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NAPA SALT MARSH RESTORATION PROJECT FEASABILITY REPORT ENGINEERING APPENDIX POND ANALYSIS MARCH 2004

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Introduction

This appendix describes the principal design features and engineering requirements associated with Napa Salt Marsh Restoration Project.

Location and Study Area

The study area is located approximately 30 miles northeast of the City of San Francisco, on the northeast side of San Pablo Bay, immediately west of the Napa River, and immediately east of Sonoma Creek. The study area encompasses portions of unincorporated Napa, Sonoma and Solano Counties. The study area consists of the Napa River Unit of the Napa Sonoma Marshes State Wildlife Area (NSMWA), which is comprised of 12 ponds formerly used for solar salt production. (Figure 1-1 Regional Location; Figure 1-2 Project area and Surrounding Areas Managed by California State Department of Fish and Game (DFG)).

Objectives

Diking or filling has destroyed approximately 90 percent of the original tidal wetlands of San Francisco Bay. The project site, historically dominated by tidal salt marsh, was diked and converted to hayfields approximately 150 years ago. In the early 1950s, the diked areas were converted to solar salt evaporation ponds.

There are two objectives in this engineering appendix. The first objective is to analyze the following four (4) scenarios:

1. Identify all of the water control features that currently exist on the ponds. This scenario will be titled **CURRENT CONDITIONS - WITHOUT PROJECT CONDITIONS** for the remainder of this appendix**.**

2. Determine what water control features are needed to maintain the ponds as self-contained individual ponds. This scenario will be titled **STAND ALONE PONDS** for the remainder of this appendix**.**

3. Determine what water control features are needed to group the ponds and maintain them as managed ponds. There are seven pond groups they are as follows: 1. Pond 1 and 1A, 2. Pond 2, 3. Pond 3, 4. Pond 4 and 5, 5. Pond 6 and 6A, 6. Pond 7 and 7A, and 7. Pond 8. This scenario will be titled **MANAGED PONDS** for the remainder of this appendix**.**

GROUP NUMBER	PONDS
1	1 AND 1A
2	2 AND 2A
3	3

4	4 AND 5
5	6 AND 6A
6	7 AND 7A
7	8

4. Determine what water control features are needed to group the ponds and maintain them as tidal marsh. There are seven pond groups they are as follows: 1. Pond 1 and 1A, 2. Pond 2, 3. Pond 3, 4. Pond 4 and 5, 5. Pond 6 and 6A, 6. Pond 7 and 7A, and 7. Pond 8. This scenario will be titled **TIDAL WETLANDS** for the remainder of this appendix**.**

The second objective is to determine the infrastructure required to remove bittern and desalinate Pond 7 using neighboring waters. In this scenario all water control features that currently exist will be identified. The water control features needed to desalinate Pond 7 using neighboring sloughs, as a water source will be identified when analyzing Group 6.

Objective 1 Scenario 1: Brief description of current conditions - without project conditions of the grouped ponds

The existing ponds fall into the following seven (7) groups with water flow as described.

1. **Ponds 1 and 1A, refer to Figure P1, 1A - 1: Pond 1, 1A Current Conditions – Without Project Conditions:** Currently water flows into Pond 1 from a water control structure that is located on the south side of Pond 1. This structure draws water from San Pablo Bay via a canal that is approximately 30 to 35-feet wide, 3,250-feet long and is about 10 feet deep. A 72-inch diameter 250-foot long water control structure goes under Highway 37 and into Pond 1. The water then flows to the north of Pond 1 and a pump (30,000 gal/min) is used to move the water from Pond 1 to a donut (water holding structure). Water is drawn from Pond 1A via a canal, approximately 875-feet long, 15 to 20-feet wide and 10-feet deep, on the north of Pond 1A. There is currently a 36 in diameter intake approximately 100-feet long from Pond 1A canal into donut Pond 1. From the donut the water is moved into Pond 2 via a 72-inch diameter siphon approximately 300-feet long that goes under South Slough.

2. **Pond 2, refer to Figure P2-1: Pond 2 Current Conditions – Without Project Conditions:** Water flows into Pond 2 via a 72-inch diameter 300-foot long siphon that connects donut Ponds 1 to Pond 2. A 48-inch diameter approximately 250-feet long water control feature draws water from South Slough into Pond 2 near the Duck Club. Water flows from Pond 2 into China Slough via a 48-inch weir with a flap valve. Water flows through a 48-inch pipe 150-foot long outfall located at Pond 2 and connects to the All American Canal. Water flows from the All American canal and into Pond 3 through a siphon that is 72-inches in diameter and approximately 340-feet long. The All American Canal runs from the

southeast corner of Pond 2, along the western edge of Pond 2A. There is a 42-inch diameter 150-foot long pipe that allows water flow from Pond 2A into the All American Canal.

3. **Pond 3, refer to Figure P3 - 1: Pond 3 Current Conditions – Without Project Conditions:** Currently water flows from the All American Canal into Pond 3 via a siphon. The siphon is a 72-inch diameter approximately 340-feet long and goes under South Slough. Water flows out of Pond 3 via a 72-inch diameter siphon that goes under South Slough and into the south side of Pond 4. On the north side of Pond 3 there is a levee breach of approximately 100-feet wide that allows flow from the South Slough into the pond. There is a second levee breach of approximately 50-feet wide southwest of Pond 3 that allows flow from Dutchman Slough into the pond.

4. **Pond 4 and 5, refer to Figure P4, 5 - 1: Pond 4, 5 Current Conditions – Without Project Conditions:** Water flows between Pond 4 and 5 via an internal levee breach. There is a 60-inch diameter 250-feet long siphon that exists on the west side of Pond 5 that goes under Devils Slough and into donut Pond 6. This water control feature draws water from donut Pond 6 into Pond 5. Water flows into Pond 4 via a 72-inch diameter 390-foot long siphon from Pond 3.

5. **Pond 6 and 6A, refer to Figure P6, 6A-1: Pond 6, 6A Current Conditions – Without Project Conditions:** Water flows into Pond 6 to 6A via an internal levee breach. Water flows from Pond 5 to donut Pond 6 via a 60-inch diameter 250-foot long siphon that goes under Devils Slough. Water goes from Pond 7 canal under Napa Slough and into donut Pond 6A via a 48-inch diameter siphon approximately 340-feet long. There are two existing donuts (water holding structures); one is on the north levee of Pond 6A, approximately 45-feet in diameter and about 20-feet deep. The other is located on the east levee of Pond 6 and is about 75-feet in diameter and approximately 20-feet deep. The donut on Pond 6 is regulated by a 6-foot wide sluice gate that allows water into Pond 6. This donut also has a 6-foot wide sluice gate that regulates the flow of water from the canal along the east side of Pond 6A. The donut on Pond 6A is regulated by a 48-inch screw gate that allows water into Pond 6A. This donut also has a 6-foot wide sluice gate that regulates the flow of water from the donut to the canal on the east side of Pond 6A.

6. **Pond 7 and 7A, refer to Figure P7, 7A-1: Pond 7, 7A Current Conditions – Without Project Conditions:** Some of the water control features at Pond 7 are currently inoperable, however they will be listed. Water flows from Pond 7 into a donut (water holding structure) on the northeast side of Pond 7 via 3-foot wide sluice gate. This fixture is currently inoperable. A 3-foot wide sluice gate from Pond 7 to canal east of Pond 7 is currently inoperable. Pond 7A has a water structure, 3-feet wide weir, located on the west side the pond that goes into donut Pond 7. The donut Pond 7 has two parallel pipes, 36-inch diameter and 100-feet long, connecting canal east of Pond 7, under the road and into donut Pond 7. The

canal east of Pond 7 is 20 to 50-feet wide and approximately 5,375-feet long. This canal is broken into two pieces that is connected by a 36-inch diameter 320-foot long siphon. There is a canal, 10 to 20-feet wide and approximately 9,500-feet long, located east of Pond 7. Currently there is a 3-foot wide sluice gate that allows water to flow from donut Pond 7 into the canal. Water can flow from Pond 7 canal into Pond 6A donut via a 48-inch diameter 340-foot long siphon.

7. **Pond 8, refer to Figure P8-1: Pond 8 Current Conditions – Without Project Conditions:** Some of the water control features at Pond 8 are currently inoperable non-the less they will be listed. There are two, 36-inch diameter approximately 150-feet long, water control structures with fish screens located on the southeast corner of Pond 8 that draws water from Mud Slough into Pond 8. Two water control structures, 48-inch diameter 50-feet long remove water from Pond 8 into the canal that runs along the east and north of Pond 8. The canal east and north of Pond 8 is 20 to 50-feet wide and approximately 5,375-feet long. This canal is broken into two pieces that is connected by a 36-inch diameter 320-foot long siphon. The siphon goes from canal north of Pond 8 under Mud Slough and into the second portion of the canal that then connects to donut Pond 7. Currently there is a water control feature, 48-inch diameter 100-foot long pipe, that draws water from Pond 8 into the canal north of pond 8 that is located northeast of Pond 8. This water control feature is currently inoperable.

SECTION 1: Levee Construction, Maintenance and Repair

Levee construction, maintenance and repair apply to all scenarios in this engineering appendix. Levee construction, maintenance and repair includes the upgrade of existing levees while long-term maintenance entails ongoing efforts to maintain levees in good condition during both salinity reduction and restoration. Cost estimates associated with levee maintenance and repair are based on a number of assumptions including the following:

1. Required footage of levee repair is based on reports from a Brown and Caldwell report.[1]

2. Department of Fish and Game (Larry Wyckoff) and GAIA consultant (Susanne von Rosenberg) were consulted regarding levee design. There are interior levees located between the following ponds: Pond 1 and 1A, Pond 2 and 2A, Pond 4 and 5, Ponds 6 and 6A, and between Pond 7 and 7A. Interior levee design is as follows: height of levee = 8 feet, top width of levee = 15 feet, with side slopes = 3H:1V. Exterior levees on all ponds have the following design: height of levee = 12 feet, top width of levee = 25 feet, with outboard slope = 3H:1V and inboard slope = 5H:1V. **NOTE: Height of levees is based from bottom of pond elevation typically.**

   Repair and maintenance will require 2.5 feet deep of material spread on entire levee. Repair base unit costs assume the use of a barge-mounted clamshell dredge for half of the repair and a land-based hydraulic excavator for the other half of the repair. It also includes the cost of spreading and dressing using a front-end loader. When maintenance and repair is being done and the material being used is Bay Mud a 1.15 consolidation rate will be used. The consolidation rate will be used when determining quantities needed for levee construction, maintenance and repair.

