Ecosystem Restoration Program - 2002

Proposal Solicitation Package (PSP) Forms 1 - 7:

Form I - Project Information

1. **Proposal Title**

   Napa-Sonoma Marsh Restoration Project (#31)

2. **List all proposal applicants.**

First Name	Last Name	Organization
Amy	Hutzel	California State Coastal Conservancy
Nadine	Hitchcock	California State Coastal Conservancy

3. **Corresponding Contact Person:** (Show name of primary contact person even if they are already listed in question 2. The corresponding contact person should be the individual to whom award letters will be sent.)

First Name:	Amy
Last Name:	Hutzel
Organization:	California State Coastal Conservancy
Address:	1330 Broadway, 11th Floor, Oakland, CA 94612
Phone: (including area code)	510-286-4180
Email:	ahutzel@scc.ca.gov

4. **Project Keywords**- Please select three keywords to describe your project.

   Environmental Engineering

   Habitat Restoration, Wetland

   Wetlands, Tidal

5. **Type of project** (*choose the one that best fits your overall project*):

   Implementation: Full-Scale

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

   If yes, is there an existing <u>specific</u> restoration plan for this site?

   - Yes **-** No

7. **Topic Area** *(check only one box)*

   Shallow Water, Tidal and Marsh Habitat

8. **Type of applicant** *(check only one box)*

   State Agency

9. **Location - GIS coordinates** *(Provide geographic coordinates (northing/easting in latitude/longitude (decimal degrees)) for your project's centroid.) If you do not have a GPS or GIS to find the coordinates of the centroid of your project, you may use the <u>TIGER Map Service</u>.*

   Provide the following information for your proposed project. Leave lat/long boxes blank if your project fits the "Multi-region (independent of specific site) Code 15: Landscape" category shown under Question 10 Location - Ecozone. For projects in multiple adjacent Ecozones, please provide your best estimate of the approximate center point. Please do not add any directional characters (e.g. N, S, E, W). Please enter numbers only.

Latitude: (example: 38.575; must be between 30 and 45)	38.166	(decimal degrees to the nearest 0.001)

Longitude: (example: -121.488; must be between -120 and -130)	-122.310	(decimal degrees to the nearest 0.001)
Datum (e.g., NAD27, NAD83) (if known--leave blank if unknown)	NAD83	

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

The project location is made up of three 3 ponds within the 9,500-acre former Cargill salt pond complex in the North Bay, now owned by the California Department of Fish and Game and managed as part of the Napa River Unit of the Napa-Sonoma Marshes State Wildlife Area. The salt pond complex is located between the western bank of the lower Napa River and the eastern bank of Sonoma Creek, just north of Highway 37 and south of Highway 12/121.

10. **Location - Ecozone**

Bay Region
Ecozone 2: Suisun Marsh & North San Francisco Bay
2.2 Napa River
2.3 Sonoma Creek

11. **Location - County** *(check all that apply)*

Napa, Solano

12. **Location - City**
Does your project fall within a city jurisdiction?

No

13. **Location - Tribal Lands**
Does your project fall on or adjacent to tribal lands?

No

14. **Location - Congressional District**

#1 (Thompson) & #7 (Miller)

15. **Location - California State Senate District & California Assembly District**

California State Senate District #2 (Chesbro)

California Assembly District #7 (Wiggins)

16. **How many years of funding are you requesting?** (You may request up to 3 years of funding.)

    3 years

17. **Requested Funds:** *(If the answer to 17a is yes, provide State overhead rate and corresponding Total State Funds, and Federal overhead rate and corresponding Total Federal funds. Leave the remaining two boxes of 17a blank. If the answer to 17a is no, provide the Single overhead rate and Total requested funds. Leave the first four boxes of 17a blank.)*

    a. Are your overhead rates different depending on whether funds are state or federal?

       No

       If no, list single overhead rate and total requested funds.

       Single overhead rate (%): 3%

       Total requested funds: $4,511,400

    b. Do you have cost share partners already identified? Yes
       If yes, list partners and amount contributed by each:

Partner	Amount Contributed
Coastal Conservancy	$1,600,000
CA Dept of Fish and Game	$561,710
U.S. Army Corps of Engineers	$700,000

c. Do you have potential cost share partners? Yes
If yes, list partners and amount contributed by each:

Partner	Amount Contributed
U.S. Army Corps of Engineers	$900.000

d. Are you specifically seeking non-federal cost share funds through this solicitation?

Yes, $4,511,400

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above? Yes

If yes, identify project number(s), title(s) and CALFED program.

Number	Title	Program
11332-0-J001	Introduced Spartina Eradication Project	Ecosystem Restoration
B81642	Hamilton Wetland Restoration Project	Ecosystem Restoration

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?** No
Have you previously received funding from CVPIA for other projects not listed above? No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**
Yes
If yes, identify project number(s), title(s) and funding source

Number	Title	Funding Source
1	Napa River Salt Marsh Restoration Feasibility Study	Coastal Conservancy, Sonoma County Water Agency, USACE, USFWS, CA Dept of Fish and Game

21. **Please list suggested reviewers for your proposal.** (optional)
22. **Comments.**

We are seeking funds for Phase 1 of the restoration project. Implementation of the restoration and enhancement work for the entire 9,500-acre site is being sought through the U.S. Army Corps of Engineers and is expected to cost between $50 and $75 million, which will be cost shared at a 65% federal, 35% non-federal rate, with land values counted towards the non-federal share. We are working towards authorization in the Water Resources Development Act (WRDA) of 2004. We are also working with the Bay Area Congressional Delegation to have language included in WRDA 2002 that allows the non-federal sponsor to be credited for work undertaken prior to project authorization that is in keeping with the Feasibility Report, allowing CALFED funds to count towards the non-federal share of the project.

Form II - Executive Summary

Proposal Title: CalFed proposal and review system

Please provide a brief but complete (about 300 words) summary description of the proposed project; its geographic location, project type, project objective, approach to implement the proposal, hypotheses and uncertainties, expected outcome and relationship to CALFED ERP and/or CVPIA goals.

The California Coastal Conservancy (Conservancy) and the California Department of Fish and Game (DFG), in association with the U.S. Army Corps of Engineers (Corps) and other agencies, are implementing the Napa-Sonoma Marsh Restoration Project (NSMRP), which will eventually restore or enhance nearly 9,500 acres of wetlands and associated habitats within the former Cargill salt pond complex in the North Bay.

The Feasibility Study and EIR/S are nearing completion. The CALFED grant would enable us to conduct Phase 1 of the project: restoration of Pond 3 (1,300 acres) to tidal habitats, and salinity reduction in preparation for potential tidal habitat restoration in Ponds 4 and 5 (1,700 acres). Work will include preparation of construction drawings, permitting, construction, project management, and monitoring. The two broad hypotheses being tested are that: (1) former commercial salt ponds can successfully be restored to tidal marsh and associated tidal habitats that support at-risk species and complex food webs and, (2) the depths and salinities of former commercial salt ponds can be managed to provide habitat for migratory shorebirds and waterfowl.

Phase 1 is an exciting opportunity to conduct a large-scale restoration project that will result in a self-sustaining wetland ecosystem, aid in the recovery of multiple at-risk species, including anadromous and resident fish, waterbirds, and mammals, and benefit a broad range of other fish, wildlife, and plant species, including migratory waterfowl and shorebirds. Implementation of Phase 1 is a major step in the restoration of the entire salt pond complex to a mix of tidal marsh and managed ponds. The Phase 1 project will serve as a model for other restoration work in the North Bay salt ponds, for restoration work in the South Bay salt ponds, as well as restoration work in other diked baylands.

Form III - Environmental Compliance Checklist

Successful applicants are responsible for complying with all applicable laws and regulations for their projects, including the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

Any necessary NEPA or CEQA documents for an approved project must tier from the CALFED Programmatic Record of Decision and Programmatic EIS/EIR to avoid or minimize the projects adverse environmental impacts. Applicants are encouraged to review the Programmatic EIS/EIR and incorporate the applicable mitigation strategies from Appendix A of the Programmatic Record of Decision in developing their projects and the NEPA/CEQA documents for their projects.

1. **CEQA or NEPA Compliance**
   a. Will this project require compliance with CEQA? Yes
   b. Will this project require compliance with NEPA? Yes
   c. If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.
2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies). Please write out all words in the agency title other than United States (use the abbreviation US) or California (use the abbreviation CA). If not applicable, put None.**

   CEQA Lead Agency: CA State Coastal Conservancy
   NEPA Lead Agency (or co-lead:) U.S. Army Corps of Engineers
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA: EIR

   NEPA: EIS

4. **CEQA/NEPA Process**
   a. **Is the CEQA/NEPA process complete?** No
   b. If the CEQA/NEPA process is not complete, please describe the dates for completing draft and/or final CEQA/NEPA documents.

   A consultant has been retained to complete the EIR/S. The administrative draft EIR/S is complete and we expect to publish the Draft EIR/S by the end of 2002.

   c. If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals**

Successful applicants must tier their project's permitting from the CALFED Record of Decision and attachments providing programmatic guidance on complying with the state and federal endangered species acts, the Coastal Zone Management Act, and sections 404 and 401 of the Clean Water Act. The CALFED Program will provide assistance with project permitting through its newly established permit clearing house.

Please indicate what permits or other approvals may be required for the activities contained in your proposal and also which have already been obtained. Please check all that apply. If a permit is *not* required, leave both Required? and Obtained? check boxes blank.

LOCAL PERMITS AND APPROVALS	Required?	Obtained?
Conditional use permit	-	-
Variance	-	-
Subdivision Map Act	-	-
Grading Permit	-	-
General Plan Amendment	-	-
Specific Plan Approval	-	-
Rezone	-	-
Williamson Act Contract Cancellation	-	-

Other	-	-

STATE PERMITS AND APPROVALS	Required?	Obtained?
Scientific Collecting Permit	-	-
CESA Compliance: 2081	-	-
CESA Compliance: NCCP	-	-
1601/03	-	-
CWA 401 certification	X	-
Coastal Development Permit	**X**	-
Reclamation Board Approval	-	-
Notification of DPC or BCDC	**X**	-
Other	**X**	-

FEDERAL PERMITS AND APPROVALS	Required?	Obtained?
ESA Compliance Section 7 Consultation	**X**	-

ESA Compliance Section 10 Permit	**X**	-
Rivers and Harbors Act	**X**	-
CWA 404	**X**	-
Other	-	-

PERMISSION TO ACCESS PROPERTY	Required?	Obtained?
Permission to access city, county or other local agency land. Agency Name:	-	-
Permission to access state land. Agency Name: CA Department of Fish and Game	**X**	**X**
Permission to access federal land. Agency Name:	-	-
Permission to access private land. Landowner Name:	-	-

6. **Comments.** If you have comments on any of the above questions, please enter the question number followed by a specific comment.

5. NPDES permit will be required for discharge of saline water to Napa River

Form IV - Land Use Checklist

1. **Does the project involve land acquisition, either in fee or through a conservation easement?** No

If you answered yes to #1, please answer the following questions:

a. How many acres will be acquired?
b. Will existing water rights be acquired? No
c. Are any changes to water rights or delivery of water proposed? Yes
d. If yes, please describe proposed changes.

Water will be diverted from the Napa River to reduce salinity in the ponds prior to discharge back to the Napa River.

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?** No

3. **Do the actions in the proposal involve physical changes in the land use?** Yes

If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

If you answered yes to #3, please answer the following questions:

a. How many acres of land will be subject to a land use change under the proposal? 1,300 acres
b. **Describe what changes will occur on the land involved in the proposal.**

Former salt pond will be restored to tidal habitats

c. List current and proposed land use, zoning and general plan designations of the area subject to a land use change under the proposal.

Category	**Current**	**Proposed (if no change, specify "none")**

Land Use	Former salt pond	Tidal habitats
Zoning	Agriculture, Watershed, and Open Space in Napa County; Land Extensive Agriculture in Solano County	none
General Plan Designation	Farmland	none

d. **Is the land currently under a Williamson Act contract?** (For multiple sites, answer Yes if true for any parcel, and provide an explanation in the Comments box below) No

e. **Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?** For more information, contact the California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program (http://www.consrv.ca.gov/dlrp/FMMP/index.htm). (For multiple sites, answer Yes if true for any parcel, and provide an explanation in the Comments box below) No

If yes, please list classification:

f. Describe what entity or organization will manage the property and provide operations and maintenance services.

CA Department of Fish and Game

4. **Comments.**

Form V - Conflict of Interest Checklist

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant

The applicants entered on the Project Information form will be used.

Subcontractor

Are specific subcontractors identified in this proposal? Yes

If yes, please list the name(s) and organization(s):

Name	**Organization**
Philip Williams and other staff	Philip Williams and Associates
John Takekawa, Keith Miles	US Geological Survey
Jasper Lament, Steve Carroll	Ducks Unlimited
Susanne von Rosenberg and other staff	GAIA, Inc.
George Harris and other staff	Hydroscience, Inc.

Helped with proposal development

Are there persons who helped with proposal development? Yes

If yes, please list the name(s) and organization(s):

Name	Organization
Davis Zweig	LSA Associates, Inc
Michelle Orr	Philip Williams and Associates
Jasper Lament	Ducks Unlimited
John Takekawa	US Geological Survey

Comments

Form VI - Budget Summary

Budget Form Instructions

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

- Federal Funds - State Funds X **Independent of Fund Source**

Year 1

Task No.	Task Description	Services or Consultants	Total Direct Costs	Indirect Costs	Total Cost
1	Project Management	80,000	80,000	2,400	82,400
2	Preliminary Engineering	200,000	200,000	6,000	206,000
3	Collection of Baseline Data	150,000	150,000	4,500	154,500
4	Plans and Specifications	200,000	200,000	6,000	206,000
5	Permitting	150,000	150,000	4,500	154,500
6	Construction	0	0	0	0
7	Monitoring	0	0	0	0
		780,000	780,000	23,400	803,400

Year 2

Task No.	Task Description	Services or Consultants	Total Direct Costs	Indirect Costs	Total Cost
1	Project Management	80,000	80,000	2,400	82,400
2	Preliminary Engineering	0	0	0	0
3	Collection of Baseline Data	100,000	100,000	3,000	103,000
4	Plans and Specifications	50,000	50,000	1,500	51,500
5	Permitting	50,000	50,000	1,500	51,500

6	Construction	3,110,000	3,110,000	93,300	3,203,300
7	Monitoring	100,000	100,000	3,000	103,000
		3,490,000	3,490,000	104,700	3,594,700

Year 3					
Task No.	**Task Description**	**Services or Consultants**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Project Management	10,000	10,000	300	10,300
2	Preliminary Engineering	0	0	0	0
3	Collection of Baseline Data	0	0	0	0
4	Plans and Specifications	0	0	0	0
5	Permitting	0	0	0	0
6	Construction	0	0	0	0
7	Monitoring	100,000	100,000	3,000	103,000
		110,000	110,000	3,300	113,300

Grand Total = $4,511,400

Comments.

CALFED funds will be matched with staff time and funds from the U.S. Army Corps of Engineers, California Coastal Conservancy, and the CA Department of Fish and Game. The Conservancy will let all contracts listed in the grant proposal and will assist with project management and permitting. Ducks Unlimited will put the contract out to bid and will hire and oversee the contractor. DFG will continue to manage the site, assist with monitoring and maintenance, and assist with construction management. The U.S. Army Corps of Engineers will provide Quality Control for engineering and construction tasks and provide project management for the overall restoration project (after Phase 1). Project monitoring will extend beyond the 3 year CALFED time frame and other funds will be secured in order to ensure at least a 10 year monitoring time period.

Year 1 (Spring, 2003 – Spring, 2004): Project Management will be done by GAIA Consulting, Inc. in collaboration with the Corps, DFG, and Conservancy. Engineering Design will be completed by Philip Williams and Associates and Ducks Unlimited. Baseline data will be collected and analyzed by USGS. Plans and Specifications will be prepared by Ducks Unlimited with assistance from Philip Williams and Associates. Permitting will be undertaken by Hydroscience, Inc. and GAIA Consulting, Inc.

Year 2 (Spring, 2004 – Spring, 2005): Project Management will be done by GAIA Consulting, Inc. in collaboration with the Corps, DFG, and Conservancy. Baseline data will be collected and analyzed by USGS. Plans and Specifications will be completed by Ducks Unlimited with assistance from Philip Williams and Associates. Permitting will be completed by Hydroscience, Inc. and GAIA Consulting, Inc. Construction Management will be conducted by Ducks Unlimited in collaboration with DFG.

Year 3 (Spring, 2005 – Spring, 2006): Post-project monitoring will be conducted by a team of biologists and hydrologists from USGS, assisted by contractors as needed.

Form VII - Budget Justification

Budget Form Instructions

Direct Labor Hours. Provide estimated hours proposed for each individual.

None to be charged to CALFED

Salary. Provide estimated rate of compensation proposed for each individual.

None to be charged to CALFED

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

None to be charged to CALFED

Travel. Provide purpose and estimate costs for all non-local travel.

None to be charged to CALFED

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

All tasks funded by CALFED will be conducted by consultants, including other agencies (USGS) that will work as consultants to the Coastal Conservancy. Detailed proposals will be obtained from the consultants using standard State contracting procedures. As part of the consulting contracts, standard billing rates for personnel will be provided. Estimates in this application have been based on rates ranging from $60 to $130/hr.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

None to be charged to CALFED

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

$80,000 per year for years one and two has been allocated to hiring consultants to provide project management functions, specifically writing scopes of work, consultant contract negotiation and oversight, budgeting, coordination and scheduling of tasks among consultants, peer review, report preparation, and presentations. Conservancy and DFG project management will be provided using other funding.

Other Direct Costs. Provide any other direct costs not already covered.

None to be charged to CALFED

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs. *[CORRECTION: If overhead costs are different for State and Federal funds, note the different overhead rates and corresponding total requested funds on Form I - Project Information, Question 17a. On Form VI - Budget Summary, fill out one detailed budget for each year of requested funds, indicating on the form whether you are presenting the indirect costs based on the Federal overhead rate or State overhead rate. Our assumption is that line items other than indirect costs will remain the same whether funds come from State or Federal sources. If this assumption is not true for your budget, provide an explanation on the Budget Justification form.]* Agencies should include any internal costs associated with the management of project funds.

The Conservancy requests a 3% overhead rate to cover administrative and legal costs associated with processing and managing consultant contracts and the CALFED grant.

CALFED Bay-Delta Program
Ecosystem Restoration Programs and Projects
Revised Proposal For Napa-Sonoma Marsh Restoration Project, #31
California Coastal Conservancy, October 1, 2002

A. PROJECT DESCRIPTION

The California Coastal Conservancy (Conservancy) and the California Department of Fish and Game (DFG), in association with the U.S. Army Corps of Engineers (Corps) and other agencies, are implementing the Napa-Sonoma Marsh Restoration Project (NSMRP), which will restore nearly 9,500 acres of wetlands and associated habitats within the former Cargill salt pond complex in the North Bay (Figure 1). A Feasibility Study (FS) and EIR/EIS have been prepared using funding from the Conservancy, DFG, and the Corps. The Draft EIR/EIS/FS will be released to the public in late 2002.

