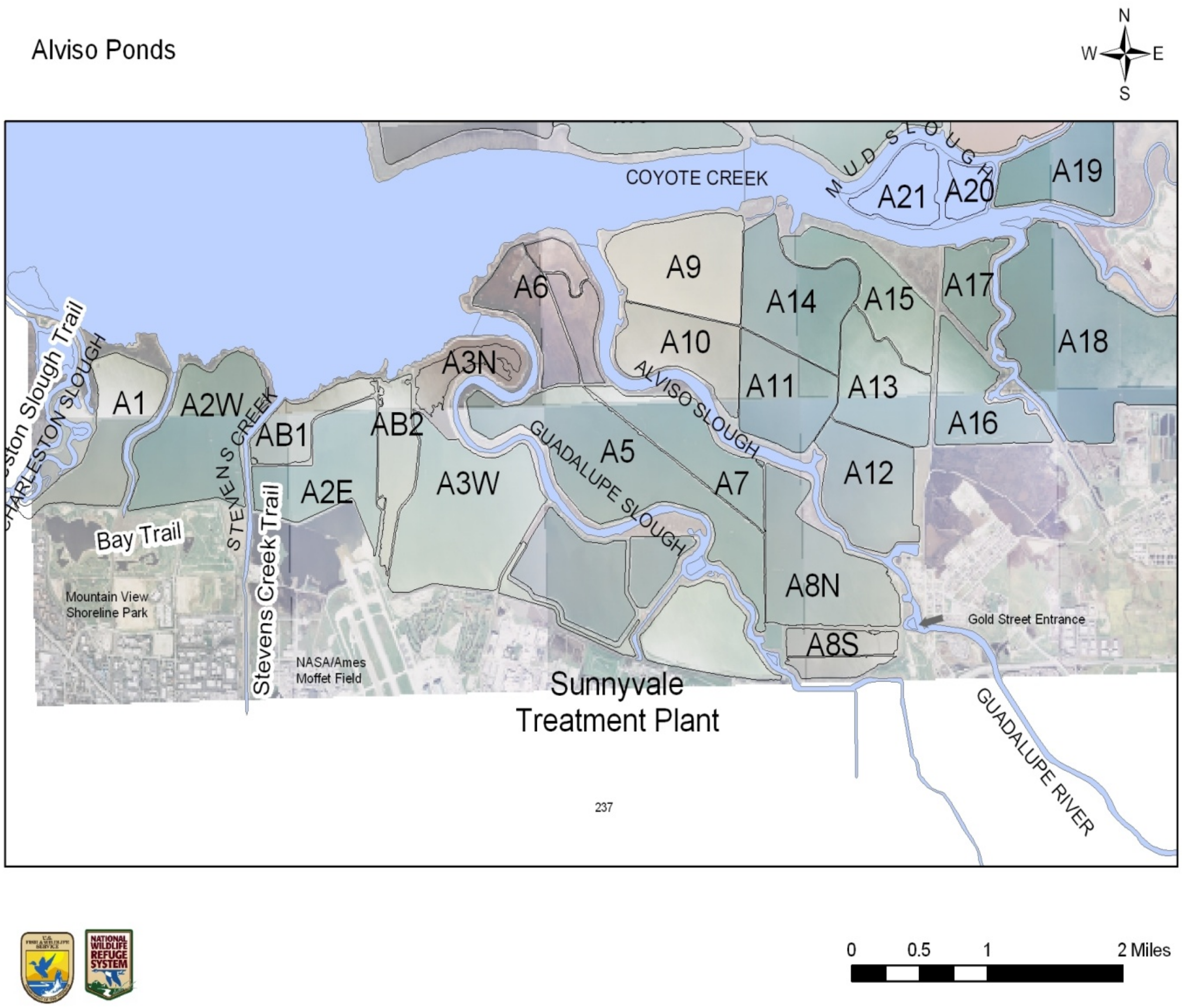


Table of Contents

Map of Pond A16/A17 System

Objectives

- Provide 130 acres of tidal marsh habitat in Pond A17 and 110 acres of managed pond habitat in Pond A16 with 16 new nesting islands
- Improve water quality through better water management
- Design accounts for storm surges or sea level rise by increasing Bay tides
- Avoid entrainment of salmonids by installing a fish screen on the A16 intake

Structures

The new Pond A16/17 system includes the following structures/features needed for water operations:

- removal of the WCS at the inlet of Pond A17 from Coyote Creek (breeched)
- lowering approximately 9,300 feet of levee on Pond A17
- New A17 water control berm with crest elevation of 11.0 feet NAVD at the levee – sloping down to approximately 4.0 feet NAVD where the berm ties into the marsh surface
- New 63-inch culvert intake at A16 near the southwest corner of A17 (200 cfs capacity)
- New fish screen installed inside the A16 intake
- New A16 outlet structure into Artesian Slough (180 cfs capacity)
- New 140-foot outlet pilot channel from A16 to Artesian Slough
- New 12.2-foot NAVD levee located in the A16-A17 canal near the southeast corner of Pond A17

