2018 Annual Self-Monitoring Report
Don Edwards San Francisco Bay National Wildlife Refuge
Fremont, California

Prepared for:

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Introduction

The South Bay Salt Pond Restoration Project (Project) 2018 Annual Self-Monitoring Report (Report) has been prepared to provide: 1) an update of the Project's 2018 accomplishments; 2) information on on-going operations of the Alviso and Ravenswood Ponds; 3) results of the 2018 studies conducted at Pond A8, A16 and SF2; 4) results of fisheries monitoring and studies; and 5) an update on Phase II planning and implementation 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 eighth 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 Project 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 2.

2018 Accomplishments

Progress towards Goals in 2018

Goal 1: Restore & Enhance Habitat

940 Acres of Habitat Restored

To date, we have opened 940 acres of former industrial salt ponds on the refuge to the Bay so nature can recreate wetlands. We are now starting our second phase of restoration work, which includes restoring 1,005 acres to salt marsh. Our initial goal is to restore half of the former salt ponds on the refuge to tidal marsh, with the other 50% in managed ponds.

Ponds that have been opened to tidal influence continue to show signs of restoring to functional tidal marsh. The endangered Ridgway's rail and endangered salt marsh harvest mouse have now been documented in the restoring island ponds unit (A21).

Goal 2: Provide Public Access

No new public access facilities were completed in 2018.

Goal 3: Provide Flood Risk Management

Shoreline Levee near Alviso

A goal of the Project is to maintain or improve existing flood risk. Managers are committed to ensuring that flood hazards to nearby communities and infrastructure do not increase as a result of the restoration: restoring salt marsh in flood-critical parts of the Project area will not occur until flood protection is established. In 2014, the U.S. Army Corps of Engineers and Santa Clara Valley Water District began planning for a 15-foot-high levee near Alviso and the San Jose water pollution plant. In 2018, the Shoreline levee was funded with a $177 million dollar supplemental funding package and permitting and planning continued through 2018. The goal is to complete all five stages of the project within a five-year timeframe. In 2019, the project is expected to begin stockpiling dirt for the construction of the first stage of the project, the levee along the eastern side of Pond A12. Once the entire levee is completed, more Alviso ponds will be opened to full tidal action as part of the project.

2018 Pond Operations

The 2018 Pond Operation Plans are included in Appendix A. In general, the goal for all ponds is to maintain circulation through the ponds while maintaining discharge salinities. A summary table for discharge salinities is provided:

Average Monthly Salinity (PPM)

Pond	May	June	July	August	September
A2W	23	25.5	30	33.5	30
A5	14	16	20	23.5	26
A7	14	15.5	19.5	20.5	22
A8	11	ND	14	ND	No Data (ND)
A14	21	23.5	25	28.5	24
A16	12	15.5	19	20	18
SF2	25	25	31	32	32

A summary of pond management is described below.

Alviso Pond System A1/A2W
The management objective for Pond System A1/A2W is to maintain full tidal circulation through ponds A1 and A2W while maintaining discharge salinities to the Bay at less than 40 ppt. These ponds are part of Phase 2 of the Project, and are likely to be breached in the next 3 years to restore the ponds to tidal marsh. The Phase 2 EIS/EIR was finalized in 2016.

Alviso Pond System A3W
The Alviso Pond System A3W consists of Ponds AB1, AB2, A3W, A2E, and A3N. The objectives for the Alviso Pond A3W system are to: 1) maintain full tidal circulation through ponds AB1, AB2, A2E, and A3W while maintaining discharge salinities to Guadalupe Slough at less than 40 parts per thousand (ppt); 2) maintain water levels in Pond A3N to cover the pond bottom due to mercury "hotspots" by leaving the A3N / A3W gate fully open, year round; and 3) maintain water surface levels lower in winter to reduce potential overtopping of A3W and A2E levee adjacent to Moffett Field.

Pond System A8
The Pond A8 system consists of Ponds A5, A7, A8N, and A8S. This system is operated to maintain muted tidal circulation through the ponds while maintaining discharge salinities to the Bay at less than 40 ppt. As part of the Phase 1 initial actions, a 40-foot armored notch with multiple bays that can be opened and closed independently at A8 and Alviso Slough was installed. In May of 2017 all 8 bays were opened year round. Ponds A5, A7 and A8 are identified as tidal habitat in the long-term programmatic restoration of the Project. The water control structures at both A7 and A5 from Alviso Slough and Guadalupe Slough respectively, have failed and intake water at high tides (cannot be fully closed). These structure are in need of repair; however, the Service has not identified funds to repair them at this time. As part of Phase II salt Pond Restoration, the southern levee of Pond A8 will receive an "ecotone levee". An ecotone levee is a 30:1 slope to allow for more high tide refugia habitat.

Pond System A14
The Pond A14 system consists of Ponds A9, A10, A11, A14, and Ponds A12, A13, and A15. The objectives of the Alviso Pond A14 systems are to: 1) maintain full tidal circulation through ponds A9, A10, A11 and A14, while maintaining discharge salinities to Coyote Creek at less than 40 ppt; 2) maintain ponds A12, A13 and A15 as higher salinity ponds and operate at 80 – 120 ppt salinity during summer to favor brine shrimp development, as possible. The winter of 2016/2017, was particularly damaging to the pond side of the levees in Ponds A9-14. Currently, the Service has a need for more material to rebuild the internal levees, which are planned to be repaired starting in summer of 2018.

Pond System A16/17
Alviso Pond A16/A17 was the final Phase I action and completed in 2012. Pond A17 is now tidal, with uninhibited hydraulic connection to Coyote Creek and Pond A16 provides 243 acres of managed shallow pond habitat with 16 nesting islands (along with 4 existing islands). The Pond A16 fish screen was repaired in 2018 and is currently running 3 screens.

Pond System SF2
The objectives of the Pond SF2 System is to manage a 155-acre pond with 30 nesting islands for nesting and roosting birds, and an 85-acre seasonal wetland for western snowy plover nesting. The water level in SF2 is designed to maintain shallow water to provide foraging habitat for shorebirds and waterfowl. Water control structures are used to manage water levels, flows into and out of Pond SF2 from the Bay, and flows between cells. The goal of this water management is to create shorebird foraging habitat and to meet water quality objectives.

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. 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 A16 and Pond SF2 Water Quality Data
In 2014, the Service committed to conducting sampling at Pond A16 and 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). This effort had delays and datasondes were not deployed until August 20, 2014. In review of the data by the USFWS Inventory and Monitoring Program, there was some uncertainty as to the degree of accuracy of all of the DO readings at both sites. What was determined was that in general, we still have low DO in both pond systems with DO falling below 3.3 mg/L as well as in adjacent waterways. As a result of these complications, this sampling effort was not repeated by USFWS in 2018.

Other DO studies in Ponds A8, A21, SF2, and E9
No new information was collected in 2018.

Update on Mercury Studies

Mercury Synthesis Report- All research that has been done over the last decade on Mercury in the project area is being combined, analyzed and synthesized into one report. This report is expected in 2019 and will provide a clear picture of the state of our knowledge of how Mercury contamination is affected by restoration efforts.

Mercury Levels in Slough Fish- Darell Slotton (UC Davis) continued work on mercury levels in Mississippi silversides in and near Alviso Slough and Pond A8.