The CALFED grant would enable us to conduct Phase 1 of the project, restoration of three former salt ponds along the Napa River, totaling approximately 3,000 acres. Phase 1 will provide for restoration of Pond 3 (1,300 acres) to tidal habitats, and salinity reduction in preparation for potential tidal habitat restoration in Ponds 4 and 5 (1,700 acres). CALFED funding is being sought for: preparation of construction drawings, permitting, construction, project management, and monitoring.

Phase 1 is an exciting opportunity to conduct a large-scale restoration project that will result in a self-sustaining wetland ecosystem, aid in the recovery of multiple at-risk species, including anadromous and resident fish, waterbirds, and mammals, and benefit a broad range of other fish, wildlife, and plant species, including migratory waterfowl and shorebirds. Implementation of Phase 1 is a major step in the restoration of the entire salt pond complex to a mix of tidal marsh and managed ponds. Future work in the 9,500-acre complex, which will not be funded under the CALFED grant, will include additional tidal marsh restoration along with construction of water control structures to enable efficient management of ponds retained for waterfowl and shorebirds. The Phase 1 project will serve as a model for other restoration work in the North Bay salt ponds, for restoration work in the South Bay salt ponds, as well as restoration work in other diked baylands.

1. Problem Statement

Historically the San Francisco and San Pablo Bays contained nearly 200,000 acres of tidal marsh and 50,000 acres of adjoining tidal mudflat. An estimated 85 percent of the historic tidal marshes in the Estuary have been filled or significantly altered over the past two centuries. Many of the native fish species as well as birds and mammals that depended upon them are in danger of extinction.

CALFED's Ecosystem Restoration Plan (ERP) assumes that restoring tidal marsh will improve conditions for the Bay's native species. Larger tracts of tidal marsh provide better habitat because the habitat can sustain a more complex food web and greater numbers of individuals of key species, preserving genetic diversity. Large areas that allow for restoration to tidal marsh are limited in the Bay Area. The San Pablo Bay's diked baylands provide an opportunity for large-scale restoration of tidal marsh, and over the last decade, state and federal resource agencies have purchased a number of properties within the Napa-Sonoma Marsh Complex, with the intent to restore much of the land to tidal marsh. The North Bay salt ponds in particular represent a unique opportunity to achieve a large percentage of the total tidal wetland goals for the North Bay, as defined in the *Baylands Ecosystem Habitat Goals Report (Goals Report).*

The Conservancy, DFG, and Corps have invested significant funds and staff time in the design and analysis of this restoration project and are anxious to begin Phase 1 sooner than feasible under the Federal authorization process. CALFED funding for Phase 1 is urgently needed to provide higher-quality, self-sustaining habitat to benefit a diversity of species, decrease the risks of unintentional levee breaches and high saline spills, and allow other, near-by restoration projects, in particular Cullinan Ranch, to proceed as soon as possible.

a) Location

The salt pond complex is located along the western edge of the lower Napa River, is owned by DFG, and is managed as part of the Napa River Unit of the Napa-Sonoma Marshes State Wildlife Area (see Figure 1). The Napa River Unit was first diked off from the San Pablo Bay during the 1850s for hay production and cattle grazing. Much of the land was later converted to salt ponds, for salt production by the solar evaporation of bay water. In the early 1990s, the Cargill Salt Company ceased the production of salt and sold the evaporator ponds and associated remnant sloughs and wetlands on the west side of the Napa River to the State of California.

The project area contains 12 ponds formerly used in the salt production process (Figure 1). The salt ponds contain various concentrations and types of salts (Figure 3). Some of the inactive salt ponds provide or have provided significant habitat for fish and wildlife, while the salinity levels in others exceed that which is beneficial to wildlife.

b) Relevant Past Studies

Extensive studies have been conducted pertaining to the NSMRP. The studies address existing conditions, salinity reduction, habitat evolution, and engineering design. Relevant past studies and reports encompass studies conducted specifically for the NSMRP, as well as regional studies and reports, and include the following:

a. Administrative Draft Feasibility Study, Napa River Salt Marsh Restoration, U.S. Army Corps of Engineers, July, 2002.
b. Draft Napa River Salt Marsh Restoration, Habitat Restoration Preliminary Design, Phase 2 Stage 2 of the Hydrology and Geomorphology Assessment in Support of the Feasibility Study, Philip Williams and Associates (PWA), July, 2002.
c. Napa Sonoma Marsh Restoration Feasibility Study: Hydrodynamic Modeling Analyses of Existing Conditions-Phase I, PWA, March, 2002.
d. Napa Sonoma Marsh Restoration Feasibility Study Hydrodynamic Modeling Study: Preliminary Salinity Reduction, Habitat Evolution, and Sediment Budget, Phase 2 Stage I, PWA, March, 2002.
e. Ground Control and Hydrographic Survey Report, Napa River Salt Marsh Restoration Project Phase II-Topographic and Hydrographic Surveys, Towill, Inc., 2001.
f. Reconnaissance Report, Napa River Salt Marsh Restoration, U.S. Army Corps of Engineers, August, 1997.
g. Napa River Salt Marsh Restoration Project, Water Quality and Sediment Characterization, Hydroscience Engineers, February, 2002.
h. Historical Napa Marsh Channels, Napa-Sonoma Marsh Color Photography (Mosaic), San Francisco Estuary Institute, 1999.
i. Baylands Ecosystem Habitat Goals [the Goals Report], San Francisco Bay Area Wetland Ecosystem Goals Project, March, 1999.
j. Draft Cost Estimate of Napa Salt Marsh Salinity Reduction and Restoration Alternatives, Brown and Caldwell, May, 2002.
k. Science support for wetland restoration in the Napa-Sonoma salt ponds, San Francisco Bay Estuary, 2000 Progress Report. Unpubl. Prog. Rep., U. S. Geological Survey, Davis and Vallejo, CA. Takekawa, J.Y., A.K. Miles, D.H. Schoellhamer, G.M. Martinelli, M.K.Saiki, and W.G. Duffy, 2000.
l. Baseline Monitoring of the Pond 2A Tidal Restoration Project, Final Report, July 1996 – July 2000, prepared for California Department of Fish and Game, MEC Analytical Systems, December, 2000.

c) Urgency

There are two primary factors that make implementation of this project, and particularly Phase 1, very urgent: (1) the decline in existing habitat value at the project area resulting from deteriorating infrastructure and increased salt concentrations in the ponds, and (2) the need to implement this project as a part of a coherent program with other restoration efforts in the vicinity.

Decline in Existing Habitat Value
The salt ponds' water quality, habitat conditions, and infrastructure are deteriorating. As the site deteriorates, ponds no longer provide functional habitat for wildlife and the risk of a high-saline spill to the Napa River and/or local sloughs rises. See Figure 2 for a schematic of existing conditions and Figure 3 for salinity ranges within the ponds. Restoration of Pond 3 to tidal habitats and installation of water control structures to achieve continuous flow-through circulation at Ponds 4 and 5 would result in a reduction in accumulated salts, improvement in wildlife habitat, and reduced risks of a high-saline spill.

Salinity levels are rising in the ponds for two reasons: DFG is unable to maintain adequate water levels in the ponds, and adding water to the ponds increases the salt load in the ponds. Deteriorating water control structures have prevented DFG from moving water into Ponds 4 and 5 for the past several years. Even when DFG can move water into the ponds, the make-up water is from San Pablo Bay via Pond 1 and/or the Napa River via Pond 8 and contributes a substantial salt load to the ponds each year. To fully compensate for evaporation from the ponds would result in the addition of *hundreds of millions* of pounds of salt to the pond system each year. Salinities in Ponds 4 and 5 have increased significantly in the past few years because these two ponds are the "dead end" of the pond system – make-up water is introduced at the north and south ends of the pond system, and flows toward these two ponds. As the levees that form the ponds deteriorate, there is a risk of an uncontrolled release of concentrated brines due to a levee failure. Although these highly concentrated salts are not considered "toxic", their uncontrolled release could be detrimental to the aquatic environment. Fish kills can occur at salinity concentrations of greater than 70 ppt. This year, salinities in Pond 4 and 5 were over 350 ppt.

Coordination with Other Projects
There are two other major proposed restoration projects in the vicinity of the Napa Marsh project: Cullinan Ranch and Skaggs Island. Cullinan Ranch is located immediately south of Pond 3, on the other side of Dutchman Slough. Skaggs Island is located immediately west of the project, on the west side of Sonoma Creek (Figure 1). The Cullinan restoration should not proceed until Pond 3 has achieved a stable elevation and is partially vegetated. Cullinan is deeply subsided, and breaching Cullinan will almost certainly widen Dutchman Slough sufficiently to undermine the levees on the south side of Pond 3. If Pond 3 has not achieved a stable elevation and been at least partially vegetated prior to breaching of Cullinan, it is likely that sediment would be transported from Pond 3 to the Cullinan site, reversing the restoration progress at Pond 3. Consequently, tidal habitat restoration at Pond 3 is a very high priority. Pond 3 has experienced relatively little subsidence, and thus is a better candidate to rapidly achieve stable site elevations and vegetate quickly. Skaggs Island will be transferred to the FWS in the next two years and restoration planning will be coordinated, particularly in development of final plans for Pond 6/6A which borders Skaggs Island.

d) Goals and Objectives

Construction of this project would achieve many of the goals and objectives outlined in the *Goals Report* and serve as a model for the restoration of thousands of acres of the South Bay salt ponds. As stated in the *Goals Report* (p. 97):

> The overall goal for the North Bay is to restore large areas of tidal marsh and to enhance seasonal wetlands. Some of the inactive salt ponds should be managed to maximize their habitat functions for shorebirds and waterfowl, and others should be restored to tidal marsh… Tidal marsh restoration should occur in a band along the bayshore, extending well into the watersheds of the subregion's three major tributaries – Napa River, Sonoma Creek, and Petaluma River… In total, the Goals for the North Bay subregion call for increasing the area of tidal marsh from the

existing 16,000 acres to approximately 38,000 acres, and creating about 17,000 acres of diked wetlands managed to optimize their seasonal wetland function.

These goals for the NSMRP were developed based upon the *Goals Report* and site-specific opportunities and constraints:

Overarching Goals

- Restore a mosaic of diverse habitats that will benefit a broad range of fish, wildlife, and plant species, including endangered and threatened species, fish and other aquatic species, and migratory shorebirds and waterfowl.
- Restore natural, self-sustaining systems that can adjust to naturally occurring changes in physical processes, with minimum ongoing intervention and restore habitats that will change over time due to inherent dynamic characteristics of the estuarine system (in terms of seasonal as well as longer-term changes).
- Design and phase the restoration in relationship with restoration projects throughout the Napa-Sonoma Marsh, particularly Cullinan Ranch and Skagg's Island, to maximize positive impacts and reduce negative impacts (such as erosion of existing marshes and unintended breaching of levees) resulting from excessive changes in the tidal prism.
- Implement habitat restoration using adaptive management techniques, phasing the restoration within the project site and monitoring results of preliminary phases to improve future phases.

Project Site Goals

- In a phased approach, restore large patches of tidal habitats that support a wide variety of fish, wildlife, and plants, including:
  - special status mammals and water birds, specifically the salt marsh harvest mouse, California clapper rail, black rail, and San Pablo song sparrow;
  - endangered fish who will use the tidal shallow-water and marsh habitat for spawning, rearing, or smoltification, specifically Delta smelt, Sacramento splittail, Central Coast steelhead trout, and Chinook salmon, and other fish species; and
  - aquatic animals, including Dungeness Crab, and other benthic and planktonic invertebrates.
- Restore tidal marsh in a band along the Napa River to maximize benefits for fish and other aquatic animals and ensure connections between tracts of tidal marsh (within the project site and with adjacent sites) to enable the movement of fish, small mammals, marsh-dependent birds, and aquatic species.
- Manage water depths of remaining ponds to provide shallow-water areas for migratory and resident shorebirds and dabbling ducks and deep-water areas for diving benthivores, and manage salinity levels in the ponds to support a rich diversity of biota.

e) External Engineering Review

A conceptual plan for Ponds 3, 4, and 5 has been developed by PWA and Brown and Caldwell as part of the U.S. Army Corps of Engineers' Feasibility Study. The next step will be to develop detailed engineering drawings and plans and specifications to put out to bid. Ducks Unlimited and PWA will complete these documents and they will be available to outside reviewers, including participants in the Napa-Sonoma Marsh Restoration Group and the public.

2. Justification

The 9,500-acre NSMRP provides a unique opportunity for landscape-scale restoration of tidal marsh to benefit water quality, physical processes, and fish and wildlife. In addition, it provides a valuable learning for other proposed restoration efforts in the immediate area, and for restoration of the South Bay salt ponds.

a) Conceptual Models

Conceptual Model for Tidal Habitats Restoration (Pond 3)

Statement of Problem

An estimated 85% of the historic tidal marshes in the Bay have been filled or significantly altered. The loss of tidal marsh has had negative effects on the physical, chemical, and biological health of the Bay, including (*Goals Report):*

- Declines in fish and wildlife populations, leading to economic losses through declines in sport and commercial hunting and fishing, and the listing of numerous species under the federal and state endangered species acts;
- Loss of tidal prism causing tidal channels to become more narrow and shallow, significantly decreasing the capacity of local rivers and streams and increasing the local hazards of flooding and need for dredging;
- Decreased water quality and increased turbidity within the Estuary; and
- Curtailment of the influence of tidal marshes on sediment transport leading to the accumulation of sediments from watersheds at the mouths of streams.

Conceptual Model

Based upon past experiences with tidal marsh restoration in the Bay, we can describe the linkages between **physical input and processes** (tidal inundation, deposition of sediment, erosion or scour of sediment, wind/wave action, river flows, evaporation and precipitation), **habitat evolution** (formation of dendritic slough channels, topographic diversity between subtidal and upland/transition zones, vegetation along the elevation gradient, daily and seasonal changes in the tide, daily and seasonal changes in salinity), and **biological responses** (sustainable populations of resident and migratory native species and complex food webs).

The NSMRP will create a mix of natural tidal habitats along a gradient from subtidal habitat to midmarsh and limited upland habitat, using natural sedimentation. The approach to tidal restoration in Pond 3 is to create an initial physical site template using restoration design features (levee breaches at the mouths of historic slough channels, historic slough excavation and creation of berms, borrow ditch blocks, and levee lowering [see Section 3. Approach]). The site template will guide the evolution of tidal habitats through the action of natural physical and vegetative processes. The approach relies primarily on natural sedimentation to raise subsided elevations, tidal scour to reestablish the majority of channels, and natural vegetative colonization to establish marsh vegetation. Direct interventions such as grading or filling are minimized in the design. However, any target habitat features, such as extensive tidal channel networks, that may not evolve on their own are given a “jump-start” with design features (PWA, 2002).

Restoration projects in the North Bay that create large-scale heterogeneous wetlands with complex tidal hydrology will benefit native at-risk species, including the California clapper rail, black rail, San Pablo song sparrow, salt marsh harvest mouse, Sacramento splittail, chinook salmon, Central Coast steelhead trout, and potentially delta smelt, along with benefiting other fish, wildlife, and plants. The site template being used in Pond 3 of the NSMRP will result in an evolving mix of heterogeneous tidal habitats with complex hydrologic processes on a landscape-scale. Daily fluctuations of the tides, seasonal variations in salinity, and winter floods on the Napa River and Sonoma Creek will favor native species and the benthic and planktonic communities they feed upon by creating habitat niches that are not subject to colonization by exotic predators or invasive aquatic vegetation. The daily and seasonal cycles of wetting and drying combined with the spatial complexity of dendritic tidal marsh provide essential refuge and feeding opportunities for native fish and wildlife.

Tidal habitat restoration in Pond 3 will help achieve restoration of the following species:

- special-status anadromous fish, specifically steelhead trout and chinook salmon, which could benefit from the tidal habitats during their upriver migration or in the smoltification process;
- special-status resident fish, specifically delta smelt and Sacramento splittail;
- harvestable fish, specifically striped bass;

- special-status waterbirds and mammals that depend upon tidal wetlands in the San Francisco Bay estuary, specifically California clapper rail, salt marsh harvest mouse, and black rail;
- aquatic invertebrate species, such as amphipods, isopods, mysid shrimp, bay crabs, bay shrimp, Dungeness crabs, polychaetes, and molluscs; and
- migratory shorebirds and dabbling ducks, which depend on Bay wetlands for feeding and resting during migration along the Pacific Flyway.

<u>Conceptual Model for Salinity Reduction (Ponds 4 and 5)</u>

Statement of Problem

The water quality and habitat conditions in Pond 4 and 5 are deteriorating: salinity levels are rising within the ponds and the water control structures connecting Pond 4 to Pond 3 and Pond 5 to Pond 6 have been blocked by a high-saline wedge during dry conditions over the past few years. As the site deteriorates, ponds no longer provide functional habitat for wildlife, the risk of a high-saline spill to the Napa River and/or local sloughs rises, and the cost of future restoration work increases. Avian surveys conducted during 1999 and 2000 indicated that Pond 4 supported tens of thousands of shorebirds and waterfowl each year and supported the highest number of birds among the surveyed ponds (Ponds 1, 2, 2A, 3, 4, 7) (Takekawa, et. al. 2000). Over the past two years, Ponds 4 and 5 have dried out for parts of the year and exceeded salinities of 350 ppt when wet.

Conceptual Model

Based upon past management and monitoring experiences with salt ponds in the North Bay, we can describe the linkages between **physical input and processes** (water inflow, water outflow, evaporation, precipitation), **habitat structure** (depth and salinity), and **biological responses** (abundance and composition of benthic and aquatic invertebrates, fish, and waterbirds).

The approach to salinity reduction and water quality improvement in Ponds 4 and 5 is to install water control structures which will allow for intake of water from Napa Slough (near its confluence with the Napa River) and discharge of water into the Napa River (see Section 3. Approach). Based on current modeling results and assumed initial conditions, salinity reduction through water control structures would require approximately 12 to 18 months for Ponds 4 and 5, depending on the starting salinity and the actual annual rainfall.

Improved Water Management in Ponds 4 and 5 will provide the following benefits:

- DFG's ability to manage water depths to support shorebirds and waterfowl will be improved.
- Inflow and outflow of Napa River water will improve water quality and decrease salinity, which will allow the ponds to support invertebrates, which will benefit waterfowl and shorebirds.
- Decreased salinities in Ponds 4 and 5 will allow for future restoration of one or both ponds to tidal habitats (future of Pond 5 as either tidal marsh or managed pond habitat is dependent upon EIR/EIS analysis; Pond 4 is restored to tidal marsh in all Habitat Alternatives in the EIR/EIS), which will have similar benefits as the Pond 3 restoration.

b) Uncertainties and Hypotheses

The broad hypothesis being tested is that tidal habitat restoration in the Napa-Sonoma Marshes is an important contribution in the Bay-Delta Estuary to the recovery of sustainable populations of native fish, wildlife, and plants, including at-risk species. The two project-level hypotheses being tested are that: (1) former commercial salt ponds can successfully be restored to tidal marsh and associated tidal habitats that support at-risk species and complex food webs and, (2) the depths and salinities of former commercial salt ponds can be managed to provide habitat for migratory shorebirds and waterfowl. These specific project hypotheses fall into two categories: those pertaining to physical habitat evolution and those pertaining to species benefits attributable to changes in the habitat.