System Description

<u>Pond A17</u>

The removal of the Pond A17 intake WCS and levee lowering in southern portions of the pond will allow uninhibited tidal fluctuations to occur in Pond A17 and hydraulic residence times will fluctuate with the tide cycle. With the restoration of Pond A17 to tidal habitat, this eliminates hydraulic residence time in Pond A17 to improve water quality. A report prepared by the United States Geological Survey titled *Sediment Deposition and Erosion in South San Francisco Bay, California from 1956 to 2005* prepared in 2006 describes sedimentation in the vicinity of Pond A17. Based on the findings of this report, it is expected that sediment will continue to accumulate south of the Dumbarton Bridge. This new tidal water regime is expected to transport sediment into the Pond A17 filling in the low elevation areas over time to match the existing marsh elevation of approximately MHW. This will result in approximately 130 acres of tidal marsh habitat.

A17 Water Control Berm

The A17 water control berm design criteria consists of the following:

- Crest elevation of 11.0 feet NAVD at the levee –sloping down to approximately 4.0 feet NAVD where the berm ties into the marsh surface.
- Side slope of 5:1.
- Final net fill height would be approximately 120% of finished grade.

A new water control berm was constructed in the borrow ditch on the east side of Pond A17 approximately 400 feet in length. The elevation of this berm is set at 11.0 feet NAVD at the levee and sloping down to approximately 4.0 NAVD feet at the marsh surface. The berm is intended to divert water through the western borrow ditch during incoming tidal flow. The diversion of water through the west borrow ditch would increase flow velocity and reduce the amount of sediment that would settle in the west borrow ditch. In addition, the berm is expected to enhance sediment settlement in the east borrow ditch by reducing flow velocities. This berm was constructed from the dry A17 levee lowering material and mechanically compacted to reduce settlement.

Pond A16

Pond A16 will be controlled by the A16 Intake and Outlet WCS's. Flows into and out of Pond A16 can be increased, decreased or completely shut off upon discretion by adjusting slide gates.

Table 1. Pond A16 Hydraulic Residence Time

Pond	**Area (acres)**	**Depth (ft)**	**Volume (acre-ft)**	**Outlet Flow ($ft^{3/s}$)**	**Residence Time (days)**
A16-New Design	243	1.68	408	60 (average flow)	3.4

The following design criteria were used for **hydraulic design**:

- Managed cell water depths.
    - Average depth approximately 2 to 8 inches (range no greater than 2- to 12-inches) around nesting islands, preferably at the lower end of the range.
    - The minimum target water level at the average depth of 2 to 6 inches is approximately 3.2 feet NAVD.
    - The design should allow flexibility to adaptively increase the area of very shallow water habitat, as needed, via adjustment of the water control structures.
- Increase flows and decrease hydraulic residence times in Pond A16 compared to existing conditions to provide adequate flushing for bird habitat and water quality objectives during the summer season.
- Prevent salmonid entrapment in Pond A16 year-round by using fish screens.

- Limit the level of effort required for the operation and maintenance during normal operations.
- Account for a storm surge or sea-level rise to increasing Bay tide levels by 16 inches (1.3 feet) relative to the baseline conditions.

Pond A16 would be managed hydraulically to meet the above stated design criteria for shallow water habitat. A large majority of Pond A16 bed has elevations ranging from 2.2 to 3.1 feet NAVD.

The following design criteria were used for **water quality management**:

- Provide sufficient hydraulic structure flow capacity to maximize flow through the managed cell to reduce residence time and maximize wind and flow-induced re-aeration.
- Design cells so that water levels can be raised or lowered for complete drainage.

The project elements have been designed to improve the existing water quality conditions within Ponds A16 and A17. Pond A16 would experience water quality improvements from the flushing of water twice a day by tide events above 3.2 feet NAVD.

<u>Pond A16 Intake WCS</u>

The A16 Intake WCS design criterion consists of the following:

- Maximum capacity of 200 cfs.
- Top of the structure elevation 15.0 feet NAVD.
- Fish screens would sit inside of guide slots cast into the concrete walls with one-way flow only through the fish screens.
- 63-inch HDPE culvert with a flow line elevation of 0.0 feet NAVD.

The location of the A16 Intake WCS is near the southwest corner of Pond A17 at the western end of the levee lowering. It will be used to screen and regulate flow into Pond A16. The intake structure is built perpendicular to the borrow ditch allowing water and debris to flow past the structure reducing the possibility for excessive debris and sediment build-up. In addition, timber piles and a log boom were constructed around the front of the intake structure to prevent large floating debris from damaging the fish screens.

Water will be conveyed from the A16 Intake WCS to Pond A16 via one 63-inch HDPE culvert (approximately 330 feet) located under the Intake WCS Levee. The intake culvert has a tide gate to prevent water from flowing back into Pond A17. The capacity of the A16 intake culvert (approximately 200 cfs) is greater than the fish screen capacity to pass flow so that water is unobstructed once it passes through the fish screen.