3. All levees will be raised to meet the above levee design requirements as the first phase of the project. This will ensure that the ponds will have a minimum water depth of three (3) feet. The minimum depth of 3 feet is necessary to maintain the assumptions used for the desalination of ponds.

4. The Brown and Caldwell Report cites a value of 10% of the length of levees per year for long-term maintenance.[2] Maintenance base unit costs assume the use of a land-based hydraulic excavator and spreading and dressing using a front-end loader.

[1] Napa Salt Marsh Restoration Project Deliverables, Brown and Caldwell, Final Cost Estimate Report, Diffusers and Fish Screens Report, Existing Structures Matrix, May 2002, Table 4 Napa Salt Marsh Restoration Project – Levee Repair and Maintenance Costs.
[2] Napa Salt Marsh Restoration Project Deliverables, Brown and Caldwell, Final Cost Estimate Report, Diffusers and Fish Screens Report, Existing Structures Matrix, May 2002, Table 4 Napa Salt Marsh Restoration Project – Levee Repair and Maintenance Costs.

5. Material needed for the repair and maintenance will be on site. The fill material will be Bay Mud from the ponds.

6. When turning managed ponds into tidal marsh ponds levees will be lowered to approximately 1.5 feet below mean high high water (MHHW). This will require approximately 2.5 feet of levee removal.

Levee Lowering:

To turn the managed ponds into tidal wetlands some external levees will need to be lowered. The excavation of the upper portion of the existing levee and partial fill of the adjacent borrow ditch will be performed along some external levees. Levee lowering is applied for several reasons. Levees are unnatural features, and can provide access and habitat for predators that compromise the ecological objectives of restoration. The crest elevation of levees can be lowered to an elevation consistent with marsh vegetation and habitat, approximately 1.5 feet below MHHW. See Philip Williams and Associates 2002 Plant Colonization as a function of Elevation by Pond Figure 2-15 EIS/EIR April 2003.[3]

To lower the levees 1.5 feet below MHHW on each pond the levee will be lowered to meet the following design: height = 1.5 feet below MHHW. Assume a minimum of 2.5 feet of external levee will need to be lowered based on the Towill Survey.[4]

Levee lowering will be performed after the ponds are open to tidal action in order to avoid the potential for an accidental pond breach. Levee lowering will be performed using land-based equipment. Front-end loaders will collect fill from the top of the levee and push it into the borrow ditch of the ponds.

Interior Levee Construction, Maintenance and Repair:

The interior levees between Pond 1 and 1A will need to be repaired; currently these ponds are separated by two internal levees. The levees will need to be raised a minimum of 2.5 feet. Similarly, Ponds 6 and 6A, and 7, 7A have interior levees that will need to be raised a minimum of 2 ½ feet. If Pond 3 is restored to a managed pond, two interior levees will need to be built. Constructing the two interior levees on Pond 3 will reduce the length of wind fetch and reduce internal levee erosion to a manageable level. The levees mentioned above will also need to be maintained annually a minimum of 10% of total interior levee length.

Each of the interior levees will have the following dimensions: height of levee = 8 feet, top width of levee = 15 feet, with side slopes = 3H:1V. Assume a 1.15 consolidation rate when constructing a new interior levee due to the volume losses in the pond waters

[3] Napa River Salt Marsh Restoration Project, Draft Environmental Impact Report / Environmental Impact Statement, April 2003, Figure 2-15 Plant Colonization as a Function of Elevation by Pond.
[4] Ground Control and Hydrographic Survey Report, Towill Surveying, Mapping and GIS Services, Napa River Salt Marsh Restoration Project Phase 2 – Topographic and Hydrographic Surveys, Contract No.: DACW07-98-D-001.

during construction and subsidence after construction. Assume a 1.15 consolidation rate when maintenance or repair is being done on an interior levee. The fill material will be Bay Mud from the ponds.

If a pond will be turned into tidal wetlands interior levees will need to be lowered to allow for tidal action. To lower the levees 1.5 feet below MHHW on each pond the levee will be lowered to meet the following design: height = 1.5 feet below MHHW, assuming a minimum of 2.5 feet of external levee will need to be lowered based on the Towill Survey.

Construction of the new levees will be performed prior to any levee breaching and while the pond is full. A barge with a clamshell dredge will be launched into the pond. It will dig a channel and place the spoils along the channel to make the levee. The levee would be constructed in a number of passes with a few months between each pass. This is needed to allow time for the dredged material to consolidate into a self-defined levee structure.

Exterior Levee Maintenance and Repair:

The exterior levee between Pond 1, 1A and highway 37 will need to be repaired; the levee will need to be raised a minimum of 2.5 feet. The extent of external levee repair varies from pond to pond; refer to note 1 Brown and Caldwell report.

Each of the exterior levees will have the following dimensions: height of levee = 12 feet, top width of levee = 25 feet, with outboard slope = 3H:1V and inboard slope = 5H:1V. Assume a 1.15 consolidation rate when constructing a new exterior levee due to the volume losses in the pond waters during construction and subsidence after construction. Assume a 1.15 consolidation rate when maintenance or repair is being done on an exterior levee. The fill material will be Bay Mud from the ponds. Maintenance and repair will be performed on site during the summer months when the pond levels are low. A volume change factor of 1.15 will be applied to the drier Bay Mud used for maintenance and repair. The 1.15 volume change factor is an estimate based on current on-site construction practices. An in-situ volume change factor based on geotechnical testing which will be developed as part of preliminary engineering design (PED).

If a pond will be turned into tidal wetlands, portions of exterior levees will need to be lowered to allow for tidal action. To lower the levees 1 ½ feet below MHHW on each pond, the levee will be lowered to meet the following design: height = 1.5 feet below MHHW, assuming a minimum of 2.5 feet of external levee will need to be lowered based on the Towill Survey.

SECTION 2: Water Control Structures for Individual Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands

Water control structures for individual stand alone ponds, managed ponds and/or tidal wetlands apply to all scenarios in the engineering appendix. There are various water control structures that will be needed to control the flow of water within the ponds and between the ponds. Inflow to the ponds is needed to make up for evaporation losses as well as to reduce salinity levels. Outflows are needed to allow for the export of salts to prevent build up of salts in the ponds. Starter channels, starter channel berms and ditch blocks will be needed to control the water flow in the ponds that will be converted to tidal marsh.

Starter Channels:

Starter channels will be excavated in ponds that are planned for restoration to tidal marsh. These channels are intended to facilitate the desirable formation of marsh. They will help in establishing a desired channel pattern, which is likely to result in maximum habitat benefits. Starter channels will facilitate the site drainage, which may increase the rate of vegetation establishment, provide habitat for fish soon after construction, and promote the more rapid formation of smaller channels, which could provide important habitat to biota.

The dimensions of the starter channels are proposed to be as follows: 50 to 100 feet wide and 4 to 8 feet deep below pond bottom, with channels becoming smaller as they move into the ponds. The channel cross-section will be trapezoidal with side slopes on the order of 5H:1V.[5]

Starter Channel Berms:

Berms will be constructed on the side, and parallel, to the starter channel. The berms elevation would be approximately MHHW. The intent is to create or form irregular, wide, low mounds with flat slopes and sinuous path paralleling channels. Berms should be discontinuous to avoid blocking channels. The material excavated to form the starter channels can be used to construct these berms. Berms limit wave generation by reducing the open water fetch lengths, and dissipating waves incident to the berms. If the wave action is reduced then the increase of sedimentation rates will provide a calmer environment conducive to vegetation establishment. The increase in sedimentation will facilitate evolution of the site toward higher elevations and vegetated marsh.

[5] Napa Salt Marsh Restoration Project Deliverables, Brown and Caldwell, Final Cost Estimate Report, Diffusers and Fish Screens Report, Existing Structures Matrix, May 2002, Pg 18.

Ditch Block:

Ditch blocks will be earthen structures constructed in ponds that will be converted to marshes. Ditch blocks will be used to inhibit borrow ditches, man-made features located adjacent to levees, from capturing the tidal supply of water and becoming a permanent site feature. These features will be placed only at locations where existing borrow ditches are located based on consideration of natural marsh morphology. Levees are lowered close to MHHW to maximize generation of relatively dry earth, while maintaining a bearing surface for construction equipment. Dimensions of the ditch blocks will be roughly 100 feet long, 40 feet wide and 4 feet tall (relative to the pond bottom) with side slopes of 5H:1V.

Construction of the ditch blocks will take place prior to opening the ponds to tidal action. The blocks will be constructed using land-based equipment utilizing soil as fill material from the top of external levees that will be lowered to turn the ponds into tidal marsh. Front-end loaders will collect and transport fill from the top of the levee to a large hydraulic excavator. The excavator will push the soil into the pond and slowly build the ditch block out into the levee.

Sediment Addition:

Flow rates through the surrounding sloughs may increase after opening ponds to tidal action. This could result in the loss of some fringe wetlands. To make up for the potential loss in habitat, sediment may be added to some areas of ponds to accelerate evolution to a vegetated marsh. Sediment will be placed no higher than 1.5 feet below MHHW elevation. Material from the dredging of the nearby Napa River, the surrounding sloughs, or starter channel construction would be used.

Ponds that will be turned into tidal marsh ponds will need to have sediment imported to raise the bottom of pond elevation to the level needed for vegetation colonization (approximately 1 ½ feet below MHHW). Note that sediment importation may be cost-shared with associated dredging projects on the Napa River and other related projects. The following ponds will need sediment imported 1, 1A, 2, 6, 6A, 7, 7A and 8.