1. Restoration of tidal habitats in the Napa-Sonoma Marshes is an important contribution in the Bay-Delta Estuary to the recovery of sustainable populations of native fish, wildlife, and plants,

including at-risk species and will contribute to a better understanding of links between restoration and recovery throughout the Estuary.

a. The Napa-Sonoma Marshes are a priority location for tidal habitat restoration in the Estuary and will contribute to the recovery of species of concern.
b. In combination with small and large-scale tidal restoration projects throughout the Estuary, such as Bair Island, Hamilton and Bel Marin Keys, Sonoma Baylands, Tolay Creek, Dutch Slough, projects in Suisun Marsh, and others, the NSMRP will contribute to determining the relationships or causal links between tidal habitat restoration and recovery of at-risk species, including:
    i. Species needs related to tidal indundation and salinity regimes,
    ii. Response of species related to spatial characteristics of tidal habitats (size, shape, and connectivity) and
    iii. Response of species related to locations of tidal habitats (South, Central, North Bay, Suisun, and Delta),
    iv. Species needs related to types of tidal habitats (subtidal, intertidal, low marsh, high marsh, upland buffers), and
    v. Identification of limiting factors in tidal habitat restoration projects.

2. Larger areas of restored tidal habitats are more beneficial to listed species than smaller areas.
    a. Larger areas support a more complex foodweb and larger populations of native species.
    b. Larger areas support greater genetic diversity and allow improved survival for listed species.
    c. Larger areas provide for more habitat niches that support at-risk species, created by tidal inundation, salinity regimes, floods, and other physical and chemical processes.
    d. Larger areas decrease opportunities for invasive predators to prey upon listed species by reducing the proportion of predator corridors to area of tidal areas.

3. The increase in tidal habitat area and diversity will benefit targeted species.
    a. Increased tidal habitat will increase primary productivity and increase the volume and diversity of aquatic and benthic invertebrates, creating more complex food webs.
    b. Increase in subtidal, intertidal and tidal marsh habitats will benefit special-status anadromous fish, specifically Central Coast steelhead trout and chinook salmon, which could benefit from the tidal habitats during their upriver migration or in the smoltification process by providing more places to take refuge and more food sources.
    c. Increase in tidal marsh habitat will benefit special-status resident fish, specifically delta smelt and Sacramento splittail by providing more places to take refuge and more food sources.
    d. Increase in tidal marsh habitat will benefit listed waterbirds and mammals that depend upon tidal wetlands in the San Francisco Bay, specifically California clapper rail, salt marsh harvest mouse, and black rail.
    e. Increase in subtidal and intertidal habitat will benefit migratory shorebirds and dabbling ducks by providing feeding and resting areas.

4. Large-scale project areas can be restored using natural sedimentation.
    b. Natural sedimentation will be adequate to restore slightly and moderately subsided ponds.
    c. Sedimentation rates are dependent on the suspended sediment concentration, wind-wave resuspension, vegetation colonization, and elevation of the area to be restored.
    d. Mare Island Straight is the primary source of sediment, and locations closer to the primary source (Pond 3) will accrete faster than locations farther from the source (Ponds 4 and 5).
    e. Sedimentation estimates and key parameters identified for the NSMRP are also applicable to sediment accretion in the South Bay Ponds and at other subsided restoration sites.

5. The proposed design features will accelerate and enhance tidal habitat formation.
    a. Long fetch resulting in wind-driven waves must be controlled through the use of berms to achieve adequate rates of sediment deposition.

    b. Starter channels will promote reestablishment of historic slough/channel networks.
    c. Borrow ditch blocks will promote the reestablishment of historic slough/channel networks by inhibiting existing borrow ditches from capturing the tidal supply.
    d. Historic channel networks will reestablish and marsh vegetation will colonize formerly farmed baylands (Pond 2A, which has already been successfully restored to tidal marsh, was not farmed prior to conversion to commercial salt production while the rest of the ponds were farmed prior to conversion).
    e. The likelihood of historic slough/channel networks being reestablished is a function of the degree of subsidence of the diked area, the rate of sediment accretion, and the tidal prism. (More deeply subsided areas require less intervention because it will take them longer to accrete, so historic channels patterns have more time to establish, a greater tidal prism means more scour which means better channel formation)

6. Conditions in the Napa-Sonoma Marshes favor the establishment of native vegetation rather than introduced species.
    a. Tidal restoration projects in the Napa-Sonoma Marshes are less susceptible to invasions of introduced *Spartina* species, due to salinity regimes and locations of initial introductions of *Spartina*.
    b. Tidal salt and brackish marsh restoration projects in the San Francisco Bay are less susceptible to invasions of introduced freshwater vegetation than restoration projects in the Delta or in riparian habitats.

7. The depths and salinities of former commercial salt ponds can be managed, using water control structures, to provide habitat for migratory shorebirds and waterfowl, and the management of ponds will benefit waterfowl and shorebirds
    a. A greater number of resident and migratory waterfowl and shorebirds will use the ponds for feeding and resting.
    b. Food sources (invertebrates) in the ponds will increase.

c) Demonstration Project

There has already been one large-scale restoration success story within the salt pond complex. Pond 2A (550 acres) was restored to tidal habitat in 1995 by DFG and has rapidly evolved into tidal marsh, serving as a model for restoration of Pond 3. Although Pond 2A has different characteristics than Pond 3 (Pond 2A was slightly less subsided than Pond 3 and was never farmed prior to conversion to a salt pond), it provides some indication of expected evolution and expected vegetation colonization and wildlife use. Pond 3 will be restored using a similar technique to the Pond 2A restoration (levee breaches), and will include additional design features. The techniques and monitoring employed in the Pond 3 restoration will in turn serve as a model for restoration of other ponds in the 10,000-acre complex and could serve as a model for restoration of the South Bay Salt Ponds.

The physical and biological evolution of the 550-acre Pond 2A marsh was monitored over a four-year period (1996-2000) through surveys of levee breach and natural slough channel width equilibrium, sediment chemistry and grain size, sedimentation rates, tidal range and response, fish usage, avian usage, and plant colonization.

Results of the monitoring include the following:

- By the year 2000, the marsh plain and slough channels were reaching equilibrium and vegetation cover had increased dramatically to 90% coverage from about 10% coverage in 1995;
- Nineteen different species of fish were caught over the four-year study period (1,314 individuals), including 142 Sacramento splittail, 3 delta smelt, 99 striped bass, and 207 topsmelt;
- The invertebrate census identified nine crustacean species, including bay crab, bay shrimp, and Dungeness crabs, along with mollusks and polychaetes; and

- Seventy different bird species were observed, primarily shorebirds and dabbling ducks, along with a few California clapper rails and black rails observed in the last two years of the surveys.

d) Site Constraints and Additional Uncertainties

As with any restoration site, there are some constraints on this site that have to be addressed during the design process. Constraints for this project include applicable laws, regulations and policies; physical (site-related) constraints; engineering constraints; and potential and existing projects affecting the project area. In addition to the numerous physical constraints (such as access considerations) that were factored into the preliminary design of the project, the following constraints have been addressed as part of the project planning effort:

- Salinity reduction and tidal marsh restoration must minimize impacts to the existing habitat and sensitive species in the area.
- Salinity reduction must not have a significant adverse impact on the water quality of the Napa River or San Pablo Bay.
- Implementation of ecosystem restoration must not increase flooding risks on the Napa River, must not adversely affect operation of the existing Napa River navigation channel due to increased velocities in response to increased tidal prism, and must avoid or mitigate for impacts to existing PG&E towers (the only non-project infrastructure in the project area).
- Restoration of the NSMRP must not adversely affect near-by restoration projects, including the Sonoma Creek Flood Control Project, Cullinan Ranch, and Skaggs Island, and vice-versa.

Each of these major constraints included a series of specific constraints (Appendix 3). The applicable constraints have been considered by the Conservancy, DFG, and CORPS as part of the feasibility study and CEQA/NEPA processes, and the project is being designed to minimize or mitigate for these constraints.

3. Approach

a) Proposed Project

Phase 1 begins the restoration of the three largest ponds in the project area, and will include restoration of Pond 3 to tidal habitats and salinity reduction in Ponds 4 and 5, enabling near-term future restoration of Ponds 4 and 5 to tidal habitats. The implementation of Phase 1 is consistent with all habitat restoration options under consideration in the EIS/EIR and Feasibility Study, and will not affect the selected habitat restoration approach.

Complete project alternatives were developed in a three-step process (Appendix 4). All project alternatives include salinity reduction (to bring all ponds to ambient or near-ambient salinities), and habitat restoration (various combinations of tidal wetland restoration and managed ponds). Four salinity reduction options and four habitat restoration options were developed. See Figures 5 and 6 for drawings of Salinity Reduction Option 1B: Napa River and Napa Slough Discharge and Habitat Restoration Option 1: Mix of Managed Pond and Tidal Marsh. The specific design elements for Phase 1 (Pond 3 habitat restoration and Ponds 4 and 5 salinity reduction) are described below.

Tidal Habitat Restoration in Pond 3

Design features for Pond 3 (1,300 acres) are briefly described below, and in greater detail in Appendix 2. Philip Williams and Associates (PWA) created preliminary designs for the habitat restoration options (Figure 7, Habitat Restoration Design for Option 1). The approach to tidal restoration is to create an initial site template that will guide the action of natural physical and vegetative processes to gradually regenerate a self-sustaining marsh ecosystem. The approach relies primarily on natural sedimentation to raise subsided elevations, tidal scour to reestablish channels, and natural vegetative colonization to establish marsh vegetation. Direct interventions such as grading or filling are minimized in the design. However, any target habitat features, such as extensive tidal channel networks, that may not evolve on their own are given a “jump-start” with design features (PWA, 2002). Design features for Pond 3 include:

- Levee Breaches: Pond 3 will first be desalinated via levee breaches. Two small breaches already exist as of August, 2002; the salinity of Pond 3 at the date of the first breach was approximately 50 ppt. Additional levee breaches will be added along South Slough and Dutchman Slough. Breaches will be located at the mouths of historic slough channels and enough breaches will be created to ensure that all drainage areas of approximately 250 acres are served by at least one breach. Breaches have been located to minimize impacts on the fringing marsh and prevent unintended breaching of near-by levees (for example, on Cullinan Ranch). In some cases, the borrow ditch will be used to connect the breach location to historic sloughs channels. Breaches for habitat restoration may be phased to manage the increase in tidal prism in Dutchman Slough. Breaches will vary in width, depending on the size of the historic slough channels with which they are associated.
- Ditch Blocks: The borrow ditches which were created to build and maintain the salt pond levees will be blocked between levee breaches to promote reestablishment of natural channels and ensure drainage within the site. Nine ditch blocks will be installed. This approach will preserve valuable fish habitat in the borrow ditches (which contain a lot of water even a low tide), while avoiding fish entrapment. Soil for the ditch blocks will be obtained by lowering adjacent perimeter levees to an elevation near MHHW.
- Starter Channels: Starter channels will be excavated from each breach some distance into the pond, and will generally be excavated in the locations of large historic slough channels. Starter channels benefit habitat by facilitating more rapid channel and marsh development, and may increase the eventual channel drainage density. The project design includes 11,200 feet of starter channels for Pond 3.
- Berms: Excavated material from the starter channels will be sidecast along the slough channel to form berms no higher than natural marshplain elevations. Berms create a diversity of marsh habitat and enhance sedimentation and marsh establishment by reducing wind wave resuspension of sediment. They also serve as early colonization sites for marsh vegetation. Berms would be constructed along one side of the sloughs only, and construction would be managed to avoid covering the junctions with smaller channels. No sediment would be imported to construct the berms. A schematic of the starter channels and berms is shown in Figure 8.
- Levee Lowering: Approximately 20% of the perimeter levees will be graded to near marshplain elevations to create new marshplain within the first few years of the project. This levee lowering is in addition to that conducted for the ditch blocks. The levees will graded into the pond, narrowing but not blocking the borrow ditches. This levee lowering will be conducted to provide habitat connectivity in areas where existing patches of fringing marsh may erode, and to provide areas for high marsh vegetation to colonize near areas of large fringe marsh. The design for Pond 3 includes 10,000 feet of levee lowering.

When first breached, Pond 3 will primarily provide intertidal mudflat habitat, which is expected to benefit at-risk fish and aquatic species, and migratory shorebirds and waterfowl. It is expected that as deposition of sediment occurs intertidal areas will aggrade to elevations at which cordgrass and bulrush can initially colonize and low marsh will form. Vegetation will extend to lower areas through lateral colonization. Low marsh, once fully established, is expected to gradually transition to mid-marsh (marshplain), predominantly pickleweed. This transition is assumed to occur in approximately 10 years, based on observations at other restored San Francisco Bay marshes (Muzzi, Bothin, and DeSilva Island), but has a relatively wide range of uncertainty (PWA, 2002). See Figure 4 for a comparison of the initial elevation of restoration projects in the Bay and number of years to vegetation establishment. Formation of low and mid marsh is expected to benefit at-risk marsh species, such as the California clapper rail and salt marsh harvest mouse, as well as anadromous and resident fish and other aquatic species. Borrow ditches are expected to largely retain their existing configuration (with the modifications described above) and will continue to provide excellent fish habitat throughout the tidal cycle. The total levee lowering conducted corresponds to approximately 20% of the Pond 3 levees.

Pond 3 will evolve to a 1,300-acre self-sustaining mix of tidal habitats, including midmarsh (marshplain), low marsh, intertidal mudflat, and subtidal channels. See Figures 9, 10, and 11 for expected tidal habitat evolution in Pond 3. The restoration will be designed to ensure that natural processes can act to gradually regenerate a marsh ecosystem. PWA has conducted preliminary analysis of the geomorphological evolution of the site, taking into account initial elevations, sedimentation rates, vegetative processes, and wind-wave action within the ponds. The analysis included evaluation of a range of suspended sediment concentrations, and use of more intensive and less intensive habitat design features (habitat design features accelerate habitat evolution).

Opportunities for tidal marsh restoration in Napa Marsh include:

- *Hydrologic connection to tidal waters.* The lower Napa River is a relatively large tidal water body and modeling shows that the existing slough channels are sufficiently sized to convey tide waters to Ponds 3, 4, and 5,
- *Suspended sediment supply.* Sediment laden inflow from San Pablo Bay and Carquinez Strait provide a source of tidal sediments and large floods on the Napa River provide and adjacent fluvial sediment supply,
- *Natural vegetative processes.* Marsh vegetation along the channels and in Pond 2A are expected to provide a source of seed and propagules for natural colonization of the restored marsh,
- *Existence of antecedent channels.* Historic channels are present in the ponds and are expected to scour preferentially.
- *Grading to elevations conducive for marsh vegetation establishment.* Lowering levee crests to marshplain elevation can be used to create areas likely to be colonized with marsh vegetation within only a few years, and
- *Connectivity to existing marsh.* Restored tidal areas will connect to significant areas of existing marsh habitat, providing large areas of contiguous habitat for use by fish and wildlife.

Below is PWA's estimated habitat evolution for Pond 3, with limited design features as proposed in the design. The evolution estimates indicate that once opened to the full tidal prism, the site will primarily consist of intertidal mudflat. As sediment deposits, elevations will rise and low marsh vegetation (cordgrass and bulrush) will colonize. Low marsh will increase between years 5 and 20 and then transition to mid-marsh habitat (predominantly pickleweed marshplain), which will increase during years 20 to 50. Complete descriptions of the assumptions and methods used are in the PWA 2002 report.

Preliminary Estimated Habitat Evolution for Pond 3 (acres)

Year*	**Present**	**0**	**5**	**10**	**20**	**30**	**40**	**50**
Subtidal	0	0	60	60	60	60	60	60
Intertidal Mudflat	0	1250	1080	880	360	60	60	60
Low Marsh	0	0	50	250	770	670	70	10
Mid Marsh	0	0	70	70	70	470	1080	1140
Managed Pond	1250	0	0	0	0	0	0	0
Upland/Transition	30	30	20	20	20	20	20	20

* Years after breaching.

Note: Areas over ten acres rounded to the nearest 10 acres.

Salinity Reduction/Water Quality Improvements in Ponds 4 and 5

The approach to salinity reduction and water quality improvement in Ponds 4 and 5 (1,700 acres) is to install water control structures which will allow for intake of water from Napa Slough (near its confluence with the Napa River) and discharge of water into the Napa River (Figure 5: Salinity Reduction Option

1B). Discharge criteria will be defined in a RWQCB permit. Currently, the ponds are a closed system with no discharge point. Reduction of salinity will improve conditions for waterfowl and shorebirds in the ponds, will reduce the risk of a high-saline spill into the Napa River or sloughs in the event of a levee breach (there is significant outboard scour along some of the Pond 4 and 5 levees), and will allow future tidal restoration work to proceed in Ponds 4 and possibly Pond 5.

Based on current modeling results and assumed initial conditions, salinity reduction through water control structures would require approximately 12 to 18 months for Ponds 4 and 5, depending on the starting salinity and the actual annual rainfall. Salinity reduction in Ponds 4 and 5 would include construction of the following structures:

- Pond 5 Intake: Up to seven 54-inch intakes will be located on Napa Slough at the north-central section of Pond 5. Based on recent conversations with USFWS and NFMS, it may be possible to avoid having to install fish screens on the intakes, which would reduce the number of intakes required.
- Pond 5 to Pond 4 Connection: To ensure effective mixing in Pond 4/5, the existing Pond 4/5 interior levee breaches will be expanded to four 100-foot long breaches.
- Pond 4 Outfall: Two 200-foot long, 48-inch outfalls will be constructed on the southeast side of Pond 4 to release water to the Napa River. The river side of the outlet will require an approximately 600-foot extension into the river, and will be equipped with a diffuser to ensure adequate mixing.

All intakes and outfalls will be equipped with check valves to prevent backflow back into the pond and with manual knife valves to provide additional control. Intakes and outfalls would largely be tidally driven, but could also be closed or reduced manually to reduce flows, if required. Fish screens, if required, will be stainless steel, and will be fitted with solar-powered cleaning devices. Due to the fact that the ponds are completely surrounded by sloughs (are located on islands), construction will have to be performed by barge-mounted equipment. More detailed design information is provided in Appendix 2.

Once the water control structures have been installed salinity reduction would begin by allowing the ponds to fill as much as possible (pond water levels would be maintained at no higher than 2 feet below the top of the levees, to minimize wind-wave erosion of the levees). Allowing the ponds to fill first will dissolve precipitated salts and minimize the salinity in the discharge. The discharge will be monitored and the discharge rate adjusted as necessary to ensure permit compliance. The goal is to begin the discharge during the winter when there are higher flows in the Napa River.