- Three slough sites were sampled nearly continuously across the 2010-2018 Phase 1 study period. One site was located in Alviso Slough directly downstream of the Pond A8/7/6 Notch (Notch Site). A second Alviso Slough site was situated midway between the Notch and the Alviso Slough/Bay confluence (Mid Alviso). A control site was located in Mallard Slough in another part of the Salt Ponds complex (Mallard). Beginning in 2013, another control site was added in Guadalupe Slough (Guadalupe). Guadalupe functions as a relatively high mercury control similar to Alviso Slough, while Mallard is a relatively lower mercury control. Other sites that were studied for several years and then discontinued include Upper Alviso, located above the notch region; Lower Alviso, near the slough/bay confluence, and the Sunnyvale wastewater treatment plant discharge channel to Guadalupe Slough.
- Whole body mercury was assessed as total mercury. Samples were analyzed for total mercury by standard cold vapor atomic absorption (CVAA) spectrophotometry, using a dedicated Perkin Elmer Flow Injection Mercury System (FIMS) with an AS-90 autosampler, following a two stage digestion under pressure at 90 °C in a mixture of concentrated nitric and sulfuric acids with potassium permanganate. The method is a variant of EPA Standard Method 245.6.
- Pre-project baseline sampling in 2010 found Alviso Slough mean Silverside mercury in the 0.60-1.10 ppm range (whole body, dry weight). Comparable Mallard Slough

Silverside mercury was lower, at 0.30-0.60 ppm. Throughout the succeeding years and varying levels of flow connection to the pond complex, mean Silverside mercury in Alviso Slough generally remained within a somewhat lower range of 0.40-0.90 ppm. There were two notable, statistically significant exceptions. In 2011, mean concentrations spiked to 1.20-1.50 ppm for several months around the time of the initial single gate opening. And in late 2016 / early 2017, mean concentrations spiked as high as 2.50 ppm. Throughout the Phase 1 period, corresponding Silverside mercury at Mallard Slough remained within the range of 0.20-0.70 ppm and, at Guadalupe Slough, 0.50-1.10 ppm. Regulatory target small fish mercury levels; all of the slough fish data were at or above these targets, consistent with the elevated mercury legacy of the region.

Water Column Mercury Study Results through Study Year 2018 -Mark Marvin-DiPasquale (USGS) continued work on changes in mercury levels in the water column.

The focus of this work is to determine if there are any demonstrable changes in water column mercury speciation or concentrations directly linked to restoration management actions, specifically the breaching of Pond A6 or the manipulation of the adjustable notch structure associated with the A5/A7/A8 Pond complex.

The research team focused on particulate and filter-passing mercury species concentrations (total mercury, methylmercury and reactive mercury) in the A5/A7/A8 complex, upper Alviso Slough, lower Alviso Slough, and reference sloughs and ponds. A large suite of non-mercury parameters were also collected, including: dissolved organic carbon, nutrients, particulate carbon & nitrogen, chlorophyll, and total suspended solids. Five sampling events were conducted during 2018 and included February, April, May, July and September, and were coordinated with prey fish collections conducted by the UC Davis group.

The final field sampling was conducted in February 2018, and the full assessment of results (including 2018 data) were recently published in the journal of Estuarine, Coastal and Shelf Science. See abstract below:

Coastal wetlands have a long history of degradation and destruction due to human development. Now recognized as one of the most productive ecosystems in the world, substantial efforts are being made to restore this critical habitat. While wetland restoration efforts are generally viewed as beneficial in terms of providing wildlife habitat and flood control, they are often accompanied by dramatic physical and chemical changes that may result in unintended consequences, which are rarely studied. Alviso Slough, a tidal slough in South San Francisco Bay, California, is the site of an ongoing effort to restore former salt-production ponds to intertidal marsh habitat. Restoration is complicated by the fact that (1) the ponds undergoing restoration are severely subsided and (2) subsurface sediments within the slough and surrounding ponds are contaminated with legacy mercury deposits. Due to concerns regarding mercury remobilization, restoration has proceeded in a cautious, methodical manner. To assess the amount of legacy mercury remobilized since restoration began, we developed a technique of combining high-resolution, biannual measurements of bathymetric scour with mercury

concentration measurements from sediment cores. We estimate that 52 kg (±3) of mercury was remobilized in the 6 years since restoration began. Net bathymetric change analyses revealed seasonal trends of peak erosion during the winter months and little to no net change during summer months. Our analyses provide crucial insight on the spatial and temporal scales of geomorphic evolution within a tidal slough resulting from both natural (seasonal) variability and restoration actions. The technique presented here could be applied to other study sites and various sediment-associated contaminants of concern to aid in the design and management of restoration projects aiming to minimize negative impacts from legacy contaminants.

Fisheries Monitoring

The Refuge did not conduct any studies on fisheries during 2018. As part of the Phase II permits, the Project committed to preforming some additional fish assemblage monitoring. This monitoring will likely begin in 2020. The plan for fish monitoring is provided below.

Phase 2 of the South Bay Salt Pond (SBSP) Restoration Project Monitoring at the Don Edwards San Francisco Bay National Wildlife Refuge

Ravenswood Ponds: outboard of pond R4, such as at Flood Slough, West Point Slough, and/or Ravenswood Slough.

Mountain View Ponds: outboard of ponds A1 and A2W such as at Stevens Creek/Whisman Slough, Permanente Creek/Mountain View Slough, and/or Outer Charleston Slough (outside of the large tide gate structure).

Exact sites will be determined by the selected research team. Within these waterways, the SBSP Restoration Project proposes to perform 1 year of pre-breach monitoring and 3 years of post-breach monitoring for the Phase 2. The proposed fish monitoring would be performed as described below.

SBSPRP Phase 2 Adaptive Management Plan (AMP) pre-breach monitoring:

- Two seasonal efforts (spring and fall) at the Ravenswood and Mountain View locations listed above.
- Those seasonal efforts would be made in 2020.
- These efforts would provide a baseline dataset of fish communities in the areas surrounding the former salt ponds that will be breached as part of Phase 2 of the SBSP Restoration Project.
- This baseline is useful for evaluating the effects of the eventual Phase 2 actions.

SBSPRP Phase 2 AMP post-breach monitoring:

- The Phase 2 monitoring would take place following pond breaching, which is expected at Ravenswood in 2021 and at the Mountain View Ponds in 2022 or 2023.
- At Ravenswood and Mountain View locations, there would be quarterly sampling and monitoring efforts.
- These monitoring efforts would take place for the first 3 years following completion of all in-water activities, the last of which would be the breaching of the ponds.

Fish Monitoring Surveys and Reporting

Fish monitoring surveys would follow the protocol used by Dr. James Hobbs (or similar) in the related fish monitoring he and his crews have performed for the SBSP Restoration Project in other parts of the Refuge (i.e., in Alviso Slough, Guadalupe Slough, Artesian Slough, and elsewhere). These fish survey efforts have consisted of fish community sampling paired with water quality measurements using otter trawls, seines, and other equipment. Exact methods will be determined by the selected research team.

In general, though, the proposed Scope of Work is as follows:

- Collect species and document fish communities associated with slough habitats in the above-listed areas.
- Measure and evaluate size/age-class distributions of fish species.
- Analyze native vs non-native species.
- Analyze abundance of fish species.
- Evaluate seasonality of fish species abundance and assemblages.
- Collect water quality measurements paired with fish sampling.

In addition, benthic and/or planktonic prey organisms may be collected using grab samples for benthic prey or plankton tows or plankton pipe traps or other similar methods for planktonic prey organisms.

Reported Fish Kills

Minimal dead fish were observed during 2018 that were associated with pond operations or Phase I/II restoration ponds. Over the course of the year only a few striped bass were found dead, cause undetermined.

South Bay Salt Ponds Restoration Phase II

The final environmental analysis document detailing the selected alternatives for Phase II was published in May of 2016. It plans for the restoration and management of 2,400 acres of ponds in the Alviso area near San Jose and Mountain View, and the Ravenswood area near East Palo Alto/Menlo Park. A summary of the Phase 2 projects is described below:

Island Ponds Project
The Alviso Island Ponds (A19, A20, and A21) were breached to the Bay in 2006. The result has been that the pond complex is filling in from the bayside areas first. In Phase 2, the plan is to further breach A19 on the Mud Slough side and lower levees between the marshes and ponds to increase sedimentation rates to speed the transition to salt marsh. Managers will leave high tide refugia zones. This project is scheduled to be completed in Fall of 2019.