Intake Structures:

Intake structures consist of a pipe or series of pipes penetrating a levee, and convey water from the sloughs into ponds during high tide. The pipes will be made of high-density polyethylene (HDPE). Intakes pipes range in length from 50 feet to 390 feet and have diameters from 16 inches to 72 inches. Pipes will be fitted with check valves on the pond side of the structures that only open when the elevation of the slough is above that of the pond. Check valves will prevent backflow from the pond into the sloughs. Manual knife valves will also be included on all pipes within the levees to control water flow into the

ponds. Fish screens will be installed on the slough side of intakes to protect fishery resources.

Construction of the intakes will be conducted using construction equipment brought to the needed location via levee tops and/or barges. A cofferdam will be constructed using sheetpiles on the pond and slough side of the levee. The inner areas of the cofferdam will be dewatered during construction as necessary. The levee will then be excavated and a pipe placed in the trench through the levee. As noted above a check valve will be fitted to the pond side of the intake pipe and a manual knife valve will be installed within the levee section of the pipe. The levee will then be rebuilt using existing material and compacted and the cofferdams removed.

On the slough side of the levee, additional pipe will be installed so that the intake elevation is 3 to 4 feet below mean lower low water (MLLW). In areas where the terrain is above high tide, inlet pipes will be installed in a trench dug out by a clamshell digger. Where the pipe is underwater at high tide, it will be attached to support pile anchors driven by a pile driver.

On the slough side of the pipe, a fish screen will be attached to a flange on the end of the intake using a crane and divers. The intake will be placed and sized so as to balance between the need to encroach as little as possible into the navigation channel while keeping structures submerged at low tide.

Fish Screens:

Each intake pipe will include a cone-shaped fish screen that rests on top of the inlet at the end of the pipe. The fish screens are self-cleaning using a brush system that intermittently rotates across the outer surface of the screen. The small submersible hydraulic motor that drives the brushes will be powered by a solar panel system. The frequency of cleaning will be set manually to meet field conditions. Screens are made of stainless steel and epoxy-coated components that are cathodically protected. Protective piles are installed around the screens to protect from large floating debris.

Fish of concern for this project include the Delta Smelt, Salmonid smolts, and the Sacramento Splittail. Based on the limiting species, the Delta Smelt, the National Marine Fisheries Service and the State of California Department of Fish and game require that fish screens be designed with a maximum approach velocity of 0.2 feet per second (fps) and a screen gap of approximately 3/32 inch.

Fish screens will be lowered onto the inlet at the end of an intake structure using a crane and dive crew. The screens will be supported by a number of pile anchors and additional piles will be installed around the screens to protect from large, floating debris.

Outfall Structures:

Outfalls are required to discharge water from ponds to the sloughs during low tide. Each outfall runs from a pond or canal, through an external levee and straight into the receiving sloughs. A manual knife valve is included on the outfall within the levee so that flow through the outfall can be controlled. Outfalls will be constructed of HDPE pipe and range in size from 150-1,100 feet in length and 36 to 54 inches in diameter. The end of each outfall includes a diffuser to enhance the dilution of saline pond water into receiving waters. Diffusers are the same diameter and material as the outfall and are roughly 50 to 100 feet in length. Construction of outfalls is similar to the construction of the intakes.

Diffusers:

Diffusers are the same diameter and HDPE material as the outfall and are roughly 50 to 100 feet in length. Each diffuser includes eight to ten ports along its length each at 6 to 10 inch diameters and one 10 to 14 inch diameter port at its end. The ports are fitted with flexible neoprene check valves that open only when tidal elevations are lower than pond elevation. Diffusers are anticipated to be adjacent to navigational channels within the sloughs and will be identified with appropriate signs and lighting.

Siphons:

Siphons are required to move water from one pond to another under sloughs. Currently there are siphons on site that were used during the salt production. Due to deterioration these siphons will be replaced and additional siphons will be added for salinity reduction.[6] The siphons will be installed with manually controlled knife valves. Siphons on the site will range in length from 250 to 390 feet and range in diameter from 48 to 72 inches. All siphons will be made of HDPE material.

Construction of the siphons will be conducted using construction equipment brought to the needed location via levee tops and/or barges. Cofferdams will first be constructed using sheetpiles on the pond side of the levee on both ponds. The levees between the ponds and the slough will be excavated. A trench will then be excavated with a clamshell dredge across the slough from one levee breach to another. A gravel bed will be placed in the trench and the siphon will be placed on to the bed using divers and a crane. A manual knife valve will be installed on the siphon within one of the levees. Once the siphon and valve are in place, the trench along the bottom of the slough and the levee at each pond will be rebuilt. After rebuilding is complete, the cofferdams will be removed.

[6] Napa-Sonoma Marsh Restoration, Napa Siphon Field Data Collection, Philip Williams & Associates, Ltd. March 9, 2001, Pg. 55

Mixing Chamber: Refer to Figure 1-3, Mixing Chamber

Currently a levee-enclosed structure called a "donut" connects flows from northern Ponds 7, 7A and 8. For salinity reduction alternatives the existing donut structure will be modified and used as a mixing chamber to dilute the highly saline water from Pond 7 with less saline water from Ponds 7A and 8. To enhance turbulent mixing of the high-density brine with other inflows, new inlet structures from Ponds 7 and 7A will discharge into a 25-foot diameter newly-constructed inner mixing chamber. Existing inlets that carry flow from Pond 8 will be extended to meet the inner mixing chamber. The mixed flow from the inner chamber will flow up and out into the outer mixing chamber area. It will then flow through outlet structures to a canal and either be discharged to the Napa Slough or to Pond 6A. All inlet and outlet structures will be made with HDPE, and all will have knife valves within the levee.

Installation of inlets and outlets through levees will be similar to the levee penetration scenario described for outlet structures. The inner mixing chamber will be constructed of sheetpiles. Two sets of sheetpiles will be installed in a rough circle. Holes will then be cut in the sheet pile and inlet pipes will be extended into the inner-mixing chamber. Sheetpiles will then also be cut to the appropriate height so that they are just below the water elevation. Concrete will be poured between the sheetpiles after inlet pipes have been positioned through the sheetpiles.

Existing Donut:

A donut is a holding facility for water, similar to a small pond. These donuts are currently located at Pond 1, 6, 6A, and 7, and vary in size from 40 to 75 feet in diameter, the depths of these donuts also vary from 20 to 25 feet deep. There are water control structures, intakes and outtakes, on the donuts.

Existing Intake under Highway 37:

Currently there is an intake, 72-inch pipe 250-feet long, that goes from the San Pablo Bay canal under Highway 37 and into Pond 1. A new 72-inch pipeline constructed out of HDPE material will replace this pipeline. A knife valve will be installed on the pond side of the pipe to control flow rate.

The pipeline will be installed using bore-and jack trenchless construction methods. A geotechnical investigation will first be conducted to confirm that the site is suitable for construction. Cofferdams will be constructed on both the jacking side (Pond 1) and receiving side (the cannel to San Pablo Bay) of the site. The areas will be dewatered and jacking and receiving pits will be excavated. A concrete base will be constructed in the receiving pit and thrust piles will be driven to support jacking. Once pipe installation is completed, a knife valve will be installed on the pond side of the pipe, along with a pile-supported walkway to access the valve.

Existing Canals:

There are various canals throughout the site that are used to facilitate the transfer of water from one pond to another or to a slough. The canals vary in size from 10 to 50 feet wide and vary in length from 800 to 6,000 feet.

SECTION 3

Group 1: Ponds 1 and 1A Analysis.

1. Pond 1 and 1A analysis: CURRENT CONDITIONS – WITHOUT PROJECT CONDITIONS

Refer to FIGURE P1, 1A – 1: POND 1, 1A CURRENT CONDITIONS – WITHOUT PROJECT CONDITIONS
Refer to TABLE P1, 1A – A: POND 1, 1A LEVEE QUANTITIES
Refer to TABLE P1, 1A – B: PONDS 1, 1A WATER CONTROL FEATURES QUANTITIES.

Note: The descriptions of the levee and water control features are different than those listed in the tables, refer to the figure for proper description of features.

Levees:

- **NOTE 1:** There are two parallel internal levees
- **NOTE 2:** Internal levee has an existing breach approximately 660-feet in length.

Water Control Features: Pond 1

- **P1-1:** Water is drawn from San Pablo Bay via a canal that is approximately 3,250-feet long, 30 to 35 feet wide and approximately 10-feet deep.
- **P1-2:** Currently water flows into Pond 1 from a water control structure that is located on the south side of Pond 1. This structure draws water from San Pablo Bay via a canal. The water control structure, 72-inch diameter 250-feet long pipe, goes under Highway 37 and into Pond 1.
- **P1-3:** The water then flows to the north of Pond 1 and a pump (30,000 gal/min) is used to move the water from Pond 1 to a donut located on the north levee of Pond 1.
- **P1-4:** The donut is a 40 to 60 foot diameter water holding structure that is approximately 20-feet deep.
- **P1-5:** From the donut the water is moved into Pond 2 via a 72-inch diameter siphon approximately 300-feet long that goes under South Slough

1. Pond 1 and 1A analysis: CURRENT CONDITIONS – WITHOUT PROJECT CONDITIONS continued

Water Control Features: Pond 1A

- **P1A-1:** Water is drawn from Pond 1A via a canal, approximately 875-feet long 15 to 20-feet wide and 10-feet deep, on the northeast side of Pond 1A.

- **P1A-2:** There is currently a 36-inch diameter intake approximately 100-feet long from Pond 1A canal into the donut of Pond 1. .