As a future phase of work, Ponds 4 and 5 may be opened to muted tidal action by simply keeping all water control structures open, once salinities in the ponds are reduced. Ponds 4 and/or 5 could then be opened to tidal action by breaching levees at the location(s) of historic major slough mouths, after Pond 3 has been vegetated by low marsh plants. The plan is to open Ponds 4 and/or 5 to full tidal action approximately 3 to 4 years after the start of Phase 1 Project. Tidal restoration of either Pond 4 or Ponds 4 and 5 would provide the same benefits as tidal restoration of Pond 3. Based upon the monitored results of restoration design features in Phase 1, Ponds 4 and 5 would employ 13 levee breaches at the mouths of historic slough channels, 13 borrow ditch blocks, 16,300 feet of starter channel excavation and 16,300 feet of berm creation, and 12,200 feet of levee lowering. Due to lower initial elevations, Ponds 4 and 5 will principally be composed on intertidal mudflat, with evolution towards lower and middle marsh vegetation occurring slowly.

Preliminary Estimated Habitat Evolution for Pond 4 (acres)

Year*	**Present**	**0**	**5**	**10**	**20**	**30**	**40**	**50**
Subtidal	0	0	50	50	50	50	50	50
Intertidal Mudflat	0	0	850	840	830	830	830	800
Low Marsh	0	0	0	10	10	20	10	40

Mid Marsh	0	0	10	10	20	20	30	30
Managed Pond	910	910	0	0	0	0	0	0
Upland/Transition	30	30	20	20	20	20	20	20

Preliminary Estimated Habitat Evolution for Pond 5 (acres)

Year*	**Present**	**0**	**5**	**10**	**20**	**30**	**40**	**50**
Subtidal	0	0	40	40	40	40	40	40
Intertidal Mudflat	0	0	700	700	690	690	690	690
Low Marsh	0	0	0	0	10	10	10	10
Mid Marsh	0	0	10	10	10	10	10	10
Managed Pond	740	740	0	0	0	0	0	0
Upland/Transition	20	20	10	10	10	10	10	10

* Years after breaching.
Note: Areas over ten acres rounded to the nearest 10 acres.

Project Tasks
Task 1: Project Management
GAIA Consulting, Inc. will be retained by the Conservancy to assist with the management of the project. The project managers will oversee work by other consultants, prepare required reports, make presentations, and report project progress to Conservancy staff and other participating agencies.

Task 2: Final Design for Tidal Restoration of Pond 3 and Water Control Structures for Ponds 4 and 5
Conceptual design of the water control structures was completed by Brown and Caldwell, Inc. Engineers with Ducks Unlimited, Inc. (DU), who have overseen the design and construction management of a water control structure on Pond 8 this year, and hydrologists and engineers with PWA who have developed a hydrologic model of the Napa Marsh and are analyzing salinity reduction alternatives and habitat restoration alternatives, will be retained by the Coastal Conservancy to develop preliminary (35%) design plans for the water control structures and tidal habitat restoration design features. The preliminary design effort in Pond 3 will consist of the following:

- Select exact locations of breaches, ditch blocks, levee lowering, and starter channels
- Select exact water control structure locations
- Prepare scaled plan view and elevation view drawings of restoration design features for Pond 3 and water control structures for Ponds 4 and 5
- Make detailed recommendations regarding construction materials and equipment to be used, and
- Review and update as necessary the sizing of features and facilities.

The preliminary engineering design effort will result in the production of 35% design drawings.

Task 3: Preparation of Construction Drawings (Plans and Specifications) for Restoration of Ponds 3 and Water Control Structures for Ponds 4 and 5
After the approval of the 35% engineering design, engineers with Ducks Unlimited and PWA will develop detailed plans and specifications for the project suitable to go out to bid. The engineers will prepare 65%, 95%, and Final design submittals.

Task 4: Permitting
Hydroscience, Inc. and GAIA Consulting, Inc. will be retained to prepare or assist with the following permit applications:

- NPDES Permit
- State Water Resources Control Board Appropriative Water Rights Permit
- Section 404 Permit

- BCDC Development Permit
- Section 7 Consultation

The project team has been working in close cooperation with the regulatory agencies, keeping the agencies informed of the status of the project, and incorporating suggestions made by the agencies.

Task 5: Construction of Tidal Restoration and Water Control Structures
After approval, the Plans and Specifications will be put out to bid by Ducks Unlimited. A contractor will be selected to construct the project and will be managed by Ducks Unlimited.

Task 6: Baseline, Construction-Phase and Post-Construction Monitoring of Water and Sediment Quality, Marsh Evolution, and Wildlife Data
Please refer to Appendix 1. Monitoring Plan for a detailed description of the monitoring program. Phase 1 of the NSMRP includes three years of post-construction monitoring. Subsequent monitoring will continue for at least of 10 years after each pond is breached. Biologists and hydrologists with the U.S. Geological Survey (USGS), and contractors as needed, will monitor the restoration project. The primary objectives of the monitoring are to evaluate: physical evolution of Pond 3 and the external slough channels, wildlife use of Ponds 3, 4, and 5 and fringing marsh, and water and sediment quality in the ponds and Napa River.

USGS has been monitoring six ponds of varying salinities (Ponds 1, 2, 2A, 3, 4, and 7) since 1999. This interdisciplinary study, involving biologists and hydrologists, has included avian, macroinvertebrate, and fish surveys, along with collection of salinity and other water quality data in the ponds and collection of hydrodynamic, salinity, and suspended sediment concentration data in the sloughs (Takekawa et al. 2001). The ongoing nature of this monitoring effort will allow for before and after comparisons. Comparisons will also be made to other restoration projects in the North Bay that are currently being monitored (such as Guadalcanal, Tolay Creek, and Pond 2A), and to the fringing marsh that exists along the slough channels within the salt pond complex. Monitoring will be coordinated with the Regional Monitoring Program and will be shared widely in order to better plan tidal restoration projects throughout the San Francisco Bay estuary.

4. Feasibility

The project is feasible from an economic, engineering, political, legal, environmental, and regulatory standpoint. The project has widespread support among the public, environmental and scientific communities, and regulators. The project is currently midway through its implementation (land has been purchased, and the EIR/EIS/FS are underway). The only barrier to continued project implementation is the availability of funding for future phases. This CALFED application addresses the funding constraint.

a) Engineering and Economic Feasibility

Modeling and conceptual engineering design have demonstrated that conducting salinity reduction and achieving habitat restoration is feasible within the constraints posed by the site. Project phasing considers the relative feasibility of restoring each component of the project.

b) Regulatory and Environmental Feasibility

As noted earlier, the EIS/R is in progress. Except for the potential project-related noise during construction, all impacts associated with action alternatives can be mitigated to less than significant levels. Discussions with key regulatory agencies (RWQCB, USFWS, and NFMS) indicate that the agencies fully support the project, and will assist in obtaining needed permits/certifications. The proposed project complies with all applicable laws and regulations.

c) Political Feasibility

Land has been acquired, and there is extensive local, regional, and national government support.

5. Performance Measures

Performance of the project will be measured through the data collection and analysis program described above in Task 6 and in greater detail in Appendix 1. Monitoring Plan. Water quality, habitat evolution, and wildlife data will be collected before and after project implementation. Using sound scientific methods, data will be presented in the monitoring report that will provide a quantitative and qualitative measure of project performance.

The project will be considered successful if the following structural and functional indicators are achieved:

Structural Indicators

- Tidal habitats in Pond 3 will evolve as predicted:
  - Historic slough channels will reestablish:
    - Starter channels will promote reestablishment of historic slough channels, and
    - Borrow ditch blocks will inhibit existing borro ditches from capturing the tidal prism and will promote reestablishment of historic slough channels.
  - Bed elevations will rise and marsh vegetation will recolonize:
    - Berms will promote colonization of marsh vegetation and will disrupt wind-wave action, promoting higher rates of sedimentation,
    - Levee lowering will promote colonization of high marsh vegetation,
    - Natural sedimentation will raise elevations and low, middle, and high marsh vegetation will colonize as elevations increase, and
    - Pond 3 will evolve from 1,250 acres of intertidal mudflat at the time of breaching to approximately 1,140 acres of mid-marsh habitat with small amounts of associated low marsh, intertidal mudflat and subtidal habitat by year 50.
- Salinity levels in Ponds 4 and 5 drop from the current 300+ ppt to ambient (Napa River) salinities in 12 to 18 months and DFG will be able to effectively manage salinities and depths of Ponds 4 and 5 using the new water control structures, and
- Ponds 4 and 5 will be reduced to salinities enabling breaching and restoration to tidal habitats.

Functional Indicators

- Pond 3 will support marsh-dependent fish, wildlife, and plants in similar proportions to reference sites consisting of historic marshes and restored marshes:
  - At-risk birds and mammals, particularly the California clapper rail, black rail, San Pablo Song Sparrow, and salt marsh harvest mouse, will be found in Pond 3 by year 5 and will have self-sustaining populations by year 25,
  - Anadromous and resident at-risk fish, particularly delta smelt, Sacramento splittail, chinook salmon, and steelhead trout, will be found in Pond 3 by year 5, and
  - the abundance of key prey species (such as certain planktonic, benthic, and pelagic species) will increase.
- Ponds 4 and 5 will support wildlife as they historically did:
  - Historic numbers of migratory waterfowl and shorebirds will use the ponds for feeding and resting, and
  - Invertebrates and fish will survive and reproduce in the ponds, providing food for migratory birds.

6. Data Handling and Storage

Baseline and post-project data, collected by the U.S. Geological Survey and others, will be primarily handled and stored by USGS. Electronic and hard copies of the data will be provided to the Conservancy and DFG for their files. Monitoring results will be made accessible on USGS's web site (http://sfbay.wr.usgs.gov/access/saltponds/index.html), and on the Napa-Sonoma Marsh Restoration web site, (http://www.Napa-Sonoma-Marsh.org).

7. Expected Products/Outcomes

The end result of the CALFED-funded project will be the successful construction of tidal habitat restoration in Pond 3 and salinity reduction in Ponds 4 and 5, in preparation for restoration to tidal habitats there. A series of work products will lead up to this end result, including the following:

1. Final Feasibility Report
2. Final Engineering and Design Report
3. Plans and Specifications (bid documents)
4. Permit Applications (and supporting technical documentation)
5. Monitoring Reports

Information will be shared at the Napa Sonoma Marsh Restoration Group meetings (see Section E, below), local and national conferences, such as the State of the Estuary Conference, and through newsletter articles and peer-reviewed journal articles. Knowledge gained will provide invaluable information to other restorations of diked baylands, particularly the South Bay Salt Pond restoration.

8. Work Schedule

Task	**Start Date**	**End Date**
Restoration Feasibility Study (Corps)*	January, 1998	December, 2002
Napa-Sonoma Marsh EIR/EIS (JSA)*	August, 2001	Spring, 2003
Collection of Baseline Data (USGS)	September, 2002	September, 2004
Preliminary Engineering Design (PWA and DU)	Spring, 2003	Fall, 2003
Permitting (Hydroscience and GAIA)	January, 2003	January, 2004
Plans and Specifications (DU)	Fall, 2003	Spring, 2004
Construction Bids	Spring, 2004	Spring, 2004
Construction (Contractor)	Summer, 2004	Fall, 2004
Post-Project Monitoring (USGS)	September, 2004	September, 2006
Long-Term Post-Project Monitoring (USGS)*	October, 2006	September, 2014

* these tasks are not part of the funding request from CALFED

B. APPLICABILITY TO CALFED ERP AND SCIENCE GOALS AND IMPLEMENTATION PLAN AND CVPIA PRIORITIES

1. ERP, Science Program and CVPIA Priorities

As described above in Section 2, Justification, the project is clearly consistent with the ERP, Science Program, and CVPIA Priorities. Specifically, the project is consistent with the following ERP priorities:

Multi-Regional Bay Delta Areas:

- Priority 5 - Ensure that restoration is not threatened by degraded environmental water quality (the project is aimed at improving water quality in former salt ponds prior to an unintentional high-saline spill).
- Priority 6 - Ensure recovery of at-risk species…. (the project will benefit a number of special status species, including anadromous and resident fish, waterbirds, mammals. The project also has a rigorous data collection and monitoring component that will add to our understanding of restoring former salt ponds).

Bay Region:

- Priority 1 – Restore wetlands in critical areas…. (the project will restore thousands of acres of wetlands).

- Priority 4 – Understand performance of wetlands restoration… (the project also has a rigorous data collection and monitoring component that will add to our understanding of restoring former salt ponds).
- Priority 5 – Restore shallow water, local stream, and riparian habitats for the benefit of at-risk species (the project will create thousands of acres of valuable shallow water habitat that will be utilized by at-risk species).
- Priority 7 – Improve scientific understanding of the linkages between populations of at-risk species and inflows… (the data collected and analyzed by USGS will add to the understanding of the relationship between water quality and habitat value.)
- Priority 8 – Use monitoring, evaluations of existing monitoring data, and new investigations to develop new strategies for restoring Bay fish populations… (the project includes a rigorous monitoring program developed by USGS that will be used in conjunction with an adaptive management program implemented by DFG to benefit fisheries).

2. Relationship to Other Ecosystem Restoration Projects

Nearby acquisitions and potential restoration projects include: the U.S. Fish and Wildlife acquisition of the 1,400-acre Cullinan Ranch, the potential future transfer of Skagg's Island to the U.S. Fish and Wildlife Service, and the proposed Sonoma Creek Flood Control project. There are also several smaller projects in the site vicinity, including DFG's acquisition of 62 acres along Huichica Creek, and several projects east of the Napa River. Transfer of the 1,400 acres of crystallizer ponds on the east side of Napa River is proposed as part of the upcoming South Bay salt pond acquisition by the State and federal government. Coordination is necessary between Cullinan Ranch, Skagg's Island, and Sonoma Creek Flood Control projects, and the NSMRP as each project will affect the tidal prism and sediment budget in the North Bay. Restoration of the Napa Marsh will also serve as a model for restoration of the South Bay Salt Ponds, if they are acquired by the federal government.

3. Requests for Next-Phase Funding

No previous Calfed funding has been received for this project.

4. Previous Recipients of CALFED Program or CVPIA Funding

The Coastal Conservancy has applied for and obtained Calfed funding for two previous projects: 1) Introduced Spartina Eradication Project (Project # 11332-0-J001, and 2) Hamilton Wetland Restoration Project (Project # B81642).

5. System-Wide Ecosystem Benefits

The Napa-Sonoma Marsh Restoration Project will result in system-wide ecosystem benefits for the Bay, as recommended in the *Goals Report*. The project will restore a large area of tidal marsh and associated tidal habitats that support a wide variety of fish, wildlife and plants, including special status mammals and water birds, specifically the salt marsh harvest mouse, California clapper rail, and black rail. Endangered fish, specifically Delta smelt, Sacramento splittail, Central Coast steelhead trout, and Chinook salmon, and other fish species will benefit from the project due to the creation of food production and rearing areas. Aquatic animals, including the Dungeness Crab and other benthic and planktonic invertebrates, will benefit from the project.

The project will restore one of the last available tidal marsh areas along the lower Napa River, providing a significant natural setting for habitat management and protection. Experience gained in restoring Pond 3 and desalinating Ponds 4 and 5 can be utilized in the restoration of other ponds in the Napa River Unit, in the South Bay, and on the east side of the Napa River.

C. Qualifications

California State Coastal Conservancy
The Conservancy was created by the State Legislature in 1976 to protect, restore, and enhance coastal resources. The Conservancy has a staff of 63, who, from 1999 to 2001, managed a budget of over $398 million, of which $230 million has already been put to work on over 300 projects along the coast of California and in the nine-county Bay Area. The Conservancy has taken the lead in developing innovative approaches to wetlands restoration throughout the state, such as Sonoma Baylands, Hamilton Airfield, and Arcata Marsh, and has acted quickly to seize unique opportunities to obtain and protect significant resource lands, including Cullinan Ranch and the Napa Salt Ponds.

The Conservancy's team includes Nadine Hitchcock, Program Manager; Amy Hutzel, Project Manager; Sam Schuchat, Executive Officer; and the support of the legal, accounting, contracts, and clerical staff of the Conservancy. Nadine Hitchcock, Program Manager for the San Francisco Bay Conservancy Program, will oversee the Conservancy's role in this project, including project management, interagency coordination, environmental compliance, facilitation of public and non-profit organization forums, and consultant and contractor selection and oversight. Ms. Hitchcock has over 17 years experience managing projects with the Conservancy, and 5 previous years experience with the Coastal Commission. Along with overall management of the Bay Program, she has managed or supervised several large-scale projects, including the Napa River Flood Control Project, the San Francisco Bay Joint Venture, the Introduced Spartina Project, and the Regional Wetlands Monitoring Plan.

California Department of Fish and Game
DFG manages 106 state wildlife areas composed of more than 631,000 acres. The state acquired these wildlife areas to protect and enhance habitat for wildlife species, and to provide the public with wildlife-related recreational uses. These lands provide habitat for a wide array of plant and animal species, including many listed as threatened or endangered. The Napa-Sonoma Marshes State Wildlife Area consists of 13,000 acres of former commercial salt ponds, tidal marshes, uplands, and seasonal wetlands. DFG's team includes Larry Wyckoff, Associate Wildlife Biologist for the Napa-Sonoma Marshes State Wildlife Area; Jim Swanson, Regional Director for DFG Region 3, and Tom Huffman, Fish and Wildlife Assistant. Mr. Wyckoff, who has been with DFG for 14 years, will assist with project management and implementation. Mr. Huffman, who has been responsible for hands-on management of the Napa ponds since they were acquired in 1994, will serve as field contact for construction activities and will assist with monitoring.

U.S. Geological Survey
The following individuals from the USGS will lead the monitoring effort for the project:

<u>Dr. John Y. Takekawa</u>**.** Dr. Takekawa has been a federal research biologist in California for 15 years. His research specialty is the ecology of migratory waterbirds, with a technical specialty in application of radio telemetry. His studies have focused on the Pacific Rim, California, and San Francisco Bay. He established the San Francisco Bay Estuary Field Station of the USGS located on San Pablo Bay in 1995. Dr. Takekawa holds a PhD from Iowa State University, Ames, Iowa (Animal Ecology/Statistics minor, 1987), an MS from the University of Idaho, Moscow, Idaho (Wildlife Resources, 1982) and a BS from the University of Washington, Seattle, Washington (Wildlife Science/Forestry, 1979).

<u>Dr. Keith Miles</u>**.** Dr. Miles' primary focus of research is on the effects of contaminants on estuarine and marine habitats, particularly federal trust species. The emphasis of his research is on determining the consequences of accumulation of contaminants, discriminating effects caused by contaminants from naturally occurring changes in wildlife populations, effects of contaminants on the structure of invertebrate and vegetative assemblages, and the potential for accumulation of these contaminants among specific prey guilds of migratory waterbirds and marine mammals. His research has examined the habitats at Chesapeake Bay, San Francisco Bay, and the Arctic environment. Dr. Miles hold a PhD from Oregon State University (Wildlife Ecology, 1987), an MS from Oregon State University (Wildlife Biology, 1976) and a BS from Howard University (Zoology, 1972).

In addition, Mike Saiki, USGS fisheries biologist, and Dr. David Schoellhamer, USGS hydrologist, will provide assistance with fisheries data collection and hydrologic monitoring.