A8 Project
In Alviso Ponds A8 and A8S, large habitat transition zones will be built on the southern edges, protecting and buffering the landfill and allowing for high tide refugia habitat to build up. The transition zone design leaves a gap to allow a potential project to reconnect adjacent creeks with the Bay. The Service is working with the Santa Clara Valley Water Distrct to complete this project and the project is anticipated to begin in spring/summer 2019.

Mountain View Project
Currently, ponds A1 and A2W are ambient bay salinity type ponds (3-4 feet subsided at 0 feet elevation). The intent in Phase 2 is to turn both ponds fully tidal. However, the Project (in conjunction with the SCVWD) needs to build a flood protection levee along the Coast Casey Forebay and between A1 and the City of Mountain View's Charleston Slough. The plan will also include creating large transition zones (30:1 slope ratio) to protect landfill areas and create high tide refugia habitat. For public access, we will retain and improve existing trails (e.g. add an ADA accessible switch back). A short new spur trail will be built to an observation platform looking out over Charleston Slough and the restored tidal marsh. There will be another out-and-back trail along the edge of Pond A2W leading out to the Bay. The plan is to begin to build the transition zone levee for pond A2W in summer 2019.

Ravenswood Project
This pond complex (R3, R4, R5 and S5 ponds) is right next to Bedwell Bayfront Park, an old landfill. Managers are proposing several types of ponds to achieve a variety of habitats. The plan is to restore Pond R4 to tidal marsh and reinforce the All American Canal inner levee. Pond R3 will remain as a managed pond for snowy plovers, with additional water control structures better management capability. Ponds R5 and S5 will be managed for deep-water habitat for waterfowl. The design includes large transition zones along the landfill/park and levee. The plan is to connect the existing Bay Trail to the pond complexes from the highway to converge the public access area where the three habitat types meet. There will be benches and interpretive panels in a similar style to what has been done in other Project areas and in neighboring parks. This project was initiated in Fall of 2018 once all permits were obtained for Phase II. In 2018, we started to construct the ecotone levee along Pond R4. In 2019, the plan is to continue to bring in dirt to build the ecotone levee around this pond.

APPENDIX A

DON EDWARDS SF BAY NWR

POND OPERATION PLANS

Updated 8/25/17

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

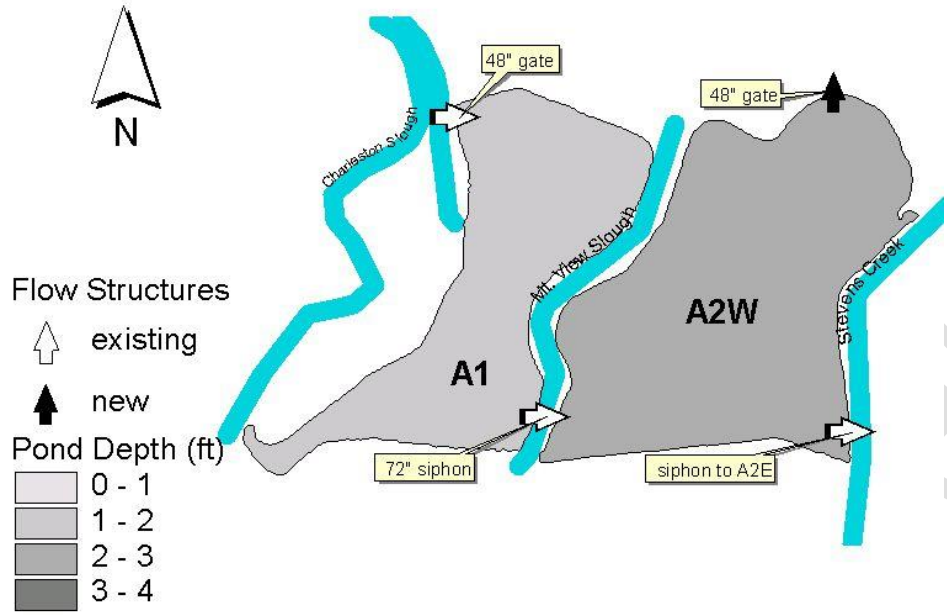
Monitoring Program

Location	Parameter
Intakes	Salinity
In-pond	Depth, Salinity, Observations
Discharges	Depth, Salinity, Observations

The 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.

Contents

A1 AND A2W



Objective
Maintain full tidal circulation through ponds A1 and A2W while maintaining discharge salinities to the Bay at less than 40 ppt. These ponds are part of the SBSPRP Phase 2, and will likely be breached in the next 5 years.

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

- 48" gate intake at A1 from lower Charleston Slough
- NGVD gauge at A1
- 72" siphon under Mountain View Slough between A1 and A2W
- staff gauge (no datum) at A1
- 48" gate outlet structure with 24' weir box at A2W to the Bay
- NGVD gauge at A2W
- The siphon to A2E is present, but closed

The system will discharge when the tide is below 3.6 ft. MLLW.

Summer Operation: May through October

Summer Pond Water Levels

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

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 A1 intake gate can be adjusted to control the overall flow through the system.

Design Water Level Ranges

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

Based on system hydraulics, pond A2W is typically about 0.1 feet below pond A1.

Winter Operation: November through April

Winter Pond Water Levels

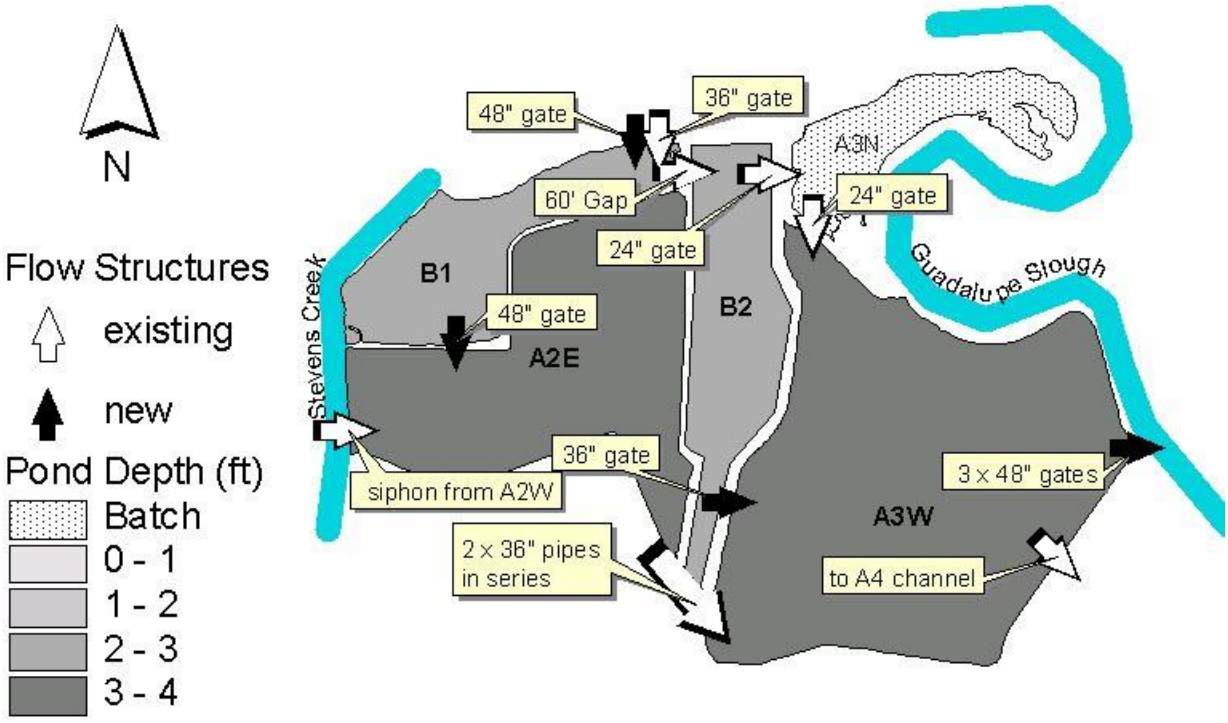
Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gauge)
A1	277	-1.8	-0.6	1.8
A2W	429	-2.4	-0.6	NA

Water Level Control
Normal winter operation would have the intake gate partially open to reduce inflow during extreme storm tides. The pond water level may vary by 0.2 ft due to the influence of 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 these ponds.