Pond A16 Intake Fish Screen

The fish screen design criteria consists of the following:

- Capacity greater than the intake structure at an approach velocity of 0.33 ft/sec regulated by porosity baffles;
- Through flow above about 3.2 feet NAVD;
- Three independent inclined traveling belt fish screens;
- Top of the fish screens at 12.2 feet NAVD;
- Fish screens would sit at the face of a concrete vault; and
- Flap/tide gates would allow one-way flow through fish screens.

The fish screen has been designed to meet the NMFS fish screen criteria for tidal areas. Three independent inclined traveling belt fish screens are installed inside of the A16 intake water control structure. Its function is to prevent fish from entering Pond A16 and the fish screen will be operated year-round. The fish screens are installed at an angle so that debris would be collected and carried over the fish screen and flow into Pond A16. The fish screen structure is installed on the face of the intake vault upstream of the culvert. Porosity baffles are installed behind the fish screen to adjust the volume of water flowing into Pond A16. The fish screen is manufactured by Intralox and is constructed of stainless steel and ultraviolet resistant Acetal plastic. Each screen is operated independently and powered by one, 2 horsepower (hp) motor.

Pond A16 Outlet WCS

The A16 Outlet WCS design criteria consists of the following:

- Discharge a maximum capacity of 180 cfs to Artesian Slough during low tide events.
- Prevent water from flowing back into Pond A16 through the outlet structure.

The location for the A16 Outlet WCS is in the east levee near the south end of Pond A16. The existing outlet structure was demolished and the new structure was constructed in the same location. The flow control into the structure is regulated by an overflow weir located within Pond A16. The crest of the weir was constructed at elevation 3.0 feet NAVD with and adjustable overflow weir installed along the top of the wall to allow the weir elevation to be raised up to 4.0 feet NAVD. Two sluice gates were installed at the bottom of the weir structure (0.0 feet NAVD) to allow additional drainage of Pond A16 if maintenance activities would require in the future.

A sluice gate is installed on the upstream side of the water control structure to regulate flows. A tide gate would be located inside the water control structure to prevent water from entering back into Pond A16 from Artesian Slough. After flowing through the tide gate, the water would flow through a 4-foot tall by 8-foot wide concrete culvert beneath the Pond A16 levee. The flow would be discharged from the culvert into a pilot channel leading directly into Artesian Slough.

The outlet structure is supported by a 12-inch concrete slab on a subgrade of gravel and geotextile. Concrete walls would be cast on top of the concrete floor.

Pond A16 Outlet Pilot Channel

The following design criteria were used for the A16 outlet pilot channel:

- Approximately 140 feet in length through salt marsh into Artesian Slough.
- Channel invert elevation would be -1.0 feet NAVD, which is approximately 1 foot below the invert of the outlet structure culverts (0.0 feet NAVD).
- Channel bottom width would be approximately 25 feet.
- Channel top width would be approximately 75 feet.
- Channel maximum side slopes of 3:1.

The existing pilot channel associated with the existing outlet structure was deepened to meet the design criteria. The pilot channel was extended by excavating through the adjacent salt marsh to extend the pilot channel directly into Artesian Slough. Material excavated from the pilot channel was placed within the Pond A16 borrow ditch in the vicinity of the outlet structure.

Pond A16 Levee

The A16 Levee design criteria consists of the following:

- Located in the A16-A17 Canal near the southeast corner of Pond A17.
- Crest elevation set at 12.2 feet NAVD and width 12.0 feet.
- Side slope of 3:1 or match existing.

Fill material was placed in the Pond A16-A17 canal to construct a new levee along the A16 levee approximately 150 feet in length. This new levee was constructed out of dry A17 levee lowering material to 12.2 feet NAVD which will be the same elevation as the other levees. The dry fill material was compacted using mechanical methods to reduce the amount of potential settlement.

A16 Intake WCS Levee

The A16 Intake WCS Levee design criteria consists of the following:

- Crest elevation at 12.2 feet NAVD and width of 20.0 feet.
- Side slope of 5:1.

A new structural levee was constructed at the A16 intake structure into Pond A16 approximately 230 feet in length. The intake WCS culvert was installed underneath this levee and the levee connects into the existing Pond A16 and A17 levees. This levee was constructed to a height of 12.2 feet NAVD to match the adjacent levees and would also serve as the new trail route. This levee was constructed from the dry A17 levee lowering material and compacted to reduce settlement.

Operation

The design features of Pond A16 and 17 is intended to allow for a full tidal (A17) and muted tidal flow-through (A16) water regime not requiring intensive operations by Service staff. If necessary, management actions can be taken to alter flow patterns in Pond A16. However, it is anticipated that Pond A17 will be restored to tidal marsh subject to full tide cycles and Pond A16 will be operated as a flow-through system with an operating fish screen year round.

Monitoring

The system monitoring will require weekly site visits to record pond and intake readings. The monitoring parameters are listed below.

Weekly Monitoring Program

Location	Parameter
A16	Depth, Salinity, Observations

The weekly monitoring program will include visual pond observations to locate potential algae buildup or signs of avian botulism, as well as visual inspections of water control structures and levees.