Ducks Unlimited
The following individuals from DU will provide design and engineering support for the project:

Dr. J. Jasper Lament. Dr. Lament is DU's primary tidal wetland biologist for the California coast, where he is managing wetlands restoration projects in San Francisco, San Diego, and Monterey Bays. Within the San Francisco Estuary, Dr. Lament is responsible for restoration projects in San Pablo Bay and Suisun Marsh. He has extensive training and experience in the biology of fish, waterbirds, and wetlands. He was educated at the University of Miami (Florida) and Queen's University (Canada), earning a Ph.D. in Biology and a Bachelor of Science (Honors) in Biology and Geography.

Steven Edward Carroll, P.E. Mr. Carroll has design and construction management responsibility for DU's restoration projects in California. He has been directly responsible for the engineering design and construction of over 10,000 acres of seasonal and tidal wetland restoration and enhancement projects. Mr. Carroll has been responsible for the design and construction of several screened intakes. Prior to joining Ducks Unlimited, Inc. Mr. Carroll assisted in the preparation of feasibility reports for constructing fish screens on the Sacramento and San Joaquin Rivers. Mr. Carroll has participated in the biological analysis of fish barriers on the Sacramento River system. Projects included an evaluation of an acoustic barrier at Georgiana Slough, and the Glen-Colusa Irrigation District fish screen and bypass at Hamilton City. While at California Department of Water Resources, Mr. Carroll participated in a study to determine the population, migration times and spawning habitat for the Sacramento splittail.

Philip Williams and Associates, Inc.,
PWA was started in 1979. Dr. Williams has been engaged in a wide range of national and international hydrologic and engineering hydraulics work since he received his Ph.D. in 1970 from the University of London. Dr. Williams has pioneered practical technical analyses in wetland hydrology, multiobjective river corridor management, lake water balances, the impacts of climate change, the hydraulics of coastal lagoons, and estuarine management. The work of PWA has addressed a wide variety of problems, including flood management, salt marsh restoration, reservoir operation, harbor maintenance dredging, riparian management, watershed sediment yield, groundwater management, and coastal lagoon restoration. The majority of work has involved assessment of the environmental effects of hydrologic change, often working with professionals of other disciplines to prepare feasibility studies, management plans, and environmental impact studies.

GAIA Consulting Inc.
GAIA is a small, woman-owned, SBA 8(a)-certified environmental consulting company. Since its inception in 1993, GAIA has completed numerous environmental projects throughout the Bay Area. Their work has focused on project management of complex, often controversial, multi-stakeholder projects. Their work has included extensive environmental documentation pertaining to base closures, preparing the engineering Feasibility Study and part of the EIS/R for the Port of Oakland 50-foot Channel Deepening Project, and managing the permitting and other environmental aspects of the Port of Oakland's maintenance dredging program.

Hydroscience Engineers, Inc.
HydroScience Engineers (HSe) specializes in the planning, permitting, design, and construction management of complex water resources projects. HSe provides engineering services for water, wastewater, and recycled water projects. They have designed and permitted a wide range of water and wastewater collection, treatment, distribution, and disposal systems for private and public agency clients throughout California. HSe has particular expertise in permitting and designing advanced membrane wastewater treatment plants for discharge to impaired waterways in the State. In addition, HSe also has expertise in permitting and designing constructed wetlands projects for recycled water and wetlands restoration projects.

D. Cost

1. Budget: See Forms VI and VII

2. Cost Sharing

The overall project has been underway for a number of years. The Cargill salt ponds were purchased by the state for $10 million in 1994. A feasibility study for the overall project is underway, as is the CEQA/NEPA documentation for the project. Contributions to fund these tasks have been made as follows:

- State Coastal Conservancy: $1,424,682
- CA Department of Fish and Game: $561,710
- U.S. Army Corps of Engineers: ca. $1,000,000

In addition, other agencies and organizations, such as U.S. Geological Survey and Ducks Unlimited, have contributed significant funds and staff time towards relevant work in the Napa Marsh.

Implementation (final design, construction, monitoring, and operations and maintenance during construction) of the entire Napa-Sonoma Marsh Restoration Project is expected to cost approximately $70 to $80 million. The total cost will be cost-shared 65% federal and 35% non-federal, with the land value added to total costs and counted as part of the non-federal share. The Water Resources Development Act of 2002 may include a clause that allows work on Napa Marsh conducted by the non-federal sponsors prior to beginning the Corps implementation to count as part of the non-federal cost share, as requested by Congressmen Mike Thompson, Lynne Woolsey, George Miller, and Ellen Tauscher in a letter to the Chair and Ranking Member of the House WRDA subcommittee. This clause is in the current House version of WRDA. Non-federal funds, such as those provided by CALFED, to conduct Phase 1 would then be able to be used towards the cost-share for the overall project. The Corps is working towards recommending this project for authorization in the Water Resources Development Act of 2004.

E. Local Involvement

Local agencies provide input on the project via the Napa-Sonoma Marsh Restoration Group (NSMRG). The NSMRG provides a forum for discussion of the NSMRP and other restoration projects in the Napa-Sonoma Marshes, and includes agency representatives, non-profit conservation organizations, and private entities, including the U.S. Army Corps of Engineers (San Francisco District), San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Geological Survey, San Francisco Estuary Institute, U.C. Davis, Cargill, Inc., Ducks Unlimited, Point Reyes Bird Observatory, The Bay Institute, Save The Bay, National Audubon Society, Southern Sonoma County Resource Conservation District, Napa County Resource Conservation District. Throughout the feasibility study, engineering, construction, and monitoring, the NSMRG meets on a regular basis to provide feedback, avoid replication of work, and identify issues requiring further study.

F. Compliance with Standard Terms and Conditions

The Coastal Conservancy is agreeable to, and able to comply with, terms and conditions included in Attachment D, the Terms and Conditions for State Funds, except as follows: (1) the Conservancy would revise or exclude Paragraph 11 in the “Attachment D Terms and Conditions for State Funds”, requiring it to indemnify, defend and save harmless the State because the Conservancy is itself an agency of the State. (2) The Conservancy would exclude Paragraph 12 in the “Attachment D Terms and Conditions for State Funds”, because agents and employees of the Conservancy are, in fact, officers and employees or agents of the State of California.

G. Literature Cited

See Relevant Past Studies in Section A and Literature Cited in Appendix 1: Monitoring Plan.

FIGURES

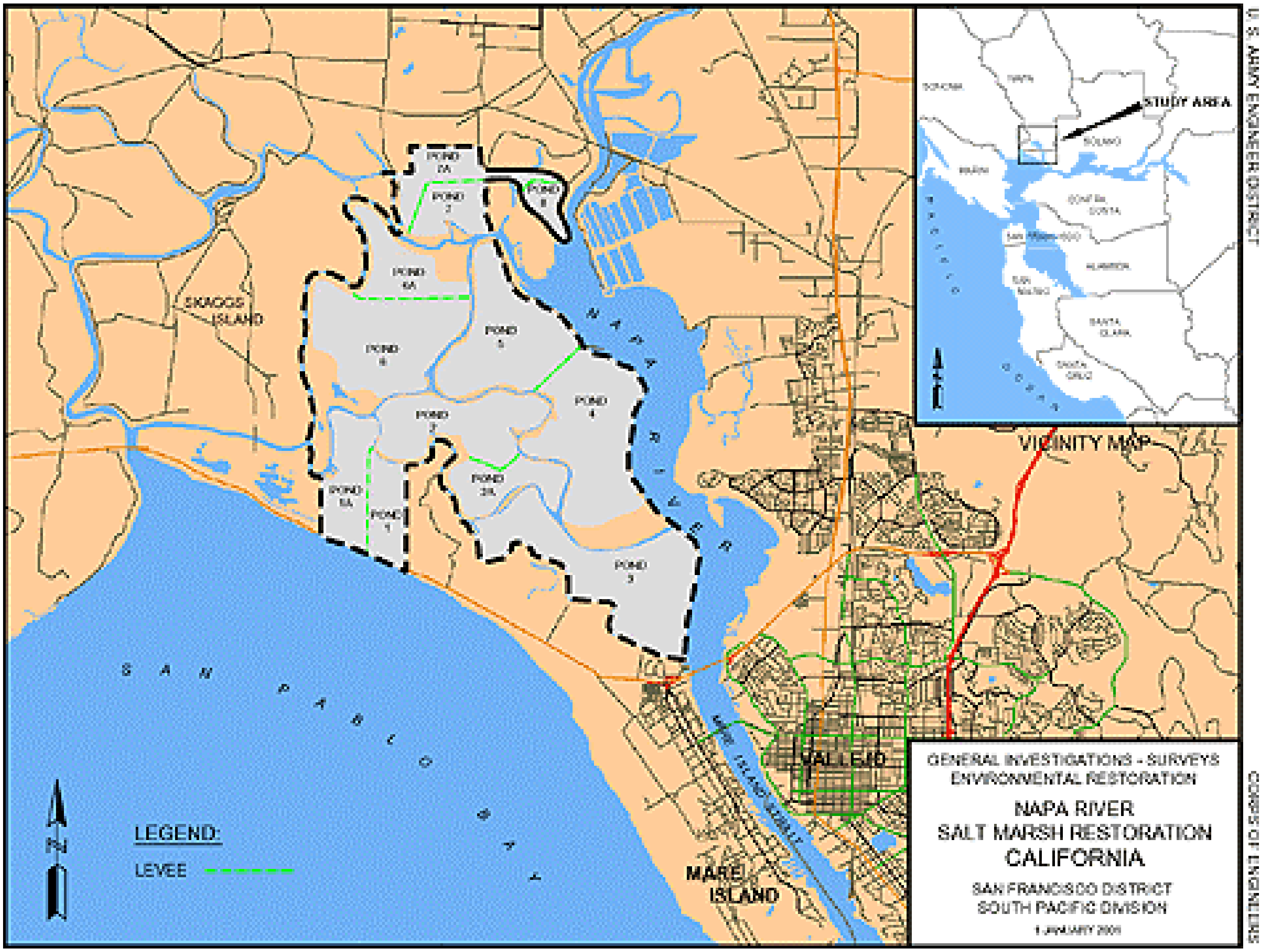


FIGURE 1
Site Location Map

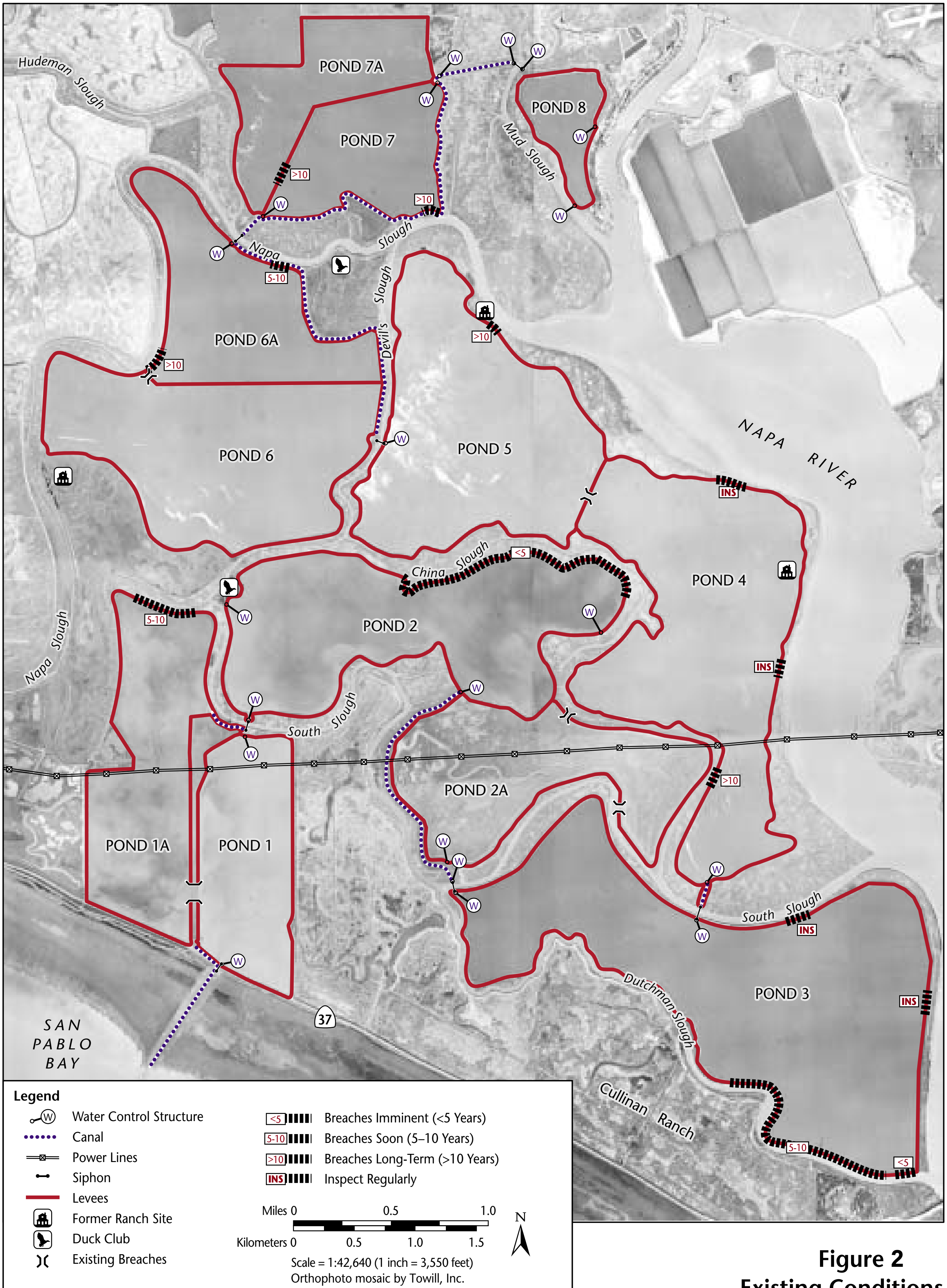
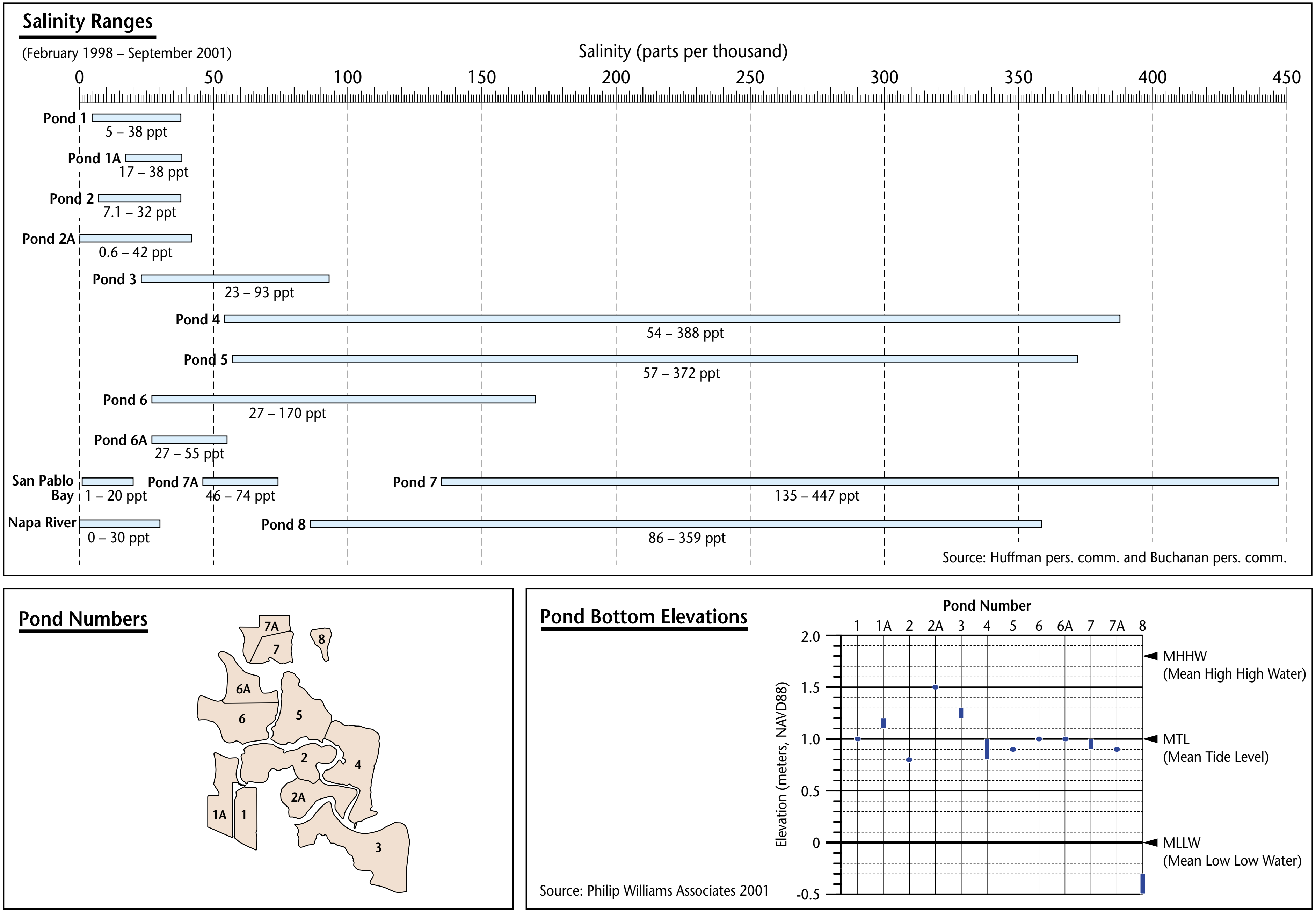


Figure 2
Existing Conditions

01396.01-002

Jones & Stokes



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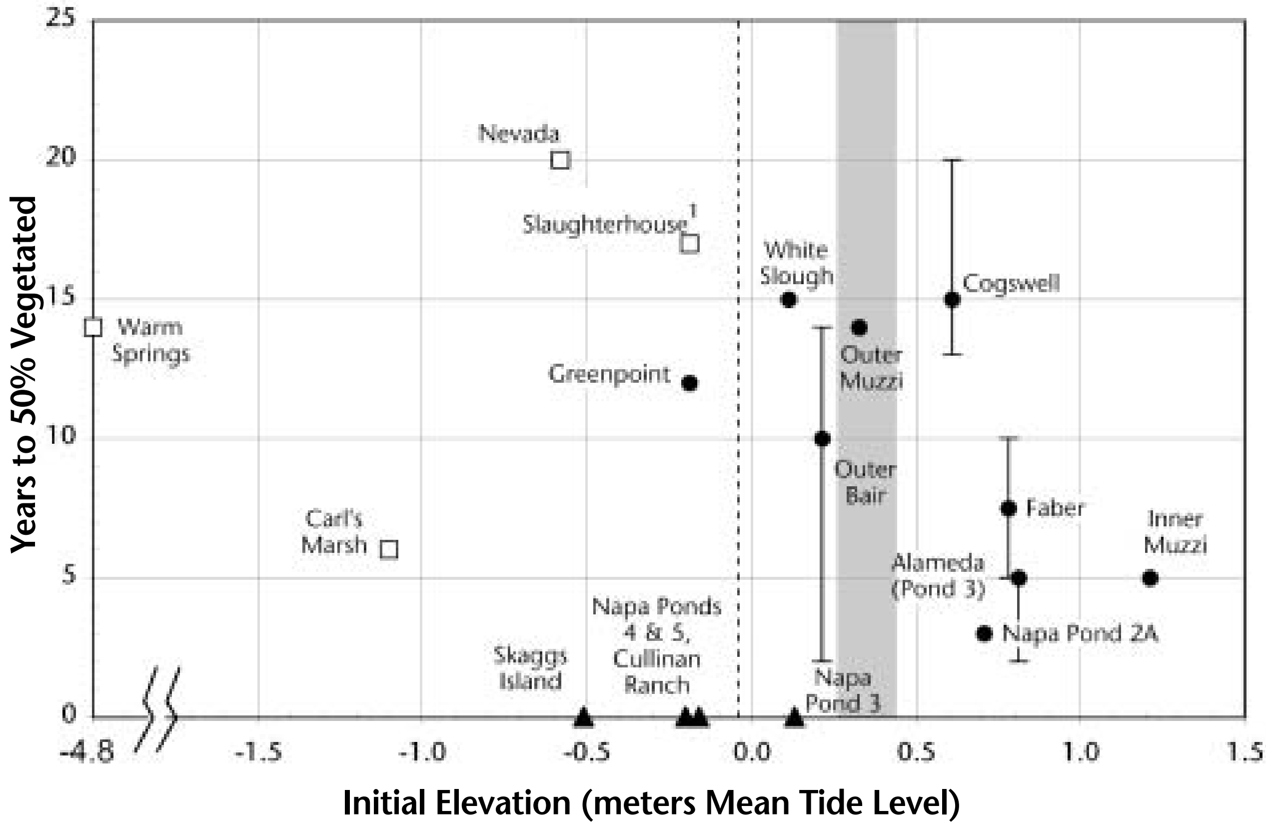
Jones & Stokes

Figure 3
Salinity Ranges and Pond Elevations



● Age when 50% vegetated

□ Current age if not vegetated (as of Year 2000)

▲ Planned Napa River Salt Marsh restorations

Notes:

Shaded bar identifies the approximate *Spartina foliosa* colonization elevation. Dashed vertical line indicates the minimum elevation for the lateral colonization of bulrush. Error bars represent the range of uncertainty based on the data available to bracket the timeframe. Mean Tide Level elevations are approximate.