B1, B2, A2E, AND A3W



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).
2. Due to mercury hotspots in Pond A3N when managed as a seasonal pond, maintain water levels to cover the pond bottom. This can be done by leaving the A3N / A3W gate fully open, year round. However, this limits western snowy plover nesting habitat.
3. Maintain water surface levels lower in winter to reduce potential overtopping of A3W and A2E levees adjacent to Moffett Field.
4. The water control structure at A3W/Guadalupe Slough was replaced September 2015.

Structures

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

- 36” gate intake structure from the bay at B1
- 48” gate intake from the bay at B1
- 48” gate between B1 and A2E
- 2x36” pipes in series between A2E and A3W (no gates)
- 36” gate between B2 and A3W
- gap between B1 and B2

- 24” gate between B2 and A3N
- 24” gate between A3N and A3W
- 3x48” gate outlet at A3W to Guadalupe Slough. Two are outlet only, and one allows both inflow and outflow, no weir
- staff gauges at all ponds and NGVD gauges at all ponds
- siphon from A2W is closed, but available if needed
- siphon to A4 is available (via pump) for emergency purposes in conjunction with SCVWD

Summer Operation: May through October

Summer Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gauge)
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, during non-hunting season.

Water Level Control

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 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. 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.

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 Gauge)	Minimum Water Elev. (ft, NGVD)	Minimum Water Level (ft, Staff Gauge)
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

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 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.

Winter Operation: November through April

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gauge)
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

Water Level Control
The water levels in A3W are important to prevent levee overtopping. The south levee separates the pond from the Moffet Field drainage ditch. The levee is low, and subject to erosion with high water levels.

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.

A5, A7, AND A8

Objectives

The Pond A8 system is 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:

- 2x48” gate intake at A5 from Guadalupe Slough. As of October 2014 this tide gate is broken and intakes water a high tide (cannot be fully closed)
- 2x48” gate in/outlet with two 24’ weir boxes at A7 from Alviso Slough; this functions as the outlet for the system when needed
- NGVD gauges at A5 and A7 structures
- Notches in the levees between A5/A7/A8/A8S; these ponds effectively function as one siphon between A4 to A5 will generally be closed; this siphon is pump driven rather than gravity fed.
- 40-foot armored notch with multiple bays that can be opened and closed independently at A8 and Alviso Slough. Current operation (2017) is 8 bays open year-round.

Weir Structure: A portion of the levee adjacent to Pond A8 was reconfigured as part of the Lower Guadalupe River Flood Protection Project to act as an overflow. The 1,000-ft long overflow weir at Pond A8 would allow high flood flows to exit Alviso Slough when water levels reach approximately 10.5 ft NAVD88. The water levels have never overtopped the weir since 2004, but it remains in place in case of a flood event.

A4 Siphon: It is possible to pump water from Pond A4 into Pond A5 or vice versa, if necessary, in accordance with the SCVWD Pond A4 Water Management Operations Plan (December 2005).

System Description

Water exchange through the notch connection is limited and the tidal range within the ponds is muted. All gravity intake flow occurs at high tide, and all outflow occurs when the tide is below 8.12 ft. MLLW. Previous seasonal water levels no longer apply here.

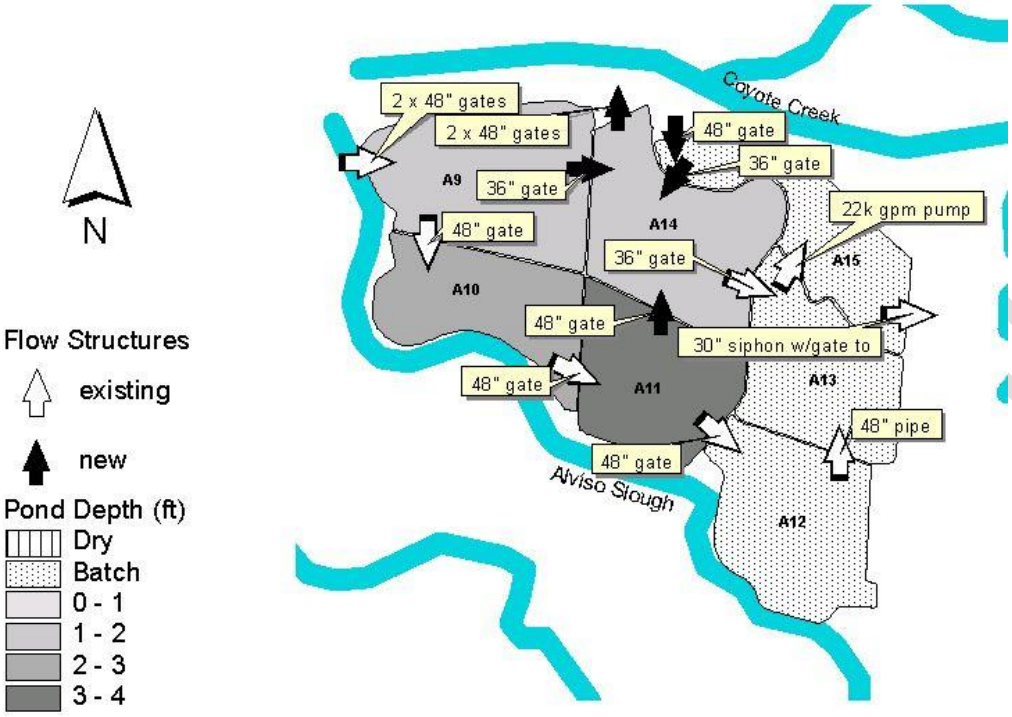
Water Level Control

The A5 and A7 intake gates can be adjusted to control the overall flow through the system. After the installation of the "notch", water levels are much higher here due to a muted tidal system into A8.

Winter Operation

All 8 bays of the notch are left open year round as of June 2017. Note that without pumping, rainfall or inflow, it will take approximately 3 weeks to drain 1.0 ft from the ponds.

A9, A10, A11, A14 AND A12, A13, A15



Objectives

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).
2. Maintain pond A15 as a higher salinity pond and operate at 80 – 120 ppt salinity during summer to favor brine shrimp development, as possible.
3. CURRENT CONDITIONS (as of 2016): A9-A14 are currently being operated at lower levels due to levee erosion along Alviso Slough.

Structures

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

- 2 x 48” gate intake at A9 from Alviso Slough
- 48” gate between A9 and A10; 48” gate between A9 and A14- left open always
- 48” gate between A10 and A11; 48” gate between A11 and A14- - left open always
- 48” gate between A11 and A12; 48” gate between A12 and A13
- 36” gate between A14 and A13
- 36” gate between A15 and A14; 22,000 gpm pump from A13 to A15 (no power, would need a generator to operate)
- 48” gate intake at A15 from Coyote Creek
- 2 x 48” gate outlet at A14 into Coyote Creek
- staff gages at all ponds and NGVD gages at all pond
- internal breaches in levees between A9/A10/A11/A14 were put in place in 2008 to improve water flow

System Description
The normal flow through the system proceeds from the intake at A9, then flow through A10-A11- to the outlet at A14. All gravity intake flow would occur at high tide, and all outflows would occur when the tide is below 6.2 ft. MLLW.