2. Pond 1 and 1A analysis: Break pond groups up into stand alone ponds: Pond 1 and 1A analysis

Refer to FIGURE P1, 1A – 2:POND 1, 1A STAND ALONE PONDS
Refer to TABLE P1, 1A – A: POND 1, 1A LEVEE QUANTITIES
Refer to TABLE P1, 1A – B: POND 1, 1A WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To separate the two ponds into stand alone units the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

Interior Levee Construction, Repair and Maintenance:

- **NOTE 1:** There are two parallel internal levees.
- **NOTE 2:** The interior levee breach of 660-feet will need to be filled.
- **NOTE 3:** The levees will need to be raised a minimum of 2.5-feet to allow the water level in the ponds to be approximately 3 feet.
- **NOTE 4:** Annual maintenance of the internal levee will be done on 10% of total levee length.

External Levee Construction, Repair and Maintenance:

- **NOTE 6:** Levee that parallels highway 37 of both Pond 1 and 1A will need to be raised a minimum of 2.5-feet on both ponds.
- **NOTE 7:** Repair on the remaining external levee of Pond 1 will need to be raised a minimum of 2.5-feet on approximately 60% of levee length.
- **NOTE 8:** Repair on the remaining external levee of Pond 1A will need to be raised a minimum of 2.5-feet on approximately 15% of levee length.

2. Pond 1 and 1A analysis: Break pond groups up into stand alone ponds: Pond 1 and 1A analysis continued

- **NOTE 9:** Annual maintenance of the external levees will require them to be raised a minimum of 2.5-ft on 10% of total levee length.

Water Control Features: Pond 1

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P1-7:** Outfall from donut Pond 1 to South Slough via a 72-inch diameter 150-foot long outfall with a diffuser. The diffuser is added to the outfall to enhance the dilution of saline pond water into receiving waters.

- **P1-8:** Four (4) intakes between the ponds will be added. These intakes are 48-inch diameter and 300-feet long pipes. They will allow flow between the ponds.

- **P1-11:** Sheet pile walkway is placed on the intake from Highway 37.

REMOVE: Water Control Feature (WCF) Removed

- **P1-5:** 72-inch diameter siphon approximately 300-feet long that goes under South Slough and into Pond 2.

Water Control Features: Pond 1A

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- No water control features added

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed

2. Pond 1 and 1A analysis: Break pond groups up into stand alone ponds: Pond 1 and 1A analysis continued

Construction or water control structures: Pond 1 and Pond 1A

Refer to TABLE P1, 1A, – B: WATER CONTROL FEATURES QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

3. Maintain group as managed ponds:

Refer to FIGURE P1, 1A – 3:POND 1, 1A, MANAGED PONDS
Refer to TABLE P1, 1A – A: POND 1, 1A LEVEE QUANTITIES
Refer to TABLE P1, 1A – B: POND 1, 1A WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To maintain the two ponds as managed ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees: Same levee structures as stand alone ponds with the following levee structures added or removed. The comparison is made to stand alone ponds scenario because no levees were discussed under current conditions – without project scenario. (for example levee maintenance etc.)

Interior Levee Construction, Repair and Maintenance:

ADD: Levee Features Added

- ❖ No levee features added

REMOVE: Levee Features Removed

- ➢ **NOTE 2:** Internal levee is not filled for this scenario.

External Levee Construction, Repair and Maintenance:

ADD: Levee Features Added

- ❖ No levee features added

REMOVE: Levee Features Removed

- ❖ No levee features removed

3. POND 1 and 1A analysis: Maintain group as managed ponds continued

Water Control Features: Pond 1

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P1-11:** Sheet pile walkway on Highway 37 intake.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed.

Water Control Features: Pond 1A

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- No water control features added

REMOVE: Water Control Feature (WCF)

- No water control features removed.

Construction or water control structures: Pond 1 and Pond 1A

Refer to TABLE P1, 1A, – B: WATER CONTROL FEATURE QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

4. Turn the ponds into tidal wetlands:

Refer to FIGURE P1, 1A – 4:POND 1, 1A TIDAL WETLANDS
Refer to TABLE P1, 1A – A: POND 1, 1A LEVEE QUANTITIES
Refer to TABLE P1, 1A – B: POND 1, 1A WATER CONTROL FEATURE QUANTITY

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To turn the grouped ponds into tidal wetlands the following water control structures will need to be added.

Levees:

Interior Levee Construction, Repair and Maintenance:

Same levee structures as stand alone ponds with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 5:** Four (4) internal levee breaches will be placed. Each levee breach is approximately 100-feet wide.

REMOVE: Levee Features Removed

- **NOTE 2:** Internal levee breach of 660-feet will not be filled.

External Levee Construction, Repair and Maintenance:

Same levee structures as stand alone ponds with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 10:** Approximately .75 miles of external levee of Pond 1A lowered to South Slough to allow tidal action.

- **NOTE 11:** Ditch Block will be placed near the external levee lowering. Dimensions of the ditch blocks will be roughly 100 feet long, 40 feet wide and 4 feet tall (relative to the pond bottom) with side slopes of 5H:1V.

4. POND 1 and 1A analysis: Turn the ponds into tidal wetlands continued

- **NOTE 12:** Starter Channel will be placed by external levee breach. Design is 75-feet wide, 6-feet deep and 75-feet long.

- **NOTE 13:** Berms will be placed by starter channel being built. The material for the berms will be the material excavated to make the starter channels (Bay Mud).

REMOVE: Levee Features Removed

- ❖ No levee features removed.

Water Control Features: Pond 1

Same water control structures as current conditions – without project conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P1-7:** Outfall from donut Pond 1 to South Slough via a 72-inch diameter 150-foot long pipe with a diffuser. The diffuser is added to the outfall to enhance the dilution of saline pond water into receiving waters.

- **P1-9:** Two (2) outfalls from Pond 1 to Sough Slough via a 54-inch diameter 200-feet long pipe with a diffuser.

- **P1-10:** Sediment imported to Pond 1 to raise pond elevation approximately 1.12-feet.

- **P1-11:** Sheet pile walkway on highway 37 intake.

REMOVE: Water Control Feature (WCF) Removed

- **P1-3:** Pump 30,000 gal/min removed.

- **P1-5:** 72-inch diameter siphon approximately 300-feet long that goes under South Slough and into Pond 2.

4. Pond 1 and 1A analysis: Turn the ponds into tidal wetlands continued

Water Control Features: Pond 1A

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- **P1A-3:** Sediment imported to Pond 1A to raise pond elevation approximately 1.12-feet.

REMOVE: Water Control Feature (WCF)

- No water control features removed.

Construction or water control structures: Pond 1 and Pond 1A

Refer to TABLE P1, 1A, – B: WATER CONTROL FEATURE QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

SECTION 4

Group 2: Pond 2 Analysis: Although Pond 2A is not designated as a pond in the Napa Salt Marsh Restoration Project it is included in this analysis because of the various water control structures that effect the water flow from Pond 2A into the All American Canal and the effect of the levee breaches on the overall morphology of the pond.

1. Current conditions – without project conditions:

Refer to FIGURE P2 – 1: POND 2 CURRENT CONDITIONS WITHOUT PROJECT CONDITIONS
Refer to TABLE P2 – A: POND 2 LEVEE QUANTITIES
Refer to TABLE P2 – B: PONDS 2 WATER CONTROL FEATURES QUANTITIES.

Note: The descriptions of the levee and water control features are different than those listed in the tables, refer to the figure for proper description of features.

Levees:

- **NOTE 1:** The second is located on the south side of Pond 2A and is approximately 100-feet wide. This breach allows water to flow into the Pond from South Slough.

- **NOTE 2:** There are two levee breaches in Pond 2A. The first one is located on the northeast corner of the pond and is approximately 50-feet wide. This breach allows water to flow into the Pond from China Slough

Water Control Features: Pond 2

- **P2-1:** Water flows into Pond 2 via a 72-inch diameter 300-foot long siphon that connects donut Ponds 1 to Pond 2.

- **P2-2:** A 48-inch diameter approximately 250-feet long water control feature draws water from Pond 2 near the Duck Club to South Slough.

- **P2-3:** Water can flow from Pond 2 into China Slough via a 48-inch weir with a flap valve.

- **P2-4:** Water can flow through a 48-inch pipe 150-foot long outfall located at Pond 2 and connects to the All American Canal.

- **P2-5:** The All American Canal runs from the southeast corner of Pond 2, along the western edge of Pond 2A.

1. Pond 2 analysis: Current conditions – without project conditions continued

- **P2-6:** Water can flow from the All American canal and into Pond 3 through a siphon that is 72-inches in diameter and approximately 340-feet long.

Water Control Features: Pond 2A

- **P2A-1:** There is a 42-inch diameter 150-foot long pipe that allows water flow from Pond 2A into the All American Canal.

2. Maintain group as managed pond:

Refer to FIGURE P2 - 2: POND 2, MANAGED POND
Refer to TABLE P2 - A: POND 2 LEVEE QUANTITIES
Refer to TABLE P2 - B: POND 2 WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To maintain the pond as managed pond the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the pond.

Levees:

External Levee Construction, Repair and Maintenance:

Same levee structures as current conditions with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 3:** Raise external levee around duck club a minimum of 2.5 feet.
- **NOTE 4:** Repair of the external levee will require raising the levee a minimum of 2.5-feet of 80% of total levee length.
- **NOTE 5:** Annual maintenance on the external levee will need to be done on approximately 10% of total levee length. This will require the levee to be raised a minimum of 2.5-feet.

REMOVE: Levee Features Removed

- No levee features removed.

2. Pond 2 analysis: Maintain group as managed pond continued

Water Control Features: Pond 2, 2A

Same water control structures as current conditions with the following levee structures added or removed.

ADD: Water Control Features Added

- All water control features listed in the current condition analysis will be replaced with the same features and sizes made of HDPE material.

REMOVE: Water Control Features Removed

- No water control features removed.

Construction or water control structures: Pond 2

Refer to TABLE P2 - B: POND 2 WATER CONTROL FEATURE QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

3. Turn the pond into tidal wetlands:

Refer to FIGURE P2 -3:POND 2 TIDAL WETLANDS
Refer to TABLE 2 - A: POND 2 TIDAL WETLAND LEVEES
Refer to TABLE 2 - B: POND 2 TIDAL WETLAND WATER CONTROL FEATURES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To turn the pond into tidal wetlands the following water control structures will need to be added.