[1] Damped tides for many years has slowed site evolution at the Slaughterhouse site.

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Source: Philip Williams and Associates 2002.

Jones & Stokes

Figure 4

Initial Elevations and Years to Vegetation Establishment

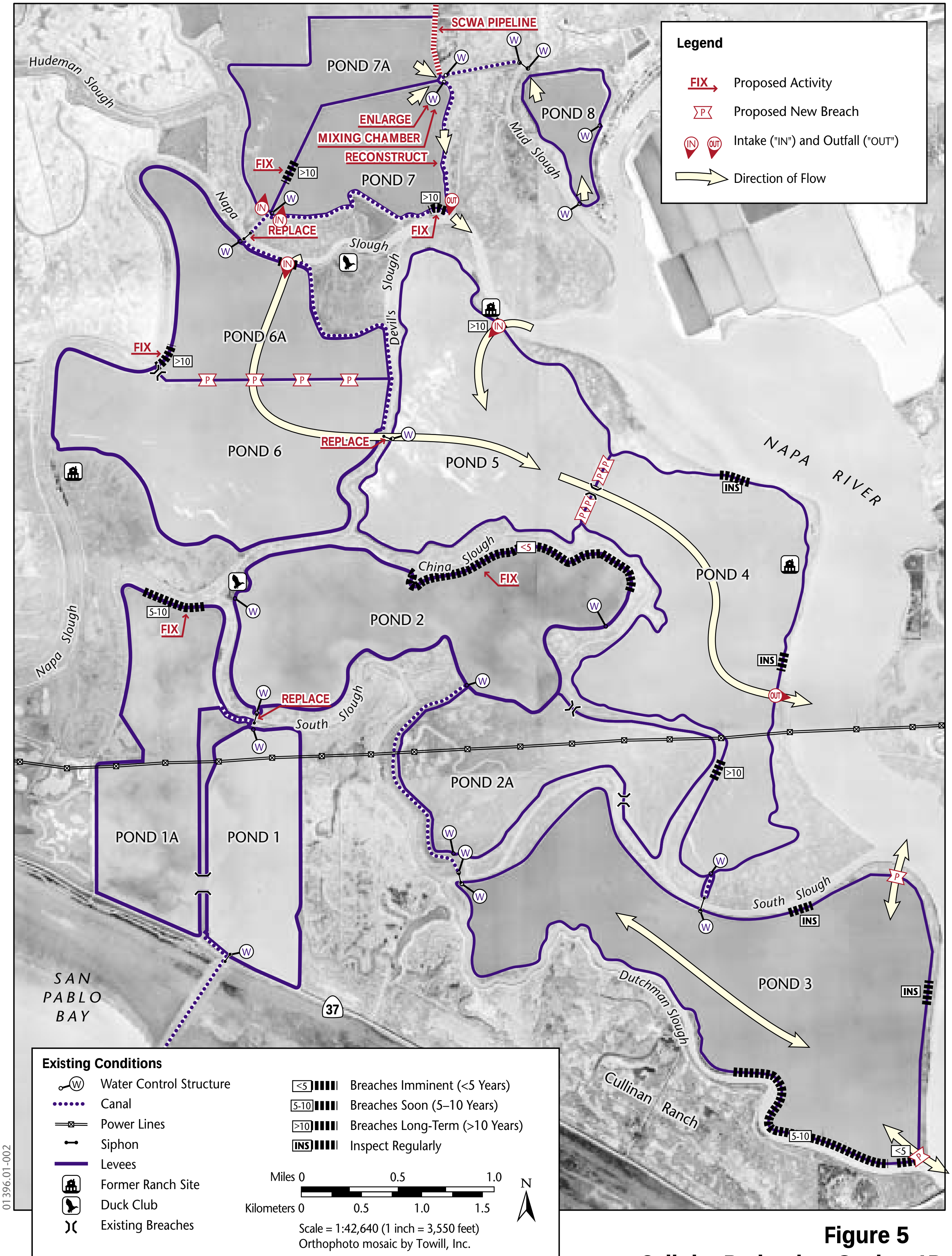
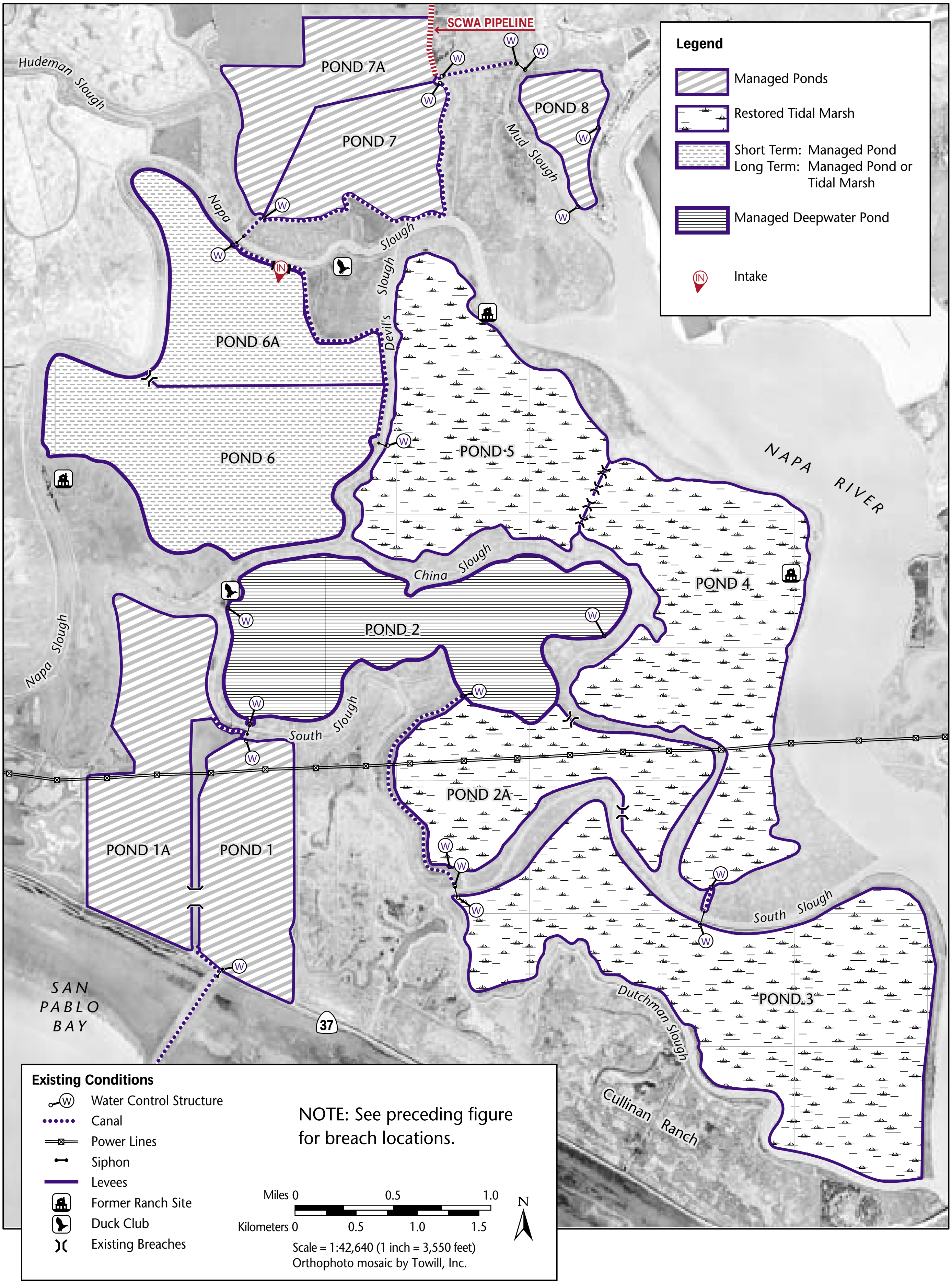


Figure 5
Salinity Reduction Option 1B:
Napa River and Napa Slough Discharge
and Breach of Pond 3

Jones & Stokes



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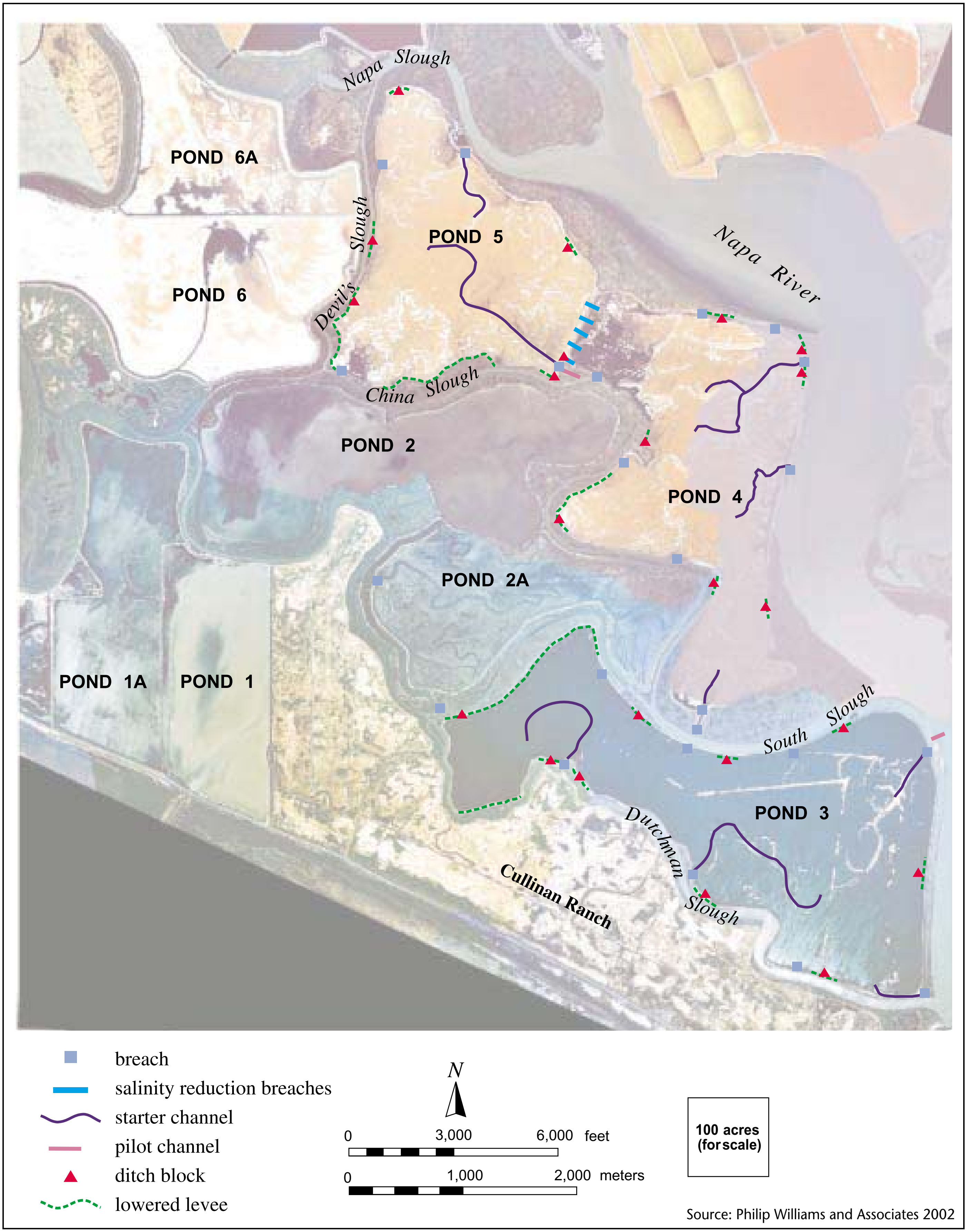
Jones & Stokes

Figure 6
Habitat Goals for Habitat Restoration Option 1:
Mix of Managed Ponds and Tidal Marsh



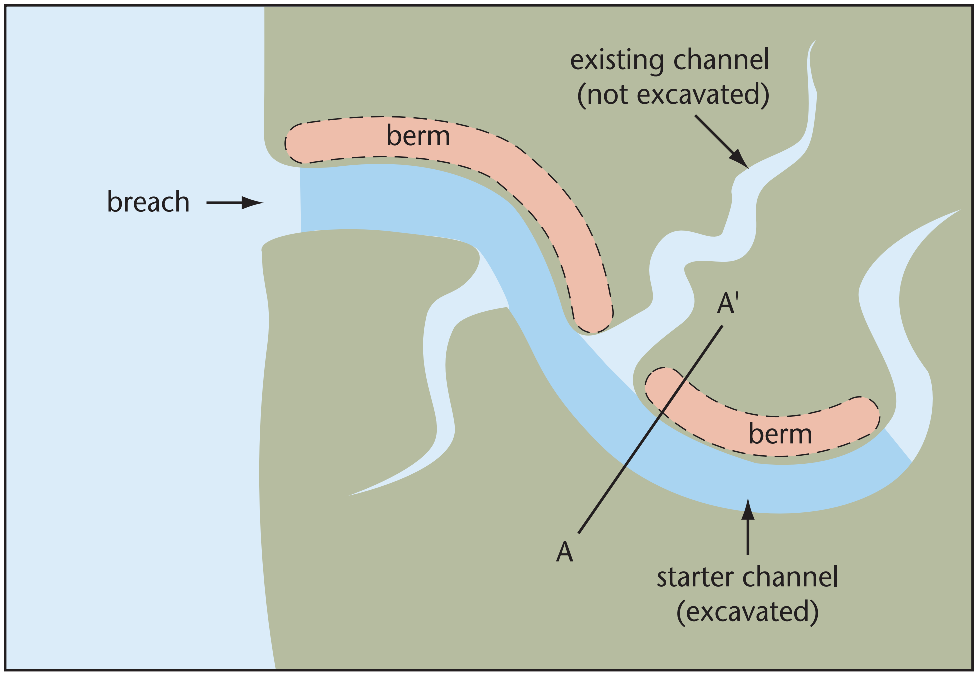
Source: Philip Williams and Associates 2002