Summer Operation: May through October

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gauge)
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 Pond Water Levels

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 gauge).

Due to the internal levee cuts, water flows freely between ponds A9 to A10 to A11 to A14.

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. Exposing the pond bottom at A9 also brings in western snowy plovers to nest, further reducing our capacity to manage water here. Recently, lower water levels have allowed western snowy plovers and American avocets to nest on the pond bottoms of A11 and A12 as well.

Salinity Control
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. Water levels in pond A14 above elevation 2.0 ft NGVD (3.4 ft gauge) 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. However, due to limited flow through here (ultimately from the intake at A9) this batch system does not usually function this way. Further, we have reduced water levels in A12 and A13 in recent years to promote nesting by terns and shorebirds. These two ponds are often mostly dry during the summer with only high salinity water in the borrow ditches and some standing water. Recently,

lower water levels have allowed western snowy plovers and American avocets to nest on the pond bottoms of A12 and A13.

Ponds A12 and A13 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); inflows from A11 and outflows to A14 would be by gravity. Pond A15 operates as a separate batch pond to some extent with inflow from A14 or by gravity from Coyote Creek.

If the salinity levels are high in A14, 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 ~ 10 ppt per month during the peak evaporation months.

Winter Operation

During the winter season, the A9 intake will be closed to prevent entrainment of migrating salmonids; December through May 31. 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. In years with low rainfall and because there is no inflow to this entire system during the winter, water levels in A9 are often very low by spring.

Winter Pond Water Levels

Pond	Area (Acres)	Bottom Elev. (ft, NGVD)	Water Level (ft, NGVD)	Water Level (ft, Staff Gauge)
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

A16

Objectives
243 acres of managed pond habitat in Pond A16, with 20 nesting islands. Some of the islands are enhanced to recruit terns to nest.

Structures

- 63” culvert intake at A16 near the southwest corner of A17 (200 cfs capacity)
- outlet structure into Artesian Slough (180 cfs capacity) with 140-ft outlet pilot channel
- siphon into New Chicago Marsh

System Description
Flows into and out of Pond A16 can be changed by adjusting slide gates.

Pond A16 is managed for shallow water habitat. A large majority of the pond bed has elevations ranging from 2.2 to 3.1 feet NAVD. In addition to the 20 islands, you can often see parts of the pond standing above the water line. The intake culvert has a tide gate to prevent water from flowing back into A17.

The Refuge and the USACE finished a project to place toppings on two islands for use by nesting Caspian terns (islands 11 and 12) and one for nesting western snowy plovers (island 3) in winter 2015. Decoys and sound systems were placed 2015-2017. In 2017, Forster's tern decoys were placed on islands 14, 15, 16, 17, 18, 20.

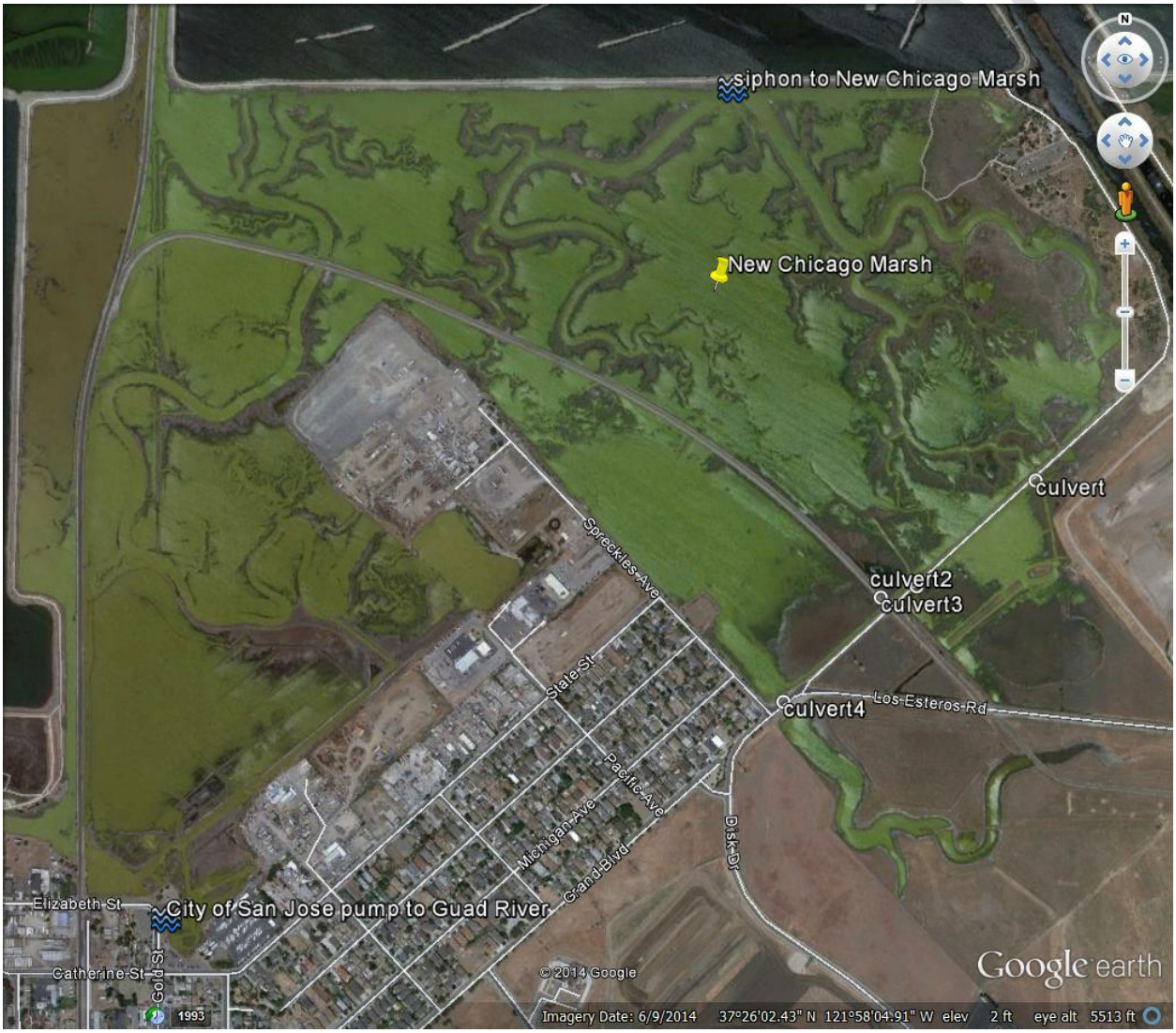
Outlet structure:

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

NEW CHICAGO MARSH

The siphon from A16 into NCM is closed in the winter unless water levels drop significantly due to low rain fall. In spring and summer the siphon is open ~3 inches to keep up with evaporation and not flood out nesting birds. Recommendations are to keep water levels between -2.5 to -2.7.

There is no outlet, although a small pump is available in the case of emergency. The pump is located in the southeast corner, along the entrance road into the EEC and releases water into Artesian Slough. Water in NCM drops ~1/10 or one inch every two days with the pump running full time. City of San Jose has a pump in the SW corner of NCM that is used to prevent flooding in Alviso.



A22 AND A23

There is one 48" gate located on Mud Slough at the cross levee between the two ponds. It takes a very high tide to get water to flow through the gate. There is no outlet for this system and these ponds currently function as seasonal ponds. Currently, the internal "donut" levee is cut to allow water to flow into A22 but not A23. These two ponds are used for snowy plover nesting habitat and need to remain dry during nesting season. Some water can be brought in during summer to allow for foraging habitat within channels and the borrow ditch. Water is brought in during the winter to provide foraging habitat for waterbirds.

