Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
Alternatives Under Active Development						
1	Napa River Water Intake	Phased salinity reduction with Pond 3 as mixing chamber. Desalinate Pond 3, then 4 & 5, then 6 & 6A. Independently desalinate 7, 7A, and 8, add dilution water to all ponds, mix in mixing chamber, and then discharge to Napa Slough. Use Napa River/Napa Slough water only.	+ Rapidly desalinates middle ponds, protects existing habitat in lower ponds, and desalinates upper ponds in a reasonable amount of time.	+ Minimal long term operations and maintenance.	+ Designed to meet discharge criteria and minimize habitat impacts.	+ Addresses all ponds requiring salinity reduction.
2	Napa River Water Augmented by Recycled Water	Phased salinity reduction. Desalinate Pond 3, then open it to tidal action. Desalinate Ponds 4 & 5, then 6 & 6A. Use Ponds 4/5 as mixing chamber for 6/6A. Independently desalinate 7, 7A, and 8, add dilution water to all ponds, mix in mixing chamber, and then discharge to Napa Slough. Use up to 15,000 acre-feet recycled water to enhance dilution for upper ponds.	+ Rapidly desalinates middle, protects existing habitat in lower ponds, and desalinates upper ponds in a reasonable amount of time accelerated by recycled water.	+ Minimal long term operations and maintenance. Additional costs associated with building recycled water pipeline.	+ Designed to meet discharge criteria and minimize habitat impacts. Uses recycled water.	+ Addresses all ponds requiring salinity reduction.
3	San Pablo Bay Discharge Pipeline	Phased salinity reduction. Route flow of desalination water through Ponds 8, 7, and 7A to Ponds 1A and 1 for discharge via the existing culvert under Highway 37 and pipeline that is extended into San Pablo Bay. Ponds 3, 4, and 5 desalinated as in Alternative 1.	0 Effective in increasing dilution, but potential negative impacts on existing habitat.	0 Additional costs associated with building pipeline to San Pablo Bay.	- Local sponsor, resource agencies, and public prefer retaining existing habitat in ponds 1 and 1A. Designed to meet discharge criteria.	- Partial alternative.

Note: Alternatives organized approximately by date considered. +=Criteria Met 0=Neutral Criteria -=Criteria Not Met

Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
4	High Flow Event	To maximize dilution, discharge pond water only under high flow conditions.	0 Effective in increasing dilution, but longer time-scale could result in levee failure prior to desalination. Delays development of habitat.	- Slow compared to year-round discharge alternatives. Higher on-going maintenance costs.	- Likely too slow to meet Corps and local sponsor requirements.	- Partial alternative.
5	Recycled Water through Ponds 8 - 3	Use recycled water to enhance salinity reduction in all ponds.	- Effective in increasing dilution, but may lead to algae blooms in ponds. 15,000 af not adequate for dilution of Ponds 8-3.	+ Increases efficiency of salinity reduction. Additional costs associated with building recycled water pipeline.	0 Designed to meet discharge criteria. Agency concerns over nutrient impacts if recycled water is used in the ponds.	- Partial alternative.
Physical Bittern Removal Alternatives						
6	Bittern Removal -- Dump at Carquinez Straights	Pump out bittern and physically remove precipitated bittern salt; load onto barges and dump at Carquinez Strait.	0 Addresses bittern, but may create new problems due to transport and handling issues.	- Very costly compared to dilution alternatives.	- Suggested by USFWS; unlikely to be able to permit.	- Not complete alternative by itself; needs to be combined with other elements.