001396.01

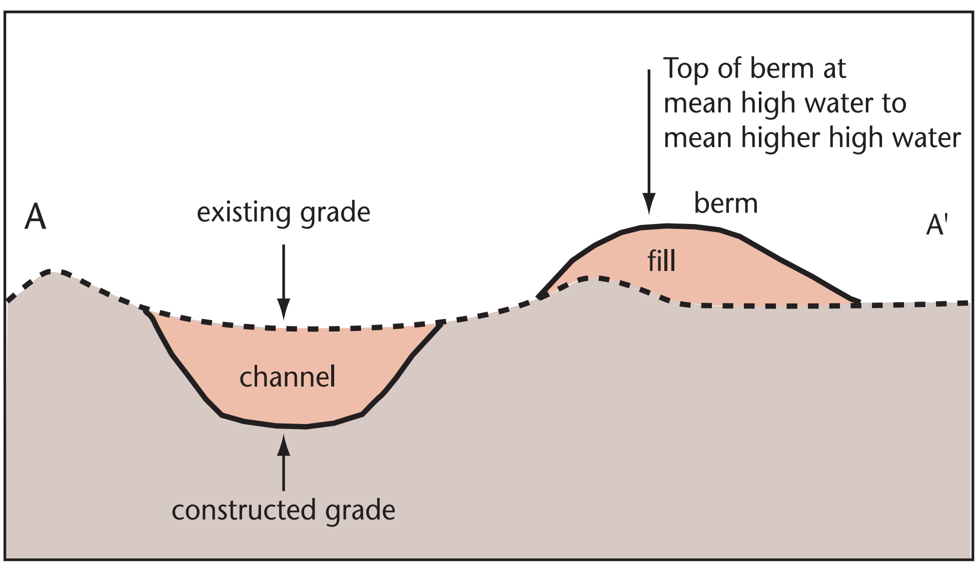
Jones & Stokes

Figure 7
Habitat Restoration Features for Habitat Restoration Option 1

Plan View Layout



Elevation View

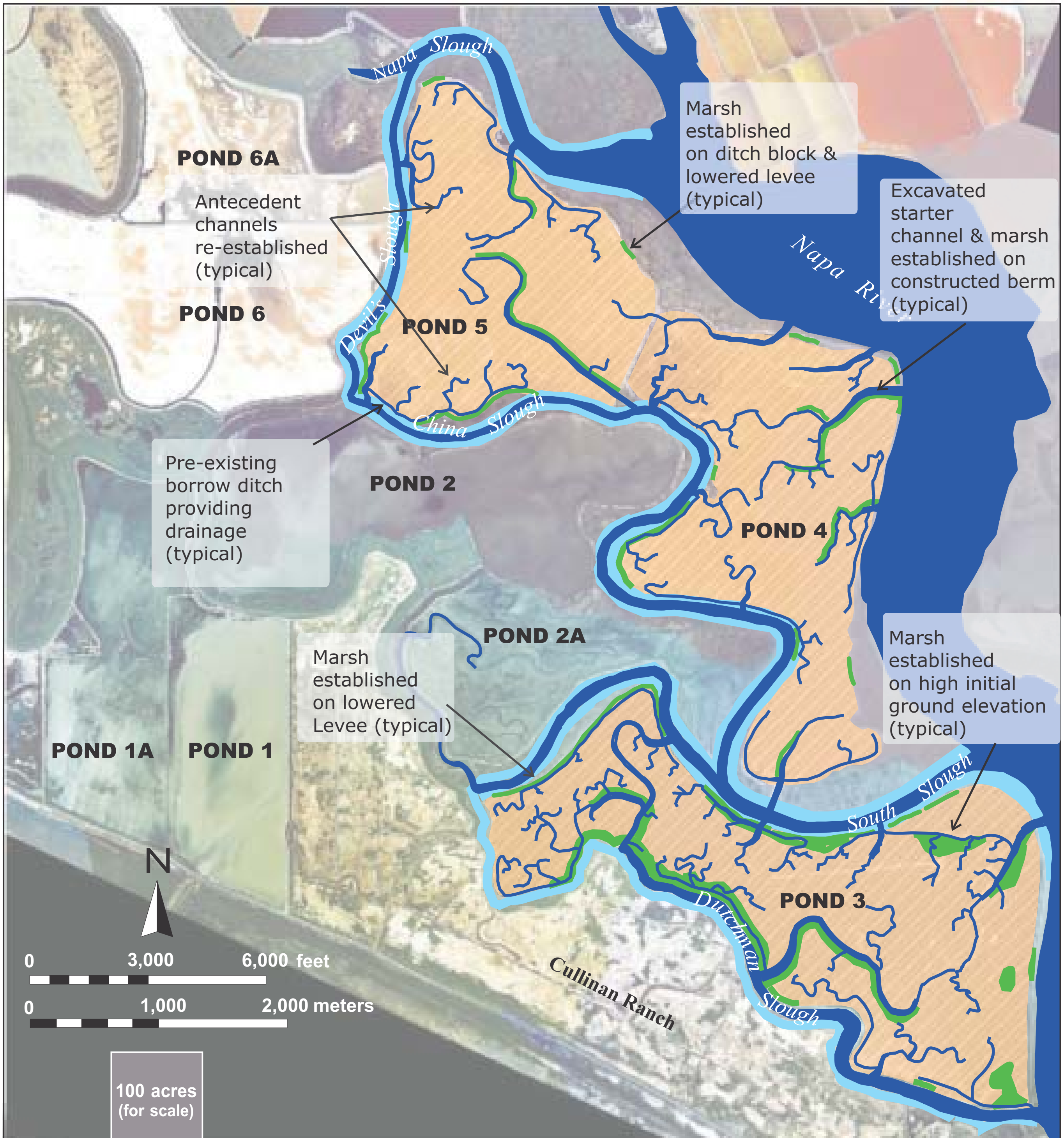


Source: Philip Williams and Associates 2002.

01396.01-002

Jones & Stokes

Figure 8
Schematic of Starter Channel and Berm



vegetated marsh

channel

intertidal mudflat

generalized areas of fringing marsh erosion (schematic)

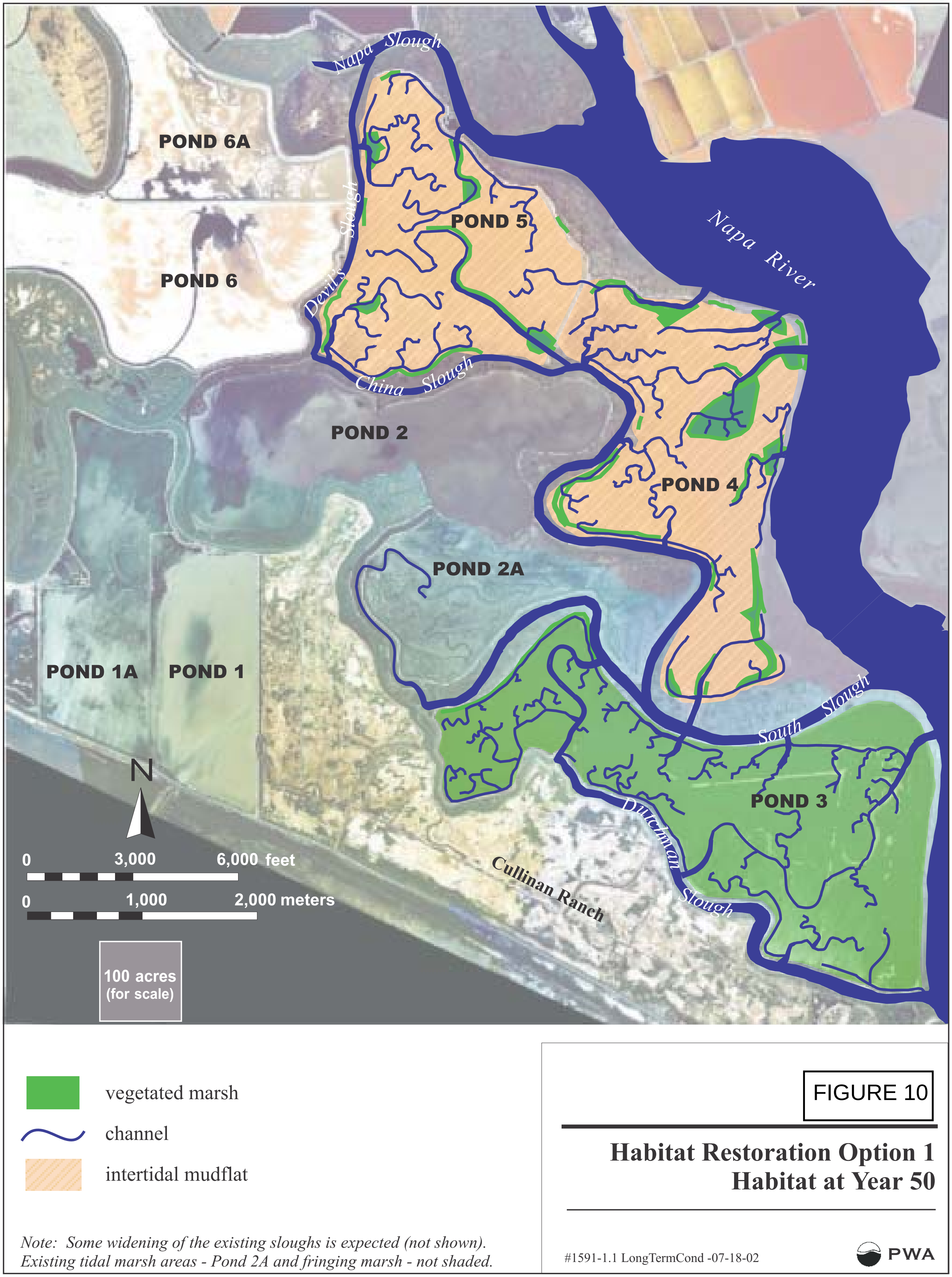
Note: A small area of fringing marsh erosion is expected on the east side of the Napa River across from South Slough (not shown). Existing tidal marsh areas - Pond 2A and the fringe marsh - not shaded.

FIGURE 9

Habitat Restoration Option 1
Habitat at Year 5

Projects/ 1591-report Fig5-10_July25-02

PWA



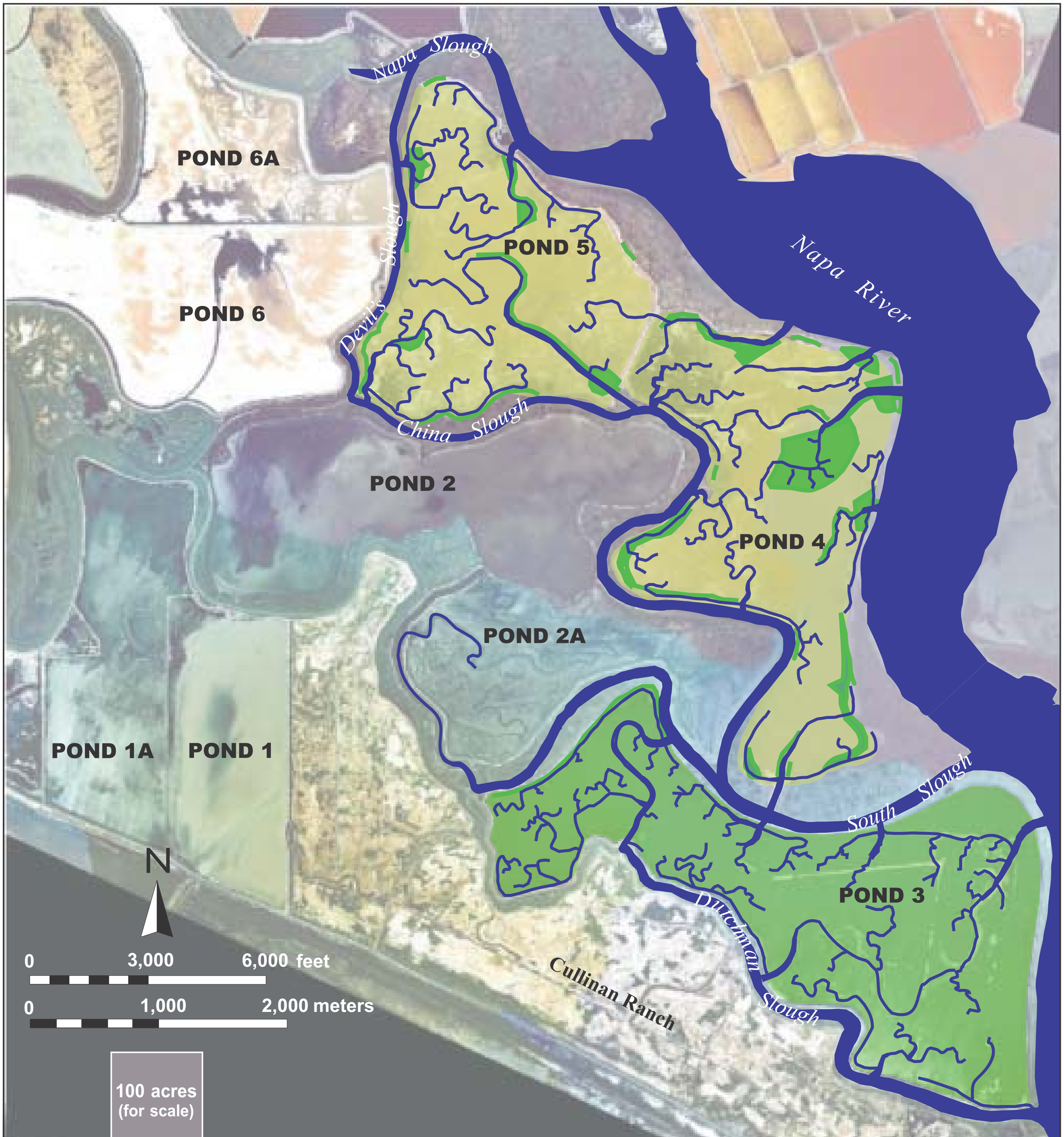
Note: Some widening of the existing sloughs is expected (not shown).
Existing tidal marsh areas - Pond 2A and fringing marsh - not shaded.

FIGURE 10

Habitat Restoration Option 1
Habitat at Year 50

#1591-1.1 LongTermCond -07-18-02

PWA



vegetated marsh

channel

tidal wetland: mosaic of vegetated marsh and intertidal mudflat

Note: Some widening of the existing sloughs is expected (not shown). Existing tidal marsh areas - Pond 2A and fringing marsh - not shaded.

FIGURE 11

Habitat Restoration Option 1
Generalized Long Term Habitat

#1591-1.1 Fig5-12final -07-22-02

PWA

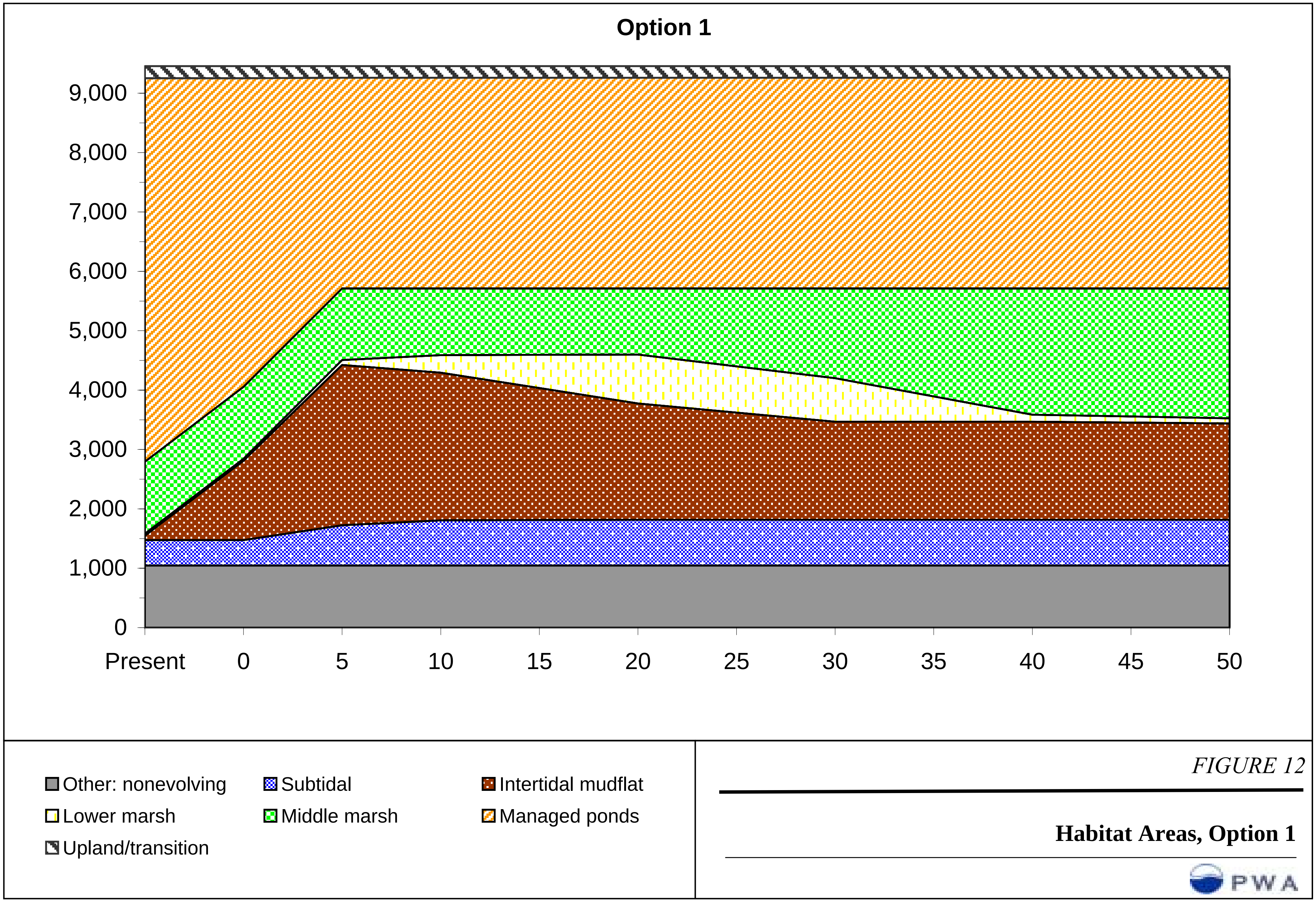


FIGURE 12

Habitat Areas, Option 1

PWA

APPENDICES

APPENDIX 1
MONITORING PLAN

Salinity Reduction Monitoring: Water and Sediment Quality

Water and sediment samples from 40 sites within the pond complex, along with sites in the Napa River, Napa Slough, and San Pablo Bay were collected in October 2001 by HydroScience Engineers after development of the *Sampling and Analysis Plan and Quality Assurance Project Plan*, which was approved by the San Francisco Bay RWQCB (HydroScience Engineers 2001). Samples were analyzed by MEC Analytical Systems, Inc., for volatile and semivolatile organics, pesticides, polychlorinated biphenyls (PCBs), heavy metals, dioxins, and general water quality parameters, including nutrients, total dissolved solids (TDS), total suspended solids (TSS), pH, temperature, salinity, and dissolved oxygen (DO).

A similar comprehensive water quality monitoring program would be prepared and implemented for the duration of the salinity reduction process. The monitoring would have well-defined data quality objectives, monitoring procedures, and data analysis and reporting protocols to ensure that project operations are controlled according to waste discharge requirements (WDRs) or the requirements of any National Pollutant Discharge Elimination System (NPDES) permit issued by the San Francisco Bay RWQCB. Monitoring at specific locations would be completed and phased out as each successive pond is restored and salinity has been reduced to ambient levels.

The discharge monitoring would include continuous recording devices for key parameters and periodic grab samples for specific constituents of concern. Measurement of key continuous monitoring variables (flow, water level stage, salinity, temperature, and TSS/turbidity) would be implemented at several pond and receiving water locations to provide for real-time management of the intakes and discharges and ensure that changes in water quality would be within the acceptable range specified in the WDRs or NPDES permit requirements. Grab samples would be used to characterize long-term changes in other constituents of concern that might be identified by the resource agencies; these constituents could include dissolved oxygen, pH, or selected inorganic ions and trace metals. Aquatic toxicity tests would also be conducted on a periodic basis.

Habitat Restoration Monitoring

USGS biologists and hydrologists, along with contractors as needed, would monitor the Napa River Salt Marsh Restoration Project. The primary objectives of the monitoring are to evaluate changes in wildlife use of restored tidal habitats, ponds, and fringing marsh and physical evolution of restored tidal habitats and the external slough channels. Monitoring would occur during salinity reduction of each pond and continue for a total of 10 years after each pond is breached.

USGS has been monitoring six ponds of varying salinities (Ponds 1, 2, 2A, 3, 4, and 7) since 1999. This interdisciplinary study, involving biologists and hydrologists, has included avian, macroinvertebrate, and fish surveys, along with collection of salinity and other water quality data in the ponds and collection of hydrodynamic, salinity, and suspended sediment concentration data in the sloughs. (Takekawa et al. 2001.) The ongoing nature of this monitoring effort would allow for before-and-after comparisons of wildlife use, water quality, and physical processes.

Marsh evolution and wildlife use in the restored Pond 2A site was monitored first by PWA and then by MEC Analytical Systems, Inc., from 1996 to 2000 (Philip Williams and Associates 1997, MEC Analytical Systems 2000). The physical and biological evolution of the 550-acre Pond 2A marsh was monitored through surveys of levee breaching and equilibrium of the width of the natural slough channel, sediment chemistry and grain size, sedimentation rates, tidal range and response, fish usage, avian usage, and plant colonization. Although Pond 2A has different characteristics than the remaining ponds (Pond 2A was slightly less subsided and was never farmed before being converted to a salt pond), it can be used as one point of comparison. Comparisons would also be made to other restoration projects in the north bay region that are currently being monitored (such as Guadalcanal and Tolay Creek), and to the fringing marsh that exists along the slough channels within the salt pond complex.