SF2

Objectives

Manage 155-acre pond with 30 nesting islands for nesting and roosting shorebirds, and an 85-acre seasonal wetland for western snowy plover nesting. The water level in SF2 is designed to maintain shallow water to provide foraging habitat for shorebirds and waterfowl. The Refuge and the USACE finished a project to place toppings on three islands for use by nesting Caspian terns (islands 17, 21, 12) and one for nesting western snowy plovers (island 10) in winter 2015. Decoys were in place 2015-2017.Decoys and sound systems were placed here in 2015. Decoys for Forster's terns were placed on island 22 only in 2016.

Structures

- intake structure consisting of 5: 4-foot intake culverts with combination slide/flap gates on each end of the culvert
- outlet structure consisting of 6: 4-foot outlet culverts, with combination slide/flap gates on both ends of each culvert
- there is one staff gauge at the outlet channel

System Description

Water flows into and out of pond SF2 through water control structures at the northern (cell 1) and southern ends (cell 4) of the bayfront levee. Weirs with adjustable flashboard risers are used to control flow in and out of cells 2 and 3. Water flows out of SF2 during low tides through the structures located along the bayfront levee. Within SF2, flashboard riser weirs are installed to convey flow into and out of cells. The Refuge replaced many of the internal weir boards in the spring and summer of 2017.

The seasonal wetland area has 1 intake and 1 outlet structure. In addition, 4 cell outlet culvert structures are located where the berms cross deeper, historic channels and borrow ditches to

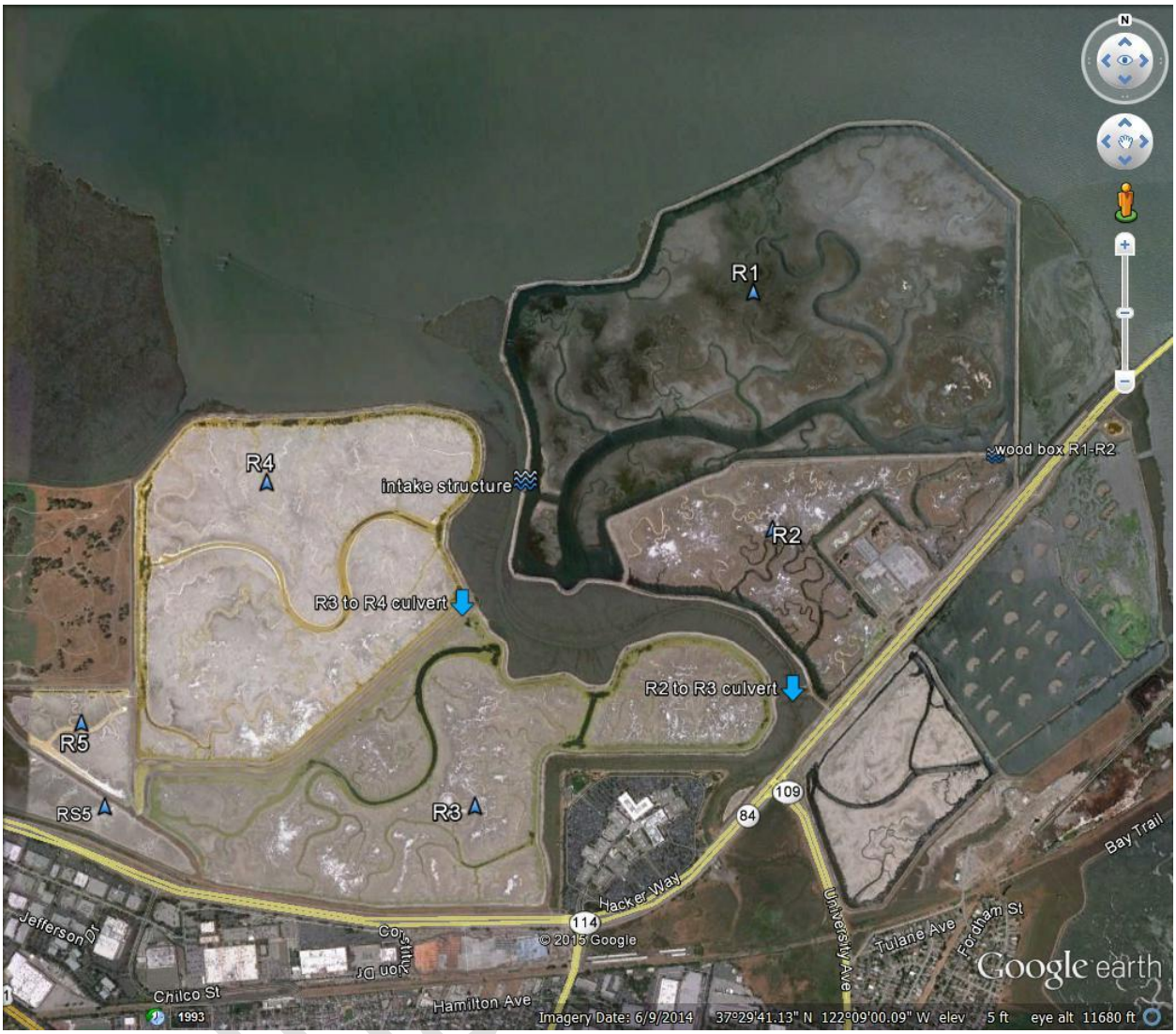
drain deeper water from these channels for periodic maintenance and as a water quality management approach.

Summer Operation
June 1-January 31, the southern water control structure is operated as a one-way outlet and the northern water control structure is operated as a one-way intake. However, during the peak shorebird months, we may 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 drain through the intakes at low tide and provide mud flat areas for foraging habitat (until the rising tides refill cell 1). The 2 way flow also helps remove built up sediment in the intake channel on Bay side.

Water Level Control
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, February through May. These measures also help protect juvenile salmon and steelhead entrainment.