Levees:

External Levee Construction, Repair and Maintenance:

Same levee structures as managed ponds with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 6:** External levee breach of Pond 2 every 250-acre feet of pond. Three (3) breaches are required. The locations of the breaches have not been established.

- **NOTE 7:** Ditch blocks will be placed at each external levee breach. Design is 40-feet wide, 4-feet high and 100-feet long. Three (3) ditch blocks are required.

- **NOTE 8:** Starter Channel will be placed by each external levee breach. Design is 75-feet wide, 6-feet deep and 75-feet long. Three (3) starter channels are required.

- **NOTE 9:** Berms will be placed by starter channel being built. The material for the berms will be the material excavated to make the starter channels (Bay Mud). One by each starter channel for a total of three (3).

REMOVE: Levee Features Removed

- No levee features removed.

3. Pond 2 analysis Turn the pond into tidal wetlands continued:

Water Control Features: Pond 2

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P2-7:** Pond 2 elevation will need to be raised a minimum of 1.78-feet.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed.

Note: All water control structures listed for current conditions – without project conditions will be replaced with new structures. The structures will be used in maintaining salinity levels in the ponds at ambient conditions.

SECTION 5
Group 3: Pond 3 Analysis.

1. Current conditions – without project conditions:

Refer to FIGURE P3 – 1: POND 3 CURRENT CONDITIONS WITHOUT PROJECT CONDITIONS
Refer to TABLE P3 – A: POND 3 LEVEE QUANTITIES
Refer to TABLE P3 – B: PONDS 3 WATER CONTROL FEATURES QUANTITIES.

Note: The descriptions of the levee and water control features are different than those listed in the tables, refer to the figure for proper description of features.

Levees: There are two levee breaches in Pond 3.

- **NOTE 1:** The first one is located north of the pond and is approximately 100-feet wide and breaches into South Slough.

- **NOTE 2:** The second is located on the southeast of Pond 3 and is approximately 50-feet wide and breaches to Dutchman Slough.

Water Control Structures: Pond 3

- **P3-1:** Currently water flows from the All American Canal into Pond 3 via a siphon. The siphon is a 72-inch diameter approximately 340-feet long and goes under South Slough.

- **P3-2:** Water flows out of Pond 3 via a 72-inch diameter siphon that goes under South Slough and into the south side of Pond 4.

2. Maintain group as managed pond:

Refer to FIGURE P3 – 3: POND 3, MANAGED POND
Refer to TABLE P3 –A: POND 3 LEVEE QUANTITIES
Refer to TABLE P3 – B: POND 3 WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To maintain the pond as managed pond the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the pond.

Levees:

Internal Levee Construction, Repair and Maintenance:

Same levee structures as current conditions with the following levee structures added or removed. New internal levees will need to construct.

ADD: Internal Levee Features Added

- **NOTE 3:** Build internal levee approximately 800-feet long
- **NOTE 4:** Build internal levee approximately 1,400-feet long.

External Levee Construction, Repair and Maintenance:

Same levee structures as current conditions with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 5:** Repair of the external levee will require raising the levee a minimum of 2.5-feet of 30% of total levee length.
- **NOTE 6:** Annual maintenance on the internal levee will need to be done on approximately 10% of total levee length. This will require the levee to be raised a minimum of 2.5-feet.
- **NOTE 7:** Annual maintenance on the external levee will need to be done on approximately 10% of total levee length. This will require the levee to be raised a minimum of 2.5-feet.

2. Pond 3 analysis: Maintain group as managed pond continued

REMOVE: Levee Features Removed

- ❖ No levee features removed.

Water Control Features: Pond 3

Same water control structures as stand alone ponds with the following levee structures added or removed.

ADD: Water Control Features Added

- ➢ **P3-3 and P3-4:** Six (6) water control features will be placed on the internal levee to allow water to flow. There will be three (3) features on each levee. Each feature will be 54-inch diameter 120-feet long.

- ➢ **P3-5:** Nine (9) intakes from Napa River will be placed with fish screens on each intake. Each intake has a 54-inch diameter 200-foot long pipe.

- ➢ **P3-6:** Three (3) intakes from Dutchman Slough will be placed with fish screens on each intake. Each intake has a 54-inch diameter 200-foot long pipe.

REMOVE: Water Control Features Removed

- ❖ No water control features removed.

Construction or water control structures: Pond 3

Refer to TABLE P3 - B: POND 3 WATER CONTROL FEATURE QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

3. Turn the pond into tidal wetlands:

Refer to FIGURE P3 – 3:POND 3 TIDAL WETLANDS
Refer to TABLE 3 – A: POND 3 TIDAL WETLAND LEVEES
Refer to TABLE 3 –B: POND 3 TIDAL WETLAND WATER CONTROL FEATURES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To turn the pond into tidal wetlands the following water control structures will need to be added.

Levees:

External Levee Construction, Repair and Maintenance:

Same levee structures as managed ponds with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 8:** External levee breach of Pond 3 every 250-acre feet of pond. Six (6) breaches are required.
- **NOTE 9:** Ditch blocks will be placed at each external levee breach. Design is 40-feet wide, 4-feet high and 100-feet long. Six (6) ditch blocks are required.
- **NOTE 10:** Starter Channel will be placed by each external levee breach. Design is 75-feet wide, 6-feet deep and 75-feet long. Six (6) starter channels are required.
- **NOTE 11:** Berms will be placed by starter channel being built. The material for the berms will be the material excavated to make the starter channels (Bay Mud). One by each starter channel for a total of six (6).

REMOVE: Levee Features Removed

- No levee features removed.

3. Pond 3 analysis: Turn the pond into tidal wetlands continued

Water Control Features: Pond 3

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- ❖ No water control features removed.

REMOVE: Water Control Feature (WCF) Removed

- ❖ No water control features removed.

Note: All water control structures listed for current conditions – without project conditions will be replaced with new structures. The structures will be used in maintaining salinity levels in the ponds at ambient conditions.

SECTION 6

Group 4: Ponds 4 and 5 Analysis.

1. Current conditions – without project conditions:

Refer to FIGURE P4, 5 – 1: POND 4, 5 CURRENT CONDITIONS WITHOUT PROJECT CONDITIONS
Refer to TABLE P4, 5 – A: POND 4, 5 LEVEE QUANTITIES
Refer to TABLE P4, 5 – B: PONDS 4, 5 WATER CONTROL FEATURES QUANTITIES.

Note: The descriptions of the levee and water control features are different than those listed in the tables, refer to the figure for proper description of features.

Levees:

- **NOTE 1:** Internal levee has an existing breach approximately 50-feet in length.

Water Control Structures: Pond 4

- **P4-1:** Water flows into Pond 4 via a 72-inch diameter 390-foot long siphon that goes under South Slough from Pond 3.

Water Control Structures: Pond 5

- **P5-1:** There is a 60-inch diameter 250-feet long siphon that exists on the west side of Pond 5 that goes under Devils Slough and into donut Pond 6. This water control feature draws water from donut Pond 6 into Pond 5.

2. Break pond groups up into stand alone ponds:

Refer to FIGURE P4, 5 – 2:POND 4, 5 STAND ALONE PONDS
Refer to TABLE P4, 5 – A: POND 4, 5 STAND ALONE POND LEVEES
Refer to TABLE P4, 5 – B: POND 4, 5 STAND ALONE PONDS WATER CONTROL FEATURES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To separate the two ponds into stand alone ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

Interior Levee Construction, Repair and Maintenance:

- **NOTE 1:** The interior levee breach of 50-feet will need to be filled.
- **NOTE 2:** The interior levee will need to be raised a minimum of 2.5-feet to allow the water level in the ponds to be approximately 3 feet. Annual maintenance of the internal levee will be done on 10% of total levee length.
- **NOTE 3**: Annual maintenance of the internal levee will be done on 10% of total levee length. Levee will need to be raised a minimum of 2.5-feet.

External Levee Construction, Repair and Maintenance:

- **NOTE 4:** Repair of Pond 5 levee will need to be done on approximately 5% of total levee length. The levee will need to be raised a minimum of 2.5-feet.
- **NOTE 5:** Annual maintenance of the external levee will be done on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

2. Pond 4, 5 analyses: Break pond groups up into stand alone ponds continued

Water Control Features: Pond 4

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P4-2:** Two (2) outfalls with diffuser from Pond 4 to Napa River. Size of each outfall is 54-inch diameter 1,100-foot long pipe.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed

Water Control Features: Pond 5

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P5-2:** Seven (7) intakes from Napa River with fish screens. Size of each intake is 54-inch diameter 150-feet long pipe.

- **P5-3:** Four (4) intakes on internal levee to control water flow between Pond 4 and 5. Each intake is 36-inche diameter 120-feet long.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed.

Construction or water control structures: Pond 4, 5

Refer to TABLE P4, 5 - B: WATER CONTROL FEATURES QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

3. Maintain group as managed ponds:

Refer to FIGURE P4, 5 – 3:POND 4, 5 MANAGED PONDS
Refer to TABLE P4, 5 – A: POND 4, 5 LEVEE QUANTITIES
Refer to TABLE P4, 5 – B: POND 4, 5 WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To maintain the two ponds as managed ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

Interior Levee Construction, Repair and Maintenance:

Same levee structures as current conditions without project scenario with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 3:** Annual maintenance on internal levee 10% if total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 6:** Four (4) internal levee breaches each 100-feet wide.

REMOVE: Levee Features Removed

- No levee features removed.

External Levee Construction, Repair and Maintenance:

Same levee structures as current conditions – without project conditions with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 4:** External levee repair on Pond 5 approximately 5% of total length. The levee will need to be raised a minimum of 2.5-feet.

3. Pond 4, 5 analyses: Maintain group as managed ponds continued

- **NOTE 5:** Annual maintenance of external levee of 5% total length. The levee will need to be raised a minimum of 2.5-feet.