Note: Alternatives organized approximately by date considered. +=Criteria Met 0=Neutral Criteria -=Criteria Not Met

Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
7	Bittern Removal -- Ocean Dumping	Pump out bittern and physically remove precipitated bittern salt; load onto barges and dump at San Francisco Deep Ocean Disposal Site.	0 Addresses bittern, but may create new problems due to transport and handling issues.	- Very costly compared to dilution alternatives.	- Suggested by USFWS; however, face opposition from other agencies.	- Not complete alternative by itself; needs to be combined with other elements.
8	Bittern Removal -- Reuse (Cargill Info)	Pump out bittern and physically remove precipitated bittern salt; load onto trucks or barges and deliver to new user.	0 Addresses bittern, but may create new problems due to transport and handling issues.	- Market for bittern is limited and costs unlikely to support this option.	+ Reusing bittern is preferable to other options if dilution is not feasible.	- Not complete alternative by itself; needs to be combined with other elements.
9	Bittern Removal -- Land-Based Disposal	Pump out bittern and physically remove precipitated bittern salt; load onto trucks or railcars and deliver to off-site landfill.	0 Addresses bittern, but may create new problems due to transport and handling issues.	- Landfill disposal is least preferred option; very costly.	- Landfill disposal is least preferred option; only transfers problem.	- Not complete alternative by itself; needs to be combined with other elements.
Historical Alternatives						
10	Prelim Sal Red Alt 1	Intake water at Pond 8 to 7/7A to 6/6A. Discharge to Napa Slough; Intake water Pond 5-> 4-> 3-> Discharge to Napa River (tidal); Ponds1/1A, 2/2A remain managed as existing.	+ Desalinates all ponds.	0 High salt load from upper ponds would slow desalination of ponds 6/6A.	- Not acceptable to local sponsor due to salt slug concern and delay in desalination.	+ Complete alternative (addresses all ponds).

Note: Alternatives organized approximately by date considered. +=Criteria Met 0=Neutral Criteria -=Criteria Not Met

Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
11	Prelim Sal Red Alt 2A	Intake water at Pond 8 to 7/7A to 6/6A to 5 to 4 to 3 to Napa River; Ponds 1/1A, 2/2A remain managed as existing.	0 Desalinates all ponds, but would require very careful monitoring to prevent "salt slug" in middle ponds.	- High salt load from upper ponds would significantly extend required desalination time for middle ponds.	- Not acceptable to local sponsor due to salt slug concern and delay in desalination.	+ Complete alternative (addresses all ponds).
12	Prelim Sal Red Alt 2B	Intake water at 6/6A to 5 to 4 to 3 to discharge to Napa River; Maintain lower (full pond) salinities with intake water into Ponds 8 to 7/7A; Ponds 1/1A, 2A remain managed as existing.	- Desalinates only middle and lower ponds.	0 High salt load from ponds 6/6Aa and 4/5 would significantly extend required desalination time for Pond 3.	- Not acceptable to local sponsor due to salt slug concern and delay in desalination.	- Incomplete -- ponds 7, 7A, 8 are only maintained, not remediated.
13	Prelim Sal Red Alt 3	Intake water at Pond 8 to 7/7A to 6/6A to 5 to 4 to 3 to 2 to 1/1A to discharge to San Pablo Bay. Pond 2A maintained as existing.	- Desalinates all ponds, but could lead to "salt slug" in middle and lower ponds damaging existing habitat.	- High salt load from upper ponds would significantly extend required desalination time for middle and lower ponds.	- Not acceptable to local sponsor due to salt slug concern and delay in desalination.	+ Complete alternative (addresses all ponds).

Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
14	Nielsen Scenario 1	Open all ponds to tidal action independently.	+ Desalinates all ponds.	0 Possible delay in desalination because salt absorption capacity of slough/river may be exceeded.	- May not be acceptable to resource agencies and public due to delays in marsh formation and potential for scouring.	+ Complete alternative (addresses all ponds).
15	Nielsen Scenario 2	Dilute hyper-saline pond water in other ponds.	- Does not address lower and middle ponds.	0 Possibly efficient for upper ponds; requires significant movement of toxic brine to middle or lower ponds.	+ Reducing toxicity of bittern is desirable.	- Not complete alternative by itself; needs to be combined with other elements.
16	Nielsen Scenario 3	Flash-dilute hyper-saline pond water with recycled water.	+ Most effective way of reducing salinity of hyper-saline waters.	0 Increased pumping and maintenance cost compared tidal mixing.	+ Excellent control of salinity in mixing zone.	- Not complete alternative by itself; needs to be combined with other elements.
17	Nielsen Scenario 4	Open non-hyper-saline ponds to tidal actions independently.	- Desalinates only middle and lower ponds.	0 Possible delay in desalination because salt absorption capacity of slough/river may be exceeded.	- Not acceptable to local sponsor due to potential scouring, delay in marsh formation.	- Not complete alternative by itself; needs to be combined with other elements.

Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
18	Nielsen Scenario 5	Run ponds 3-6A in reverse.	- Desalinates only middle and lower ponds.	0 High salt load fromponds 6/6Aa and 4/5 would significantly extend required desalination time for Pond 3.	- Not acceptable to local sponsor due to salt slug concern and delay in desalination.	- Incomplete -- ponds 7, 7A, 8 are not addressed.
19	Nielsen Scenario 6	Without project.	- Does not solve long-term problems of increasing salinity/habitat loss and potential catastrophic levee breach.	- Levee maintenance would likely become very costly over time.	- Not acceptable to local sponsor, resource agencies, or public.	0 Fairly complete but likely to require new levee investments.
20	Remix Bittern with Brine	Trickle bittern into existing brine ponds to create salt mix more closely resembling actual marine conditions.	0 Feasible and likely effective for upper ponds; difficult and potentially impacts habitat for middle and lower ponds.	0 Possibly efficient for upper ponds; requires significant movement of toxic brine to middle or lower ponds.	+ Reducing toxicity of bittern is desirable.	- Not complete alternative by itself; needs to be combined with other elements.

Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
21	Flow Science-Strategy 1A	Pond 6/6A Concentrator/Pond 1 Mixing Pool.	- Using ponds 1 and 1A as a mixing chamber degrades existing habitat.	- Increasing the salinity in one or more ponds is counter to the overall objectives. Existing culvert may not have sufficient capacity (if so, installation of a new water discharge pipe over or under Highway 37 would be required).	- Concentrating brine in another pond is not acceptable to local sponsor and resource agencies.	0 Fairly complete but likely to require new levee investments.
22	Flow Science-Strategy 1B	Ponds 6/6A Concentrator for 3-5, "cook up" 7/7A/8, open Ponds 3-5 to tidal action independently when desalinated/Ponds 1 and 2 Mixing Pool.	- Desalinates all ponds, but worsens conditions in Ponds 6/6A, and 7/7A/8.	0 Reduces pumping costs.	- "Cooking up" ponds is not acceptable to local sponsor, resource agencies, or downwind public.	+ Complete alternative (addresses all ponds).

Table 2. Salinity Reduction Alternative Matrix

Alternative Number	Alternative Designation	Alternative Summary	Effectiveness	Efficiency	Acceptability	Completeness
			Achieves opportunities and alleviates problems	*Cost-effective and efficient*	*Acceptance by state and local entities*	*Accounts for necessary investments*
23	Flow Science-Strategy 2	Pump brine from Ponds 1-3 and 5-8 to Pond 4. Pond 4 is a mixing pool. Need to partially drain Pond 4 and dilute with River water prior to opening tidal gate to prevent excess salinity discharge.	0 Desalinates all ponds. Limiting discharge to Pond 4 may reduce efficiency of desalination; extended desalination period for Ponds 4, 5, 6, 6A, due bringing through brine from 7, 7A, and 8.	0 Relatively high pumping cost.	- Potential damage to middle ponds form hypersaline brines. Not acceptable to local sponsor and resource agencies.	+ Complete alternative (addresses all ponds).
24	Flow Science-Strategy 3	Take in and pump dilution water from Pond 3 to mixing ponds (Ponds 1, 1A, and 2). Pump brine from 4, 5, 7, 7A, and 8 to 6/6A and meter from 6/6A to 2 for mixing/discharge. A small amount of water from Pond 3 is diverted to 4, 5, 6/6A for make-up water.	+ Desalinates all ponds.	- High salt load from upper ponds would slow desalination of ponds 6/6A, may also damage existing habitat in lower ponds. High pumping cost.	- Not acceptable to local sponsor and resource agencies due to potential damage to existing habitat in lower ponds.	+ Complete alternative (addresses all ponds).