R1, R2, R3, R4, R5 AND RS5



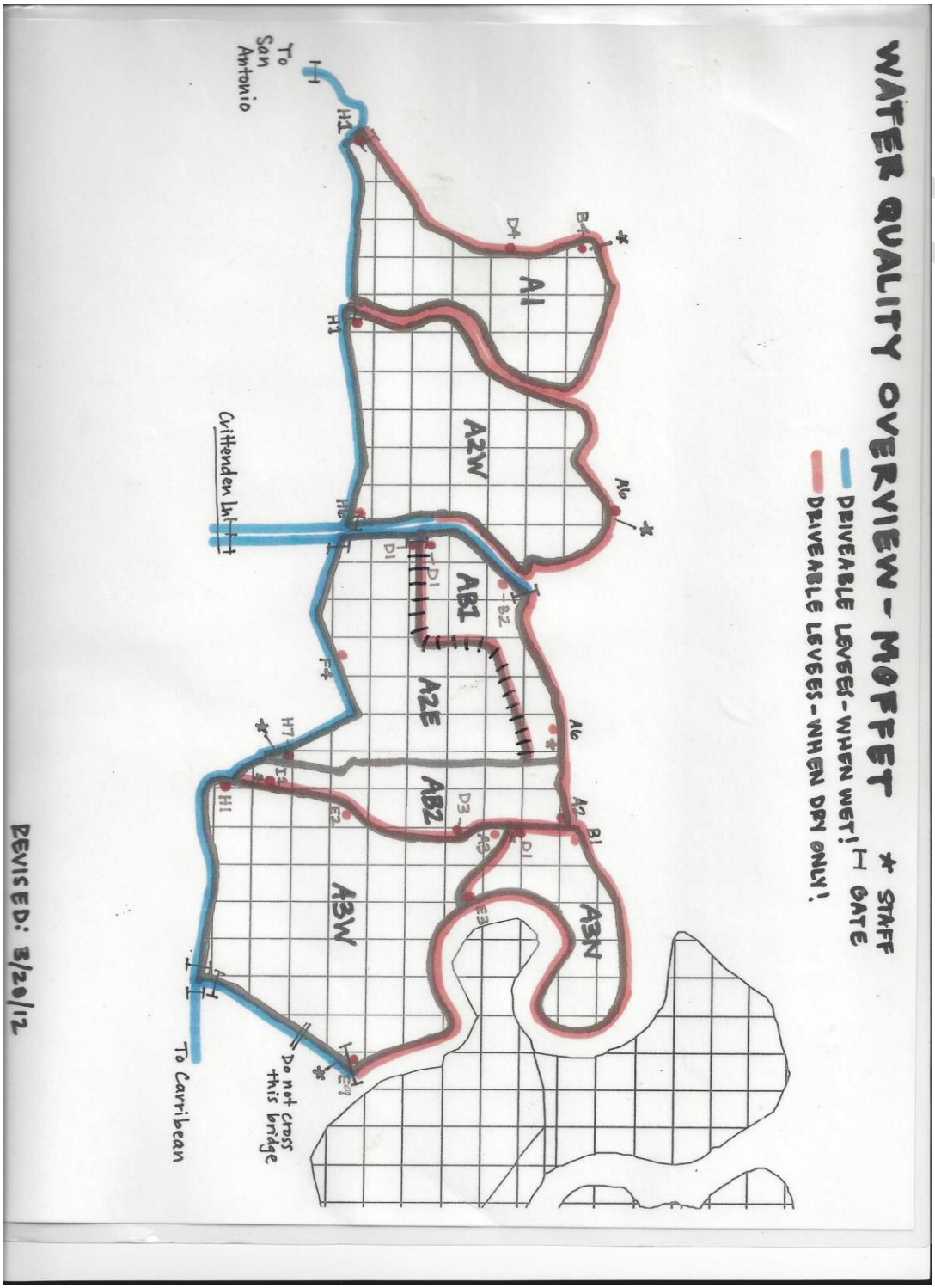
There are two 72” gates located at R1 to feed this entire pond system; there are no discharge points for the system. Water moves from R1-R2-R3-R4, and in general the previous pond must be filled before beginning to fill the subsequent pond. The All American Canal can no longer be used to get water to R5 and RS5. All of the water control structures in this system are old, and may not be totally operational. In particular the culverts R2-R3 and R3-R4 appear to not open and/or close properly.

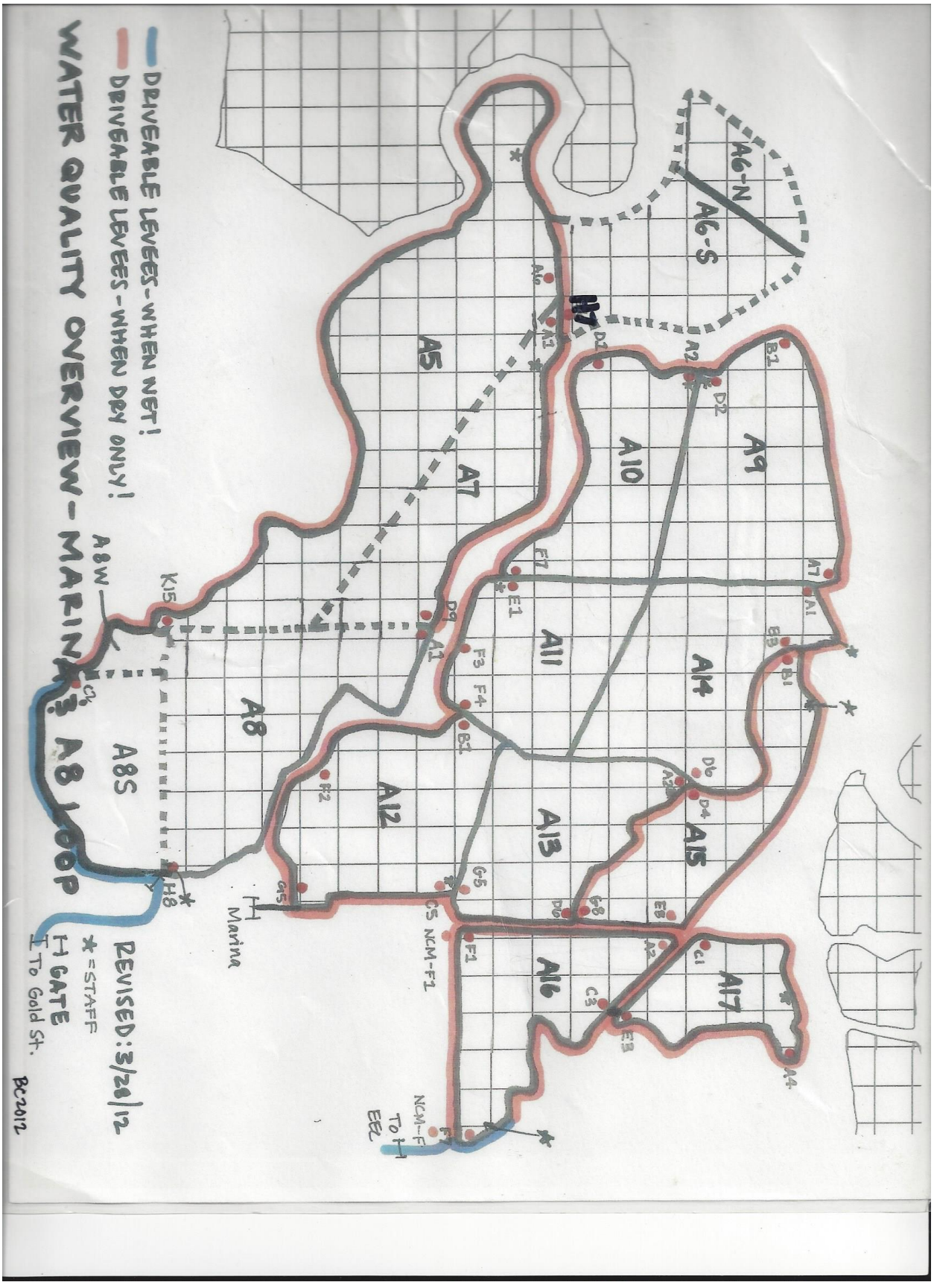
R3, R4, R5, and RS5 currently function as seasonal ponds and receive only rainwater.

For R1 and R2, during summer operations, these ponds are drawn down for snowy plover nesting habitat. During winter operations, one of the intakes is opened ~ 20”, and left open for several weeks to cover the pond bottom in R1 and R2 for waterfowl habitat and hunting season, Oct–Jan.

If there is a build-up of vegetation on R3 and R4, then the Refuge has flooded up the ponds to cover the pond bottom after nesting season by bringing in water: R1-R2-R3-R4. Drying time is at least a few months depending on rain. This was last done in ~2009.