REMOVE: Levee Features Removed

- ❖ No levee features removed

Water Control Features: Pond 4

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P4-2:** Two (2) outfalls with diffuser from Pond 4 to Napa River. Size of each outfall is 54-inch diameter 1,100-foot long pipe.

REMOVE: Water Control Feature (WCF) Removed

- ❖ No water control features removed.

Water Control Features: Pond 5

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- **P5-2:** Seven (7) intakes from Napa River with fish screens. Size of each intake is 54-inch diameter 150-feet long pipe.

REMOVE: Water Control Feature (WCF)

- ❖ No water control features removed.

3. Pond 4, 5 analyses: Maintain group as managed ponds continued

Construction or water control structures: Pond 4, 5

Refer to TABLE P4, 5 - B: WATER CONTROL FEATURES QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

4. Turn the ponds into tidal wetlands:

Refer to FIGURE P4, 5 – 4:POND 4, 5 TIDAL WETLANDS
Refer to TABLE P4, 5 – A: POND 4, 5 LEVEE QUANTITIES
Refer to TABLE P4, 5 – B: POND 4, 5 WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To turn the grouped ponds into tidal wetlands the following water control structures will need to be added.

Levees:

Interior Levee Construction, Repair and Maintenance:

Same levee structures as current conditions – without project condition with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 7:** Internal levee will need to be lowered a minimum of 2.5-feet to allow tidal action between the ponds.

REMOVE: Levee Features Removed

- No levee features removed.

External Levee Construction, Repair and Maintenance:

Same levee structures as current conditions no project condition with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 8:** Lower external levee of Pond 4 approximately 1,000-feet to allow tidal action from Napa Slough.

- **NOTE 9:** Lower external levee of Pond 4 approximately 3,000-feet to allow tidal action from Napa Slough.

4. Pond 4, 5 analysis: Turn the ponds into tidal wetlands continued:

- **NOTE 10:** Lower external levee of Pond 5 approximately 800-feet to allow tidal action from Napa River.

- **NOTE 11:** Lower external levee of Pond 5 approximately 2,200-feet to allow tidal action from Devils Slough.

- **NOTE 12:** Ditch blocks will be built at each location where the external levee is lowered. Four (4) ditch blocks will be built.

- **NOTE 13:** Starter Channel will be placed by external levee breach. Design is 75-feet wide, 6-feet deep and 75-feet long. Four (4) starter channels will be built.

- **NOTE 14:** Berms will be placed by starter channel being built. The material for the berms will be the material excavated to make the starter channels (Bay Mud). Four (4) starter berms will be built.

REMOVE: Levee Features Removed

- No levee features removed.

Water Control Features: Pond 4

Same water control structures as current conditions – without project condition with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- No water control features added.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed

Water Control Features: Pond 5

Same water control structures as current conditions – without project condition with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- No water control features added

4. Pond 4, 5 analyses: Turn the ponds into tidal wetlands continued:

REMOVE: Water Control Feature (WCF)

- ❖ No water control features removed.

Note: All water control structures listed for current conditions – without project conditions will be replaced with new structures. The structures will be used in maintaining salinity levels in the ponds at ambient conditions.

SECTION 7

Group 5: Ponds 6 and 6A Analysis.

1. Current conditions – without project conditions:

Refer to FIGURE P6, 6A – 1: POND 6, 6A CURRENT CONDITIONS – WITHOUT PROJECT CONDITIONS
Refer to TABLE P6, 6A – A: POND 6, 6A LEVEE QUANTITIES
Refer to TABLE P6, 6A – B: PONDS 6, 6A WATER CONTROL FEATURES QUANTITIES.

Note: The descriptions of the levee and water control features are different than those listed in the tables, refer to the figure for proper description of features.

Levees:

- **NOTE 1:** Internal levee has an existing breach approximately 50-feet in length.

Water Control Structures: Pond 6

- **P6-1:** Water flows from donut Pond 6 to Pond 5 via a 60-inch diameter 250-foot long siphon, which goes under Devils Slough.

- **P6-2:** The donut on Pond 6 is regulated by a 6-foot wide sluice gate that allows water into Pond 6.

- **P6-3:** A donut is located on the east levee of Pond 6 which is about 75-feet in diameter and approximately 20-feet deep.
-
- **P6-4:** This donut also has a 6-foot wide sluice gate that regulates the flow of water from the canal along the east side of Pond 6A.

Water Control Structures: Pond 6A

- **P6A-1:** Canal runs east of pond 6A down to Pond 6. Canal is 10 to 20-feet wide 5,750-feet long and approximately 10-feet deep.

- **P6A-2:** There is a donuts (water holding structures) on the north levee of Pond 6A, approximately 45-feet in diameter and about 20-feet deep.

- **P6A-3:** The donut Pond 6A is regulated by a 6-foot wide screw gate that allows water into Pond 6A.
-

1. Pond 6, 6A analyses: Current conditions – without project conditions

- **P6A-4:** This donut also has a 6-foot wide sluice gate that regulates the flow of water from the donut to the canal on the east side of Pond 6A. This water flows down the canal into donut Pond 6.

- **P6A-5:** Water goes from Pond 7 canal under Napa Slough and into donut Pond 6A via a 48-inch diameter siphon approximately 340-feet long.

2. Break pond groups up into stand alone ponds:

Refer to FIGURE P6, 6A – 2:PONND 6, 6A STAND ALONE PONDS
Refer to TABLE P6, 6A – 2A:POND 6, 6A STAND ALONE POND LEVEES
Refer to TABLE P6, 6A – 2B: POND 6, 6A STAND ALONE PONDS WATER CONTROL FEATURES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To separate the two ponds into stand alone ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

Interior Levee Construction, Repair and Maintenance:

- **NOTE 1:** The interior levee breach of 50-feet will need to be filled.
- **NOTE 2:** The levees will need to be raised a minimum of 2.5-feet to allow the water level in the ponds to be approximately 3-feet. Annual maintenance of the internal levee will be done on 10% of total levee length.
- **NOTE 3:** Annual maintenance on internal levee on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

External Levee Construction, Repair and Maintenance:

- **NOTE 4:** Repair of Pond 6 levee will need to be done on approximately 5% of total levee length. The levee will need to be raised a minimum of 2.5-feet.
- **NOTE 5:** Repair of Pond 6A levee will need to be done on approximately 20% of total levee length. The levee will need to be raised a minimum of 2.5-feet.
- **NOTE 6:** Annual maintenance of the external levee will be done on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

2. Pond 6, 6A analyses: Break pond groups up into stand alone ponds continued

Water Control Structures: Pond 6

Same water control structures as current conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P6-5:** Four (4) intakes 36-inch diameter 120-feet long pipe. Allow flow between the two ponds.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed

Water Control Features: Pond 6A

Same water control structures as current conditions – without project conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- **P6A-6:** Ten (10) intakes from Napa Slough with fish screens. Size of each intake is 54-inch diameter 150-feet long pipe.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed.

Construction or water control structures: Pond 6, 6A

Refer to TABLE P6 - B: WATER CONTROL FEATURES QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

3. Maintain group as managed ponds:

Refer to FIGURE P6, 6A – 3:POND 6, 6A MANAGED PONDS
Refer to TABLE P6, 6A – A: POND 6, 6A LEVEE QUANTITIES
Refer to TABLE P6, 6A – B: POND 6, 6A WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition - without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To maintain the two ponds as managed ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

Interior Levee Construction, Repair and Maintenance:

Same levee structures as current conditions – without project conditions scenario with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 3:** Annual maintenance on internal levee 10% if total levee length.

REMOVE: Levee Features Removed

- No levee features removed.

External Levee Construction, Repair and Maintenance:

Same levee structures as current conditions – without project conditions with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 4:** External levee repair on Pond 6 approximately 5% of total length.
- **NOTE 5:** External levee repair on Pond 6A approximately 20% of total length.
- **NOTE 6:** Annual maintenance of external levee of 5% total length both ponds.

3. Pond 6, 6A analyses: Maintain group as managed ponds continued

REMOVE: Levee Features Removed

- ❖ No levee features removed

Water Control Features: Pond 6

Same water control structures as current conditions – without project conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- ❖ No water control features removed

REMOVE: Water Control Feature (WCF) Removed

- ❖ No water control features removed.

Water Control Features: Pond 6A

Same water control structures as current conditions – without project conditions with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- ➢ **P6A-6:** Ten (10) intakes from Napa River with fish screens. Size of each intake is 54-inch diameter 150-feet long pipe.

REMOVE: Water Control Feature (WCF)

- ❖ No water control features removed.

Construction or water control structures: Pond 6, 6A

Refer to TABLE P6, 6A - B: WATER CONTROL FEATURES QUANTITIES

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

4. Turn the ponds into tidal wetlands:

Refer to FIGURE P6, 6A – 4:POND 6, 6A TIDAL WETLANDS
Refer to TABLE P6, 6A – A: POND 6, 6A LEVEE QUANTITIES
Refer to TABLE P6, 6A – B: POND 6, 6A WATER CONTROL FEATURE QUANTITIES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To turn the grouped ponds into tidal wetlands the following water control structures will need to be added.

Levees:

Interior Levee Construction, Repair and Maintenance:

Same levee structures as current conditions – without project condition with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 7:** Internal levee will need to be lowered a minimum of 2.5-feet to allow tidal action between the ponds.

REMOVE: Levee Features Removed

- No levee features removed.

External Levee Construction, Repair and Maintenance:

Same levee structures as current conditions – without project condition with the following levee structures added or removed.

ADD: Levee Features Added

- **NOTE 8:** Lower external levee of Pond 6 approximately 1,300-feet to allow tidal action from Devils Slough.

- **NOTE 9:** Lower external levee of Pond 6A approximately 3,200-feet to allow tidal action from Napa Slough.

4. Pond 6, 6A analyses: Turn the ponds into tidal wetlands continued

- **NOTE 10:** Ditch blocks will be built at each location where the external levee is lowered. Two (2) ditch blocks will be built.