LEVEE DRIVING AND STAFF GAUGE MAPS
Updated May 2012, by Stacy Moskal USGS




WATER QUALITY OVERVIEW - MARINA & A8 LOOP
DRIVEABLE LEVEES - WHEN WET!
DRIVEABLE LEVEES - WHEN DRY ONLY!
REVISED: 3/20/12
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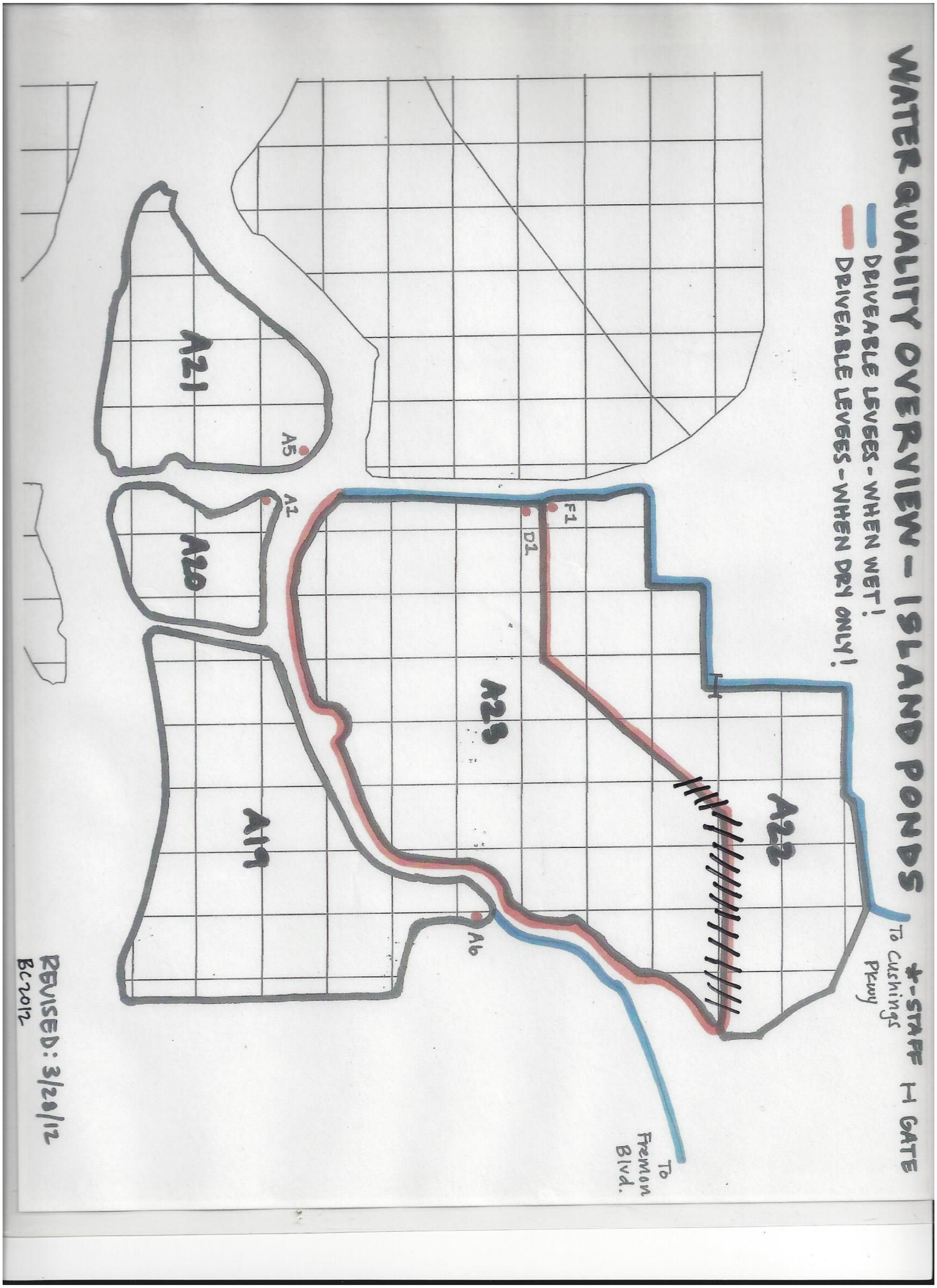
WATER QUALITY OVERVIEW - ISLAND PONDS
DRIVEABLE LEVEES - WHEN WET!
DRIVEABLE LEVEES - WHEN DRY ONLY!
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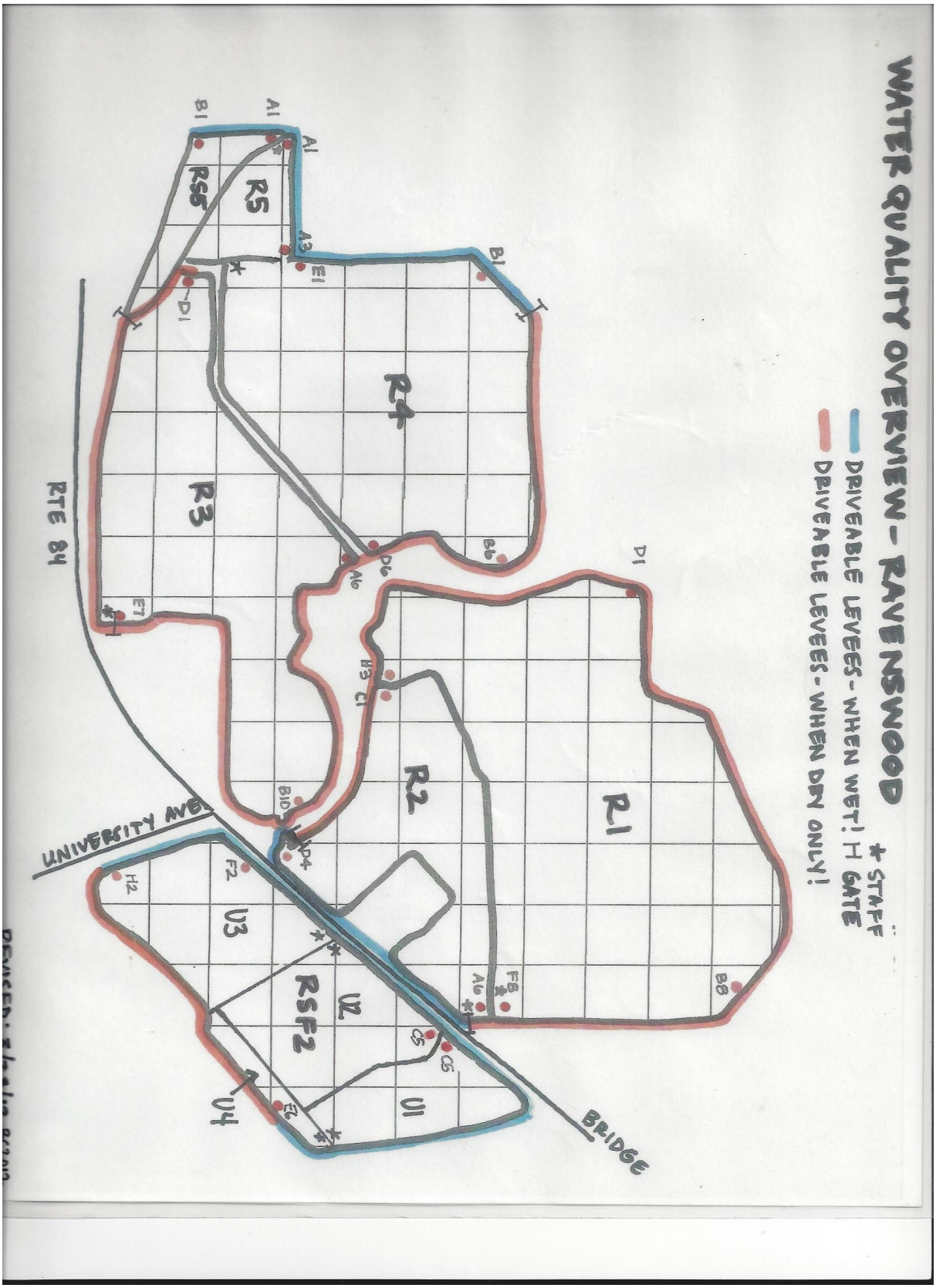
WATER QUALITY OVERVIEW - RAVENSWOOD
* STAFF
DRIVEABLE LEVEES - WHEN WET! H GATE
DRIVEABLE LEVEES - WHEN DRY ONLY!
R5
RSF
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R3
R2
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RSF2
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RTE 84
UNIVERSITY AVE
BRIDGE