- **NOTE 11:** Starter Channel will be placed by external levee breach. Design is 75-feet wide, 6-feet deep and 75-feet long. Two (2) starter channels will be built.

- **NOTE 12:** Berms will be placed by starter channel being built. The material for the berms will be the material excavated to make the starter channels (Bay Mud). Two (2) starter berms will be built.

REMOVE: Levee Features Removed

- No levee features removed.

Water Control Features: Pond 6

Same water control structures as current conditions no project condition with the following water control structures added or removed.

ADD: Water Control Feature (WCF) Added

- No water control features added.

REMOVE: Water Control Feature (WCF) Removed

- No water control features removed

Water Control Features: Pond 6A

Same water control structures as current conditions – without project condition with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- No water control features added

REMOVE: Water Control Feature (WCF)

- No water control features removed.

4. Pond 6, 6A analyses: Turn the ponds into tidal wetlands continued

Note: All water control structures listed for current conditions – without project conditions will be replaced with new structures. The structures will be used in maintaining salinity levels in the ponds at ambient conditions.

SECTION 8

Group 6: Ponds 7 and 7A Analysis.

Desalination and Bittern Removal using Neighboring Waters

Objective number two of this engineering appendix is to determine the infrastructure required to remove bittern and desalinate Pond 7 using neighboring waters. In this scenario all water control features that currently exist will be identified for Ponds 7 and 8 and canals and sloughs with their respective infrastructure. The water control features needed to desalinate Pond 7 using neighboring sloughs as a water source will be identified when analyzing Group 6.

Hudeman, Mud and Napa Slough, Napa River, Ponds 7A and 8, the canals that draw water from east and north of Pond 8, east of Pond 7 and finally the canal that goes from the mixing chamber and runs on the east and south sides of Pond 7.

GAIA Consulting, Inc was tasked with estimating the time required to remove bittern from Pond 7. The required information included both the time required to reach a bittern concentration of 5% and 1% of the initial concentration, and the time required to reach salinities of 175, 80 and 50 parts per thousand (ppt) in the pond, for three different dilution water scenarios. One of the three dilution water scenarios consisted of a base case scenario using no recycled water (Neighboring Waters Scenario).[7]

From the GAIA report it was concluded that it would take approximately 8 years to return Pond 7 to ambient conditions. This would require a flow rate of a minimum of 918 acre-feet a year. Refer to note 8 Table 2.

The canal that extends from the mixing chamber at Pond 7 and is parallel on the east and south sides of the pond was determined to be a possible constraint. The capacity of the mixing chamber and the canal east of Pond 7 needed also required some additional analysis. Water Resource Section of the US Army Corps of Engineers San Francisco District was tasked to analyze and determine the flow capacity of the canal system and mixing chamber.[8] It was concluded that the canals and the mixing chamber had sufficient capacity to allow a minimum of 918 acre-feet of neighboring waters to flow needed to remove bittern and desalinate Pond 7.

[7] Napa Salt Marsh Restoration Project, Napa-Sonoma Marshes State Wildlife Area, CA, GAIA Consulting Inc, Pond 7 Bittern Salinity Reduction Duration Estimate Report, March 5, 2004, Pg. 1
[8] Memorandum for CESPN-PM: (Tolle), Flow Capacities for the Napa Salt Marsh Canal System Between Pond 7&8, S.T. Su, Chief, Water Resources Section, 9 February 2004

The analysis of Pond 7, 7A will be as follows: **Please note that the Neighboring Waters Alternative will also include a discussion of the water control features needed for Pond 8 and the canals that have outfalls to the mixing chamber.**

- Current conditions,
- The water control structures needed to remove bittern and desalinate Pond 7 will be analyzed. This will be the Neighboring Waters Alternative to remove bittern and salinity from Pond 7. This will then become the current conditions for Pond 7, 7A
- Stand alone ponds,
- Managed Ponds,
- And finally tidal wetlands.

1. Current conditions – without project conditions:

Refer to FIGURE P7, 7A – 1: POND 7, 7A CURRENT CONDITIONS WITHOUT PROJECT CONDITIONS
Refer to TABLE P7, 7A – A: POND 7, 7A LEVEE QUANTITIES
Refer to TABLE P7, 7A – B: PONDS 7, 7A WATER CONTROL FEATURES QUANTITIES.

Note: The descriptions of the levee and water control features are different than those listed in the tables, refer to the figure for proper description of features.

Water Control Structures: Pond 7 (some of the water control features at Pond 7 are currently inoperable, however they will be listed)

- **P7-1:** Water can flow from Pond 7 canal into Pond 6A donut via a 48-inch diameter 340-foot long siphon, which goes under Napa Slough.

- **P7-2:** There is a canal, 10 to 20-feet wide and approximately 9,500-feet long, located east and south of Pond 7.

- **P7-3:** The donut on Pond 7 has two parallel pipes, 36-inch diameter and 100-feet long, connecting canal east of Pond 7, under the road and into donut Pond 7.

- **P7-4:** Currently there is a 3-foot wide sluice gate that allows water to flow from donut Pond 7 into the canal.

- **P7-5:** Currently there is a 3-foot wide sluice gate that allows water to flow from donut Pond 7 into the canal.

- **P7-6:** A 3-foot wide sluice gate from Pond 7 to canal east of Pond 7 is currently inoperable.

1. Pond 7, 7A analyses: Current conditions – without project conditions

- **P7-7:** Water flows from Pond 7 into a donut on the northeast side of Pond 7 via 3-foot wide sluice gate. This fixture is currently inoperable.

Water Control Structures: Pond 7A

- **P7A-1:** Pond 7A has a water structure, 3-feet wide weir, located on the west side the pond that goes into donut Pond 7.

2. The water control structures needed to remove bittern and desalinate Pond 7.

SEE FIGURE P7, 7A - 1: POND 7, 7A NEIGHBORING WATERS
Refer to TABLE P7, 7A - A: POND 7, 7A LEVEES AND WATER CONTROL FEATURES NEIGHBORING WATERS
SEE FIGURE P8 - 1: POND 8 NEIGHBORING WATERS
Refer to TABLE P8 - A: POND 8 LEVEES AND WATER CONTROL FEATURES NEIGHBORING WATERS

NOTE: For this scenario all water control features listed in the current condition - without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To separate the two ponds into stand alone ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees

Interior Levee Construction, Repair and Maintenance:

- **NOTE 1:** Raise interior levee a minimum of 2.5 feet to allow water level in ponds to be a minimum of three (3) feet.

- **NOTE 2:** Annual maintenance of the internal levee will be done on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

External Levee Construction, Repair and Maintenance:

- **NOTE 3:** Repair on external levee Pond 7 on 15% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 4:** Repair on external levee Pond 7A on 5% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 5:** Repair on external levee Pond 8 on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 6:** Annual maintenance of external levee for Ponds 7, 7A and 8 will be done on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

2. Pond 7, 7A and 8 analyses: The water control structures needed to remove bittern and desalinate Pond 7 continued:

Water Control Structures: Pond 7

- **P7-2:** The canal is approximately 10 to 20-feet wide 9,500 feet long and approximately 10-feet deep.

- **P7-5:** Two (2) 36-in diameter 60-feet long outfall from canal 8 to mixing chamber.

- **P7-6:** On the south side of the canal ambient water is discharged into Napa Slough via an outfall, 48-inch diameter 120-foot long pipe.

- **P7-8:** Outfall from pond 7 to mixing chamber Pond 7. Outfall is 16-inch diameter 120-feet long.

- **P7-9:** Four (4) intakes from Pond 71 to Pond 7. Intakes are 48-inch diameter 120-feet long.

- **P7-10:** Outfall from canal 7 to Napa Slough. Outfall is 48-inch diameter 120-feet long.

- **P7-11:** The donut that is listed as donut Pond 7 is changed to mixing chamber. Refer to Section 2 Water Control Structures for Individual Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for a description of the mixing chamber. The mixing chamber is 75-feet in diameter and approximately 25-feet deep.

Water Control Structures: Pond 7A

- **P7A-1:** There are two (2) outfalls from Pond 7A into Pond 7 mixing chamber. These outfalls are each 48-inch diameter 120-feet long.

- **P7A-2:** Two intakes from Hudeman Slough will be placed on the southwest side of Pond 7A. These intakes are 48-inch diameter and 120-feet long each. These intakes also have fish screens.

2. Pond 7, 7A and 8 analyses: The water control structures needed to remove bittern and desalinate Pond 7 continued:

Water Control Structures: Pond 8

- **P8-1:** Currently there are two intakes with fish screens from Mud Slough to Pond 8. Two additional intakes of the same size will be added. These two additional intakes are 48-inch diameter 100-feet long each.

- **P8-2:** Two outfalls exist from Pond 8 to the canal east of Pond 8; two additional outfalls of the same size will be added they are each 48-inch diameter and 100-feet long.

- **P8-3:** There is a 48-inch diameter 100-foot long outfall on northwest side of Pond 8 that is currently inoperable this will be replaced with a new outfall of the same size. This outfall goes to Pond 8 canal on the north of the pond.

- **P8-4:** A siphon currently goes from the canal north of Pond 8 under Mud Slough and into the large canal east of pond 7. This single siphon will be replaced with two siphons each being 48-inches in diameter and 320-feet long.

- **P8-5:** The canal that this siphon drains into is 20 to 50-feet wide 5,375-feet long and approximately 15 feet deep.

- **P8-6:** From this canal there are currently two 36-inch diameter 100-feet long pipes they will be replaced with two new water control features of the same size.

Construction or water control structures: Pond 7, 7A and 8

Refer to TABLE P7, 7A - B: STAND ALONE PONDS WATER CONTROL FEATURES for quantities.
Refer to TABLE P8 - B: STAND ALONE PONDS WATER CONTROL FEATURES for quantities.

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

3. Break pond groups up into stand alone ponds:

Refer to FIGURE P7, 7A - 2: PONND 7, 7A STAND ALONE PONDS
Refer to TABLE P7, 7A - A: POND 7, 7A STAND ALONE POND LEVEES
Refer to TABLE P7, 7A - B: POND 7, 7A STAND ALONE PONDS WATER CONTROL FEATURES

NOTE: For this scenario all water control features listed in the current condition - without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To separate the two ponds into stand alone ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

Interior Levee Construction, Repair and Maintenance:

- **NOTE 2:** Annual maintenance of the internal levee will be done on 10% of total levee length.

External Levee Construction, Repair and Maintenance:

- **NOTE 3:** Repair of Pond 7 levee will need to be done on approximately 15% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 4:** Repair of Pond 7A levee will need to be done on approximately 5% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 5:** Annual maintenance of the external levee will be done on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

Water Control Structures: Pond 7

Same water control structures as Neighboring Waters with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- No water control features added

3. Pond 7, 7A analyses: Break pond groups up into stand alone ponds

REMOVE: Water Control Feature (WCF)

- ❖ No water control features removed.

Water Control Structures: Pond 7A

Same water control structures as Neighboring Waters with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- ❖ No water control features added.

REMOVE: Water Control Feature (WCF)

- ❖ No water control features removed.

Construction or water control structures: Pond 7, 7A

Refer to TABLE P7, 7A - B: STAND ALONE PONDS WATER CONTROL FEATURES for quantities.

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

4. Maintain group as managed ponds:

Refer to FIGURE P7, 7A- 3: POND 7, 7A MANAGED PONDS
Refer to TABLE P7, 7A - A: POND 7, 7A MANAGED POND LEVEES
Refer to TABLE P7, 7A - B: POND 7, 7A MANAGED PONDS WATER CONTROL FEATURES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To maintain the two ponds as managed ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

Interior Levee Construction, Repair and Maintenance:

- **NOTE 2:** Annual maintenance of the internal levee will be done on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

External Levee Construction, Repair and Maintenance:

- **NOTE 3:** Repair of Pond 7 levee will need to be done on approximately 15% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 4:** Repair of Pond 7A levee will need to be done on approximately 5% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 5:** Annual maintenance of the external levee will be done on 10% of total levee length.

Water Control Structures: Pond 7

Same water control structures as Neighboring Waters with the following water control structures added or removed.

ADD: Water Control Feature (WCF)

- No water control features added

4. Pond 7, 7A analyses: Maintain group as managed ponds

REMOVE: Water Control Feature (WCF)

- ❖ No water control features removed.

Water Control Structures: Pond 7A

Same water control structures as Neighboring Waters with the following water control structures added or removed.

ADD: Water Control Features (WCF) added

- ➢ **P7-9:** Four (4) 100-foot wide breaches will be placed on the internal levee.

REMOVED: Water Control Features (WCF) removed

- ➢ **P7-8:** Two (2), 48-inch 120-foot, intakes from Pond 7A to Pond 7 will be removed.

Construction or water control structures: Pond 7, 7A

Refer to TABLE P7, 7A - B: MANAGED PONDS WATER CONTROL FEATURES for quantities.

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

Note: All water control structures listed for current conditions – without project conditions will be replaced with new structures. The structures will be used in maintaining salinity levels in the ponds at ambient conditions.

5. Turn the ponds into tidal wetlands:

Refer to FIGURE P7, 7A – 1: POND 7, 7A CURRENT CONDITIONS WITHOUT PROJECT CONDITIONS
Refer to TABLE P7, 7A – A: POND 7, 7A LEVEE QUANTITIES
Refer to TABLE P7, 7A – B: PONDS 7, 7A WATER CONTROL FEATURES QUANTITIES.

To turn the grouped ponds into tidal wetlands the following water control structures will need to be added.

Levees:

Interior Levee Construction, Repair and Maintenance:

- **P17-13:** Lower interior levee a minimum of 2.5 feet to allow tidal action between the two ponds.

External Levee Construction, Repair and Maintenance:

- **NOTE 3:** Repair of the remaining external levee of Pond 7 is required. This repair will be done on 15% of the external remaining levee. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 4:** Repair of the remaining external levee of Pond 7A is required. The levee will need to be raised a minimum of 2.5-feet. This repair will be done on 5% of the external remaining levee. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 5:** Annual maintenance of the external levee will be done on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 7:** External levee of Pond 7A along the Hudeman Slough is lowered a minimum of 2.5-feet to allow tidal action. The length of this levee lowering is approximately 1,300-feet.

- **NOTE 8:** Ditch blocks will also need to be built for each external levee breach.

- **NOTE 9:** a starter channel will need to be built on each external levee lowering.

- **NOTE 10:** For each external levee breach mentioned above with berms will need to be built.

5. Pond 7, 7A analyses: Turn the ponds into tidal wetlands

Water Control Structures: Pond 7

Same water control structures as Neighboring Waters with the following water control structures added or removed.

ADD: Water Control features (WCF) added

- ❖ No water control features removed.

REMOVED: Water Control Features (WCF) removed

- ❖ No water control features removed.

Water Control Structures: Pond 7A

Same water control structures as Neighboring Waters with the following water control structures added or removed.

ADD: Water Control features (WCF) added

- ❖ No water control features added.

REMOVED: Water Control Features (WCF) removed

- ❖ No water control features removed.

Construction or water control structures: Pond 7, 7A

Refer to TABLE P7, 7A – A: TIDAL WETLAND LEVEES for quantities.

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

SECTION 9
Group 5: Pond 8 Analysis.

1. Current conditions – without project conditions:

Refer to FIGURE P8 – 1: POND 8 CURRENT CONDITIONS - WITHOUT PROJECT CONDITIONS
Refer to TABLE P8 – A: POND 8 LEVEE QUANTITIES
Refer to TABLE P8 – B: PONDS 8 WATER CONTROL FEATURES QUANTITIES.

Note: The descriptions of the levee and water control features are different than those listed in the tables, refer to the figure for proper description of features.

Water Control Structures: Pond 8 (Some of the water control features at Pond 8 are currently inoperable non-the less they will be listed)

- **P8-1:** There are two, 36-inch diameter approximately 100-feet long, water control structures with fish screens located on the southeast corner of Pond 8 that draws water from Mud Slough into Pond 8.

- **P8-2:** Two water control structures, 48-inch diameter 100-feet long remove water from Pond 8 into the canal that runs along the east and north of Pond 8.

- **P8-3:** Currently there is a water control feature, 48-inch diameter 100-foot long pipe, that draws water from Pond 8 into the canal north of pond 8 that is located northeast of Pond 8. This water control feature is currently inoperable.

- **P8-5:** The canal east and north of Pond 8 is 20 to 50-feet wide and approximately 5,375-feet long. This canal is broken into two pieces that is connected by a 36-inch diameter 320-foot long siphon. The siphon goes from canal north of Pond 8 under Mud Slough and into the second portion of the canal that then connects to Pond 7 donut.

Note: the current conditions listed above are for what existed before the pond was used to remove bittern and desalinate Pond 7. The following analysis managed ponds and tidal wetlands will use infrastructure that was used in the neighboring waters scenarios.

2. Maintain group as managed ponds:

Refer to FIGURE P8 - 2: POND 8 MANAGED PONDS
Refer to TABLE P8 - A: POND 8 MANAGED POND LEVEES
Refer to TABLE P8 - B: POND 8 MANAGED PONDS WATER CONTROL FEATURES

NOTE: For this scenario all water control features listed in the current condition – without project condition will be replaced. All intakes and outfalls are constructed out of HDPE material and have a knife valve installed that will regulate water flow. A check valve is also installed to ensure that flow is regulated only in one direction. A check valve is not installed on interior levee water control structures.

To maintain the two ponds as managed ponds the following water control structures will need to be added. Assume that a minimum of three (3) feet of water will be maintained in the ponds.

Levees:

External Levee Construction, Repair and Maintenance:

- **NOTE 1:** Repair of Pond 8 levee will need to be done on approximately 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

- **NOTE 2:** Annual maintenance on 10% of total levee length. The levee will need to be raised a minimum of 2.5-feet.

Water Control Structures: Pond 8

- **P8-1:** Intake from Mud Slough to Pond 8. Intake is 48-inch diameter 100-feet long.

- **P8-2:** Outfall from Pond 8 to canal east of Pond 8. Outfall is 48-inch diameter 100-feet long.

- **P8-3:** Outfall from Pond 8 to canal north of Pond 8. Outfall is 48-inch diameter 100-feet long.

- **P8-4:** Two siphons from canal north of Pond 8 to canal east of Pond 7. Each siphon is 48-inch diameter and 320-feet long.

- **P8-5:** Canal east of Pond 7 is 20 to 50 feet wide 5,375-feet long and approximately 15-feet deep.

- **P8-6:** Two intakes from canal east of Pond 7 to mixing chamber Pond 7.

Construction or water control structures: Pond 8

Refer to TABLE P8 - B: MANAGED PONDS WATER CONTROL FEATURES for quantities.

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.

3. Turn the ponds into tidal wetlands:

Refer to FIGURE P8 – 1: POND 8 TIDAL WETLANDS
Refer to TABLE P8 – A: POND 8 LEVEE QUANTITIES
Refer to TABLE 8 – B: PONDS 8 WATER CONTROL FEATURES QUANTITIES.

To turn the grouped ponds into tidal wetlands the following water control structures will need to be added.

Levees:

External Levee Construction, Repair and Maintenance:
ADD: levees

- ❖ No levees added.

REMOVED: Water Control Features (WCF) removed

- ❖ No levees removed.

Water Control Structures: Pond 8

ADD: Water Control features (WCF) added

- ❖ No water control features added.

REMOVED: Water Control Features (WCF) removed

- ❖ No water control features removed.

Construction or water control structures: Pond 8

Refer to TABLE P8 – A: POND 8 LEVEE QUANTITIES
Refer to TABLE 8 – B: PONDS 8 WATER CONTROL FEATURES QUANTITIES.

Refer to Section 2: Water Control Structures for Stand Alone Ponds, Managed Ponds and/or Tidal Wetlands for construction methods of water control features.