Marsh Evolution: Sedimentation, Hydrology, and Vegetation Monitoring

A topographic and bathymetric survey of the salt ponds, slough channels, and associated marsh plain was conducted by Towill, Inc., as part of the feasibility study with the Corps (Towill 2001). The aerial survey included a very accurate primary-control-level loop through the site that was connected to high-confidence benchmarks outside the site. This survey was used in the development of the hydrodynamic model by PWA and will be useful for before-and-after comparisons of elevations.

Sediment, hydrology, and vegetation monitoring would be conducted immediately before levee breaching to establish baseline conditions, and annually for approximately 10 years after breaching. Prebreach monitoring would involve performing additional surveys for consistency with postproject monitoring locations, as well as installation of sedimentation stations. Postconstruction (postbreach) and some additional prebreach surveys of tidal geomorphic evolution would document rates and patterns of habitat evolution and key underlying physical processes in each pond restored to tidal habitats.

Monitoring results would be used to identify the need for any adaptive management required to improve tidal circulation within restored ponds. They would also be used to inform and adaptively manage the tidal wetland restoration designs for future tidal restoration in other ponds.

Sedimentation Rates

Sedimentation would be monitored to understand rates and patterns of marsh evolution within breached ponds. Sedimentation would be measured using methods such as marker horizons, sedimentation plates and pins, and topographic resurveys.

Levee Breach and Slough Channel Cross Sections

Cross-sectional surveys of levee breaches, external sloughs, and pond-internal sloughs and adjacent berms (if used) would be conducted to understand patterns of tidal scour and drainage and to determine when the widths and depths of the breaches and external and internal sloughs reach equilibrium in response to the tidal prism. Water surface elevations in the sloughs and restored ponds would be monitored to identify any drainage constraints caused by increases in the tidal prism.

Vegetation Colonization

Vegetation-elevation transects would be conducted within breached ponds to document rates and patterns of vegetation colonization in the new tidal marsh. For comparison, similar data would be collected for a natural reference marsh. Aerial photographs would aid in the documentation of vegetation colonization throughout an entire breached pond.

Introduced Vegetation

Vegetation surveys would also include monitoring for introduced species of cordgrass (*Spartina* spp.). The project team would work with the San Francisco Estuary Invasive Spartina Project to monitor and control introduced species of cordgrass, and to ensure regional coordination and use of effective eradication techniques.

Wildlife Monitoring in Managed Ponds and Restored Tidal Habitats

Integrated Wildlife-Usage Surveys

Baseline, construction, and postconstruction macroinvertebrate, mammalian, fisheries, and avian usage data would be collected at locations within restored and managed ponds to assess the impacts of the restoration upon the wildlife. The baseline condition would incorporate data collected by USGS during 1999 and 2000 (Takekawa et al. 2001). All surveys would be conducted within Universal Transverse

Mercator (UTM) grids overlaid on the ponds. Results from initial waterbird surveys would be used to select a subsample of grids, based on bird presence (random grids would be selected if bird use is not evident), for further survey each quarter. Analyses would examine both temporal and seasonal variation in pond and tidal habitats usage.

Primary and Secondary Productivity

Water samples would be collected quarterly from each sample site within each pond for chlorophyll-a and nutrient (nitrogen and phosphorous) analyses. Chlorophyll-a concentration, a measure of algal community primary productivity, would be determined using spectrophotometry (Wetzel and Likens 1991). Nutrient concentration (soluble reactive phosphorous, total phosphorous, and nitrogen) would be determined using standard analytical methods (Clesceri et al. 1989). Zooplankton would be collected, preserved, and identified under a stereomicroscope (Pennak 1989).

Invertebrates

Invertebrates would be sampled in the water column using net sweeps and in the benthos with Eckmann grab samples. Sweep and grab samples would be taken monthly in each pond. Biomass (dry weight) and diversity of invertebrates would be measured on a seasonal basis.

Fish

Fish populations would be surveyed seasonally in the ponds and restored tidal areas. Surveys would assess distribution and relative abundance of juvenile and adult fishes. There will be a special emphasis on small species likely to occur in the study area (e.g., rainwater killifish [*Lucania parva*], topsmelt [*Altherinops affinis*], yellowfin goby [*Acanthogobius flavimanus*]) (Lewis Environmental Services and Wetland Research Associates 1992), as well as an emphasis on determining presence and abundance of at-risk species (chinook salmon, steelhead trout, delta smelt, and Sacramento splittail), if collection is permitted by DFG, FWS, and NMFS. Captured fish would be counted, identified to the species level, and subsequently released. A subset of the captured individuals of each species would be measured for standard length and weight. Relative weight (measured weight of an individual divided by a standard weight for the species), a measure of body condition, would be also calculated for these individuals (Wege and Anderson 1978; Anderson 1980). Stomach contents would also be collected and analyzed for a sample of individuals from selected species.

Mammals

Presence and abundance of at-risk marsh mammals, particularly salt marsh harvest mice, will be determined using live-trap methods conducted at least annually, if permitted by FWS and DFG. Temporal and spatial usage trends will be examined.

Waterbirds

Surveys would be conducted bimonthly following current USGS protocols (Takekawa et al. 2001). Locations of flocks would be mapped in a grid overlay and displayed in geographic information systems (GIS) maps. Usage trends would be examined by comparing data from before and after installation of water control structures and/or restoration to tidal habitats. Water depth and foraging preferences would also be examined (Collazo et al., in review).

Contaminants

Invertebrate samples would be analyzed yearly for chemical residues to determine the level to which elemental contaminants such as mercury are being transferred to animals feeding on pond-dwelling macroinvertebrates. Net sweeps samples and grab samples of benthic invertebrates would be collected during the month of maximum bird use. Contaminant presence would be analyzed using standard laboratory techniques.

Introduced Predators

Nighttime spotlight surveys and track surveys (using track plates) would be conducted to monitor for the presence of introduced mammalian predators, particularly red fox, on the project site. Surveys would be focused on marshes containing populations of California clapper rails. When possible, nighttime predator surveys would include searches for fox dens and surveys of wildlife remains near fox dens. Track stations would be set up for the track surveys. Wildlife services staff from the U.S. Department of Agriculture would be hired to monitor for introduced mammalian predators, if staff are available.

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APPENDIX 2
PRELIMINARY DESIGN INFORMATION

Preliminary design for the project has been completed. The design included development of appropriate habitat restoration features to reach the desired endpoint for the habitat, construction approaches for the habitat restoration features, and engineering for salinity reduction. The design effort addressed the entire project. Relevant design information for Ponds 3, 4, and 5 is presented below. Because the proposed desalination and restoration of Ponds 3, 4, and 5 is scheduled to begin within the next several years, levee maintenance has not been included in the project design or cost estimate for these ponds. Should salinity reduction and construction of habitat restoration features for these ponds be delayed for more than five years, levee maintenance will also be required at these three ponds. Levee maintenance will be required for all other ponds either because desalination is delayed, or because the ponds will be retained as managed ponds in the long-term.

Salinity Reduction for Ponds 4 and 5 -- Installation of Water Control Structures

Salinity reduction at Ponds 4 and 5 requires the creation of 4 100-foot levee breaches, and installation of water conveyance and control structures. Water conveyance and control structures required for salinity reduction at Ponds 4 and 5 include intakes, outfalls, and diffusers. They may also include fish screens. This section first describes the levee breaches, and then the water conveyance and control structures. It includes information on how the how water conveyance and control structures were sized, and how they may be constructed.

Interior Levee Breaches
Interior levee breaches for salinity reduction are simple to construct. These levee breaches would be created using explosives. Typically, explosives are packed into PVC tubes that are drilled into the levee. The quantity of explosives is adjusted in proportion to the volume of levee material. The blast disperses the levee material over a wide area, so no soil movement is required. Each breach would approximately 100 feet wide. Because little scouring is expected (the tidal signal in the pond will be muted), the breaches will be constructed as 100-foot breached. DFG staff have previously conducted several similar levee breaches at the site.

Intake Structures
Intake structures consist of a pipe or series of pipes penetrating a levee, and convey water from the river and sloughs into ponds during high tide. Pipes will most likely be constructed of a coated corrugated metal, because these intakes would be removed soon after installation (Hopefully within 2 to 4 years after installation). Intake pipes range would be approximately 600 feet long and 54 inches in diameter. The number of pipes per intake ranges from 3 to 11, depending on the pond. Peak capacity of individual intake pipes is approximately 55 cubic feet per second (cfs) or 35 million gallons per day (mgd). Pipes will be fitted with check valves on the pond side of the structures. The check valves only open when the elevation of the river or slough is above that of the pond and will prevent back-flow from the pond into the river or slough. Manual knife valves will also be included on all pipes. To improve access to the knife valves, they will be installed within the levees. If required, fish screens will be installed on the slough side of the intakes to protect fishery resources.

For the preliminary design, intake structures were sized to meet peak flow requirements predicted from hydraulic modeling, and considering the limited available head difference between the Pond 5 and the receiving waters. The effective head available to drive flows was estimated as the elevation difference between the pond and the slough, corrected for headlosses through fish screens and head required to overcome density differences between inlet and outlet waters. Head to overcome salinity differences were estimated based on salinity modeling results. Head required to overcome density differences resulting from differential salinity can be substantial. For example, a 50-ppt salinity difference is equivalent to a head differential of approximately 1 foot. The initial salinity difference between Pond 5 and the Napa Slough intake water is estimated to be 110 to 120 ppt. After correcting for fish screens and density differences, effective head driving flows through intake structures ranged from 0.5 to 1.3 feet. The number and diameter of intakes also reflects head losses associated with entrance, exit, friction, valve, and bend losses. The design outlined above is conservative. Facilities sizes may decrease in magnitude during detailed design, and if the need for fish screens is avoided.

Construction of the intakes will be conducted using construction equipment brought to the needed location via 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 as necessary during construction. The levee will then be excavated and a pipe or series of pipes placed in the trench through the levee. A check valve will be fitted to the pond side of each intake pipe and a manual knife valve will be installed within the levee section of each pipe. Valves would be constructed of stainless steel to enable them to withstand the corrosive environment. The levee will then be back filled and compacted and the cofferdams removed. On the river or slough side of the levee pipe will be extended so that the intake elevation is 3 to 4 feet below lower low tide. 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 under water at high tide, it will be attached to support piles driven by a pile driver. The intakes will be placed and sized so as to balance between the need to encroach as little as possible into active navigation areas while keeping structures submerged at low tide. If required, a fish screen would be attached to a flange on the end of the intake, on the slough side of the pipe.

Fish Screens

Some or all of the intake pipes may include a cone shaped fish screen that rests on top of the inlet at the end of the pipe. Fish of concern for this project include the Delta Smelt, salmonid smolts, and the Sacramento Splittail. Based on the limiting species, the Delta Smelt, NFMS and the DFG 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 inches. The screens were sized to meet these constraints.

The screens would be self-cleaning and powered by a solar panel system. The frequency of cleaning will be set manually to meet field conditions. Screens would be made of stainless steel and epoxy coated components that are cathodically protected. 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 piles and additional piles will be installed around the screens to protect them from large floating debris. Ducks Unlimited recently installed a similar screen system on an intake from Mud Slough to Pond 8.

Screens must be very large in order to achieve acceptable approach velocities at peak flow. They are approximately 6 feet high and 18 feet in diameter. Use of fish screens results in substantial head loss (around 0.5 feet) relative to the tidal head (around 2 feet). As a result, adding fish screens will increase the number of intakes required. As discussed above, the number and size of intakes for Pond 5 has been designed to accommodate fish screens on all the intakes; if fish screens are not required, the number of intakes could be reduced by as much as 50%.

Outfall Structures

Outfalls are required to discharge water from Pond 4 to the Napa River during low tide. The proposed design consists of two 48-inch outfalls. The outfalls run from the pond through the external levee and straight out into the Napa River. A manual knife valve is included on each outfall within the levee so that flow through the outfall can be controlled. The length of the Pond 4 outfall through the levee is approximately 200 feet, with an additional 600 feet of pipe required to reach the deepest portion of the river. The outfalls would be constructed of the same material as the intakes. The peak capacity of the Pond 4 outfall is approximately 85 cfs (55 mgd). Outfalls are constructed in a similar fashion to intakes.

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. Each diffuser includes ten 8- to 10-inch-diameter ports along its length and one 12- to 16-inch-diameter port at its end. The ports are fitted with flexible neoprene check valves that open only when tidal elevation is lower than pond elevation. Diffusers are anticipated to border navigational channels within the Napa River and will be identified with appropriate signs and lighting.

Outfalls were designed to meet peak flow requirements predicted from hydraulic modeling based on head difference between the pond and the receiving waters. Maximum head at low tide was approximately 6 to 6.5 feet. Diffuser ports were sized to minimize head losses while maximizing port discharge velocities. Higher velocities lead to greater dilution, but also higher head loss. Preliminary dilution modeling confirms that the diffusers as proposed achieve a dilution factor of around 1:10 at peak flow with no river current and at one-half peak flow with a river current of 1 fps. Modeling assumed a salinity differential between pond water and receiving water of 50 ppt. Dilution will increase as this salinity differential decreases.

Decommissioning of Water Control Structures
Water control structures on Ponds 4 and 5 would have to be removed before the ponds are breached for habitat restoration. Some piping and most check valves and knife valves would be salvaged. Fish screens would be salvaged and reused, if feasible. In addition, the unused siphon betweens Pond 3 and Pond 4 may need to be decommissioned early on in the project. The siphon and other structures with little or no salvage value would most likely be left in place and plugged.

The proposed intake and outfall locations are at the same location as two of the proposed breaches for habitat restoration (see below), and removal of the pipes would coincide with the construction of these habitat restoration breaches.

Restoration Design Features
Restoration design features are designed to speed sediment accretion, ensure adequate circulation of water within the Pond, and provide suitable for establishment of marsh vegetation. Restoration design features consist of levee breaching, ditch blocks with levee lowering, supplemental levee lowering, and starter channels and berms. Levee breaches would be installed after ditch blocks and starter channels and berms have been completed. This allows the two features to be constructed in relatively still water, and with only minimal tidal impacts. Typical dimensions of each of the proposed design features are shown in Table A.2-1. The specific number and length of design features proposed for Pond 3 is shown in Table A.2-2.

As for the water conveyance and control structures, construction equipment would be brought to the site by barge.

Construction of Ditch Blocks
Multiple ditch blocks will be constructed for all ponds that will be opened to tidal action. Nine ditch blocks will be constructed for Pond 3. The purpose of a ditch block is to inhibit borrow ditches, man-made features located adjacent to levees, from capturing the tidal supply of water and becoming a permanent site feature. Ditch blocks are therefore placed only where existing ditches are located or configured differently than desired, based on a consideration of natural marsh morphology. Nearby levee tops provide earth to build the blocks and provide construction access. Levees will be a lowered close to MHHW to maximize generation of relatively dry earth, while maintaining a bearing surface for construction equipment. The proposed elevation of the lowered levees will provide an area conducive to the establishment of mid-marsh vegetation.

Ditch blocks will roughly be 100 feet long, 40 feet wide and 4 feet tall (relative to the pond bottom) with side slopes of 5:1. Assuming that the borrow ditch volume is roughly the same as the levee, and assuming an additional 50% in volume (to account for losses in pond waters during construction and subsidence after construction), each ditch block will require 5,600 cubic yards of soil. This volume is roughly equivalent to lowering 670 feet of levee by 3 feet a. Two 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 from the levee into the pond.

Construction of Starter Channels and Berms

Starter channels help establish a desired channel pattern, typically similar to the historic pattern, that is likely to result in maximum habitat value. The starter channels also enhance site drainage, which may increase the rate of vegetation establishment, would provide habitat for fish soon after construction, and promote the more rapid formation of smaller channels, which could provide important habitat to biota.

Starter channel dimensions range from 50 to 100 feet wide and 4 to 8 feet deep, with channels becoming smaller as they move into the ponds. The channel cross section is trapezoidal with side slopes on the order of 5:1. One foot of channel length is roughly equivalent to 5 to 18 cubic yards of material, depending on the size of the channel.

Excavated material would be used to construct berms on the side of starter channels. Berms limit wave generation by limiting reducing the open water fetch lengths, and dissipating waves incident to the berms. Reduced wave action will increase sedimentation rates and will provide a calmer environment conducive to vegetation establishment. Increased sedimentation will facilitate evolution of the site toward higher elevations and vegetated marsh. The berms also locally provide site elevations conducive to vegetation establishment. Berms will be located parallel to starter channels, the excavation of which provides soil for berm construction. The berm elevation would vary around MHHW. The intent is an irregular, wide, low mound with flat slopes and a sinuous path paralleling channels. Berms would be discontinuous to avoid blocking side-channels. Figure 8 shown a plan view and cross section of a starter channel and berm.

Three excavation methods were evaluated: "dynamic excavation" (using explosives), land-based excavation (assuming pond draw-down) using a hydraulic excavator or a dragline excavator, and barge-based excavation using a hydraulic suction dredge or a clamshell excavator. Dynamic excavation was deemed too intrusive to construct the required length of starter channels (i.e., it is considered acceptable for tens to hundreds of feet of levee breaching, but not for thousands of feet of starter channels). In addition, using explosives eliminates the possibility of using the material removed from the starter channels as berms; instead the sediment would be unevenly spread over a wide area within the pond. Land-based construction is the most efficient, but may not be feasible given the low strength of the soils in the ponds. In addition, pond drawn-down (drying out the pond) is considered undesirable because it could lead to acidifcation of the sediments in the pond. Thus, the preliminary design focused on barge-based construction as the method of choice for constructing starter channels. The use of land-based equipment may be reevaluated during detailed design.

A barge-mounted hydraulic suction dredge or clamshell excavator would be used to dredge out historical channels without draining the ponds. This approach assumes that the location of the channels could be determined and marked without drawing down the ponds. This approach also avoids the risk of getting equipment stuck in the pond sediment during excavation. Pond drawn-down is not required, thus minimizing habitat impacts during construction. The berms would be constructed simultaneously along side of the channels. This method results in lower production rates than land-based equipment.

Supplemental Levee Lowering

In addition to the levee lowering performed to create ditch blocks, levee lowering will also be performed to provide habitat connectivity, opportunities for marsh vegetation colonization, and to reduce predator pathways. The crest elevation of levees will be lowered to an elevation consistent with marsh vegetation and habitat. The preliminary design assumes a levee width of 75 feet, levee side slopes of 2:1 on the external side and 5:1 on the internal side, and a lowering distance of 3 feet. This is equivalent to 10 cubic yards of excavation per linear foot of levee lowered. The material will be pushed into the borrow ditch and will narrow, but not block, the borrow ditch.

Levee lowering will likely be performed after the ponds are open to tidal action in order to avoid the potential for an accidental pond breach. As with ditch block construction, 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 pond.

Levee Breaching

As part of the restoration process levee breaches, termed enhanced levee breaches, will be created where starter channels meet exterior levees. Unlike breaches associated with salinity reduction, which will initially convey high flow rates, enhanced breaches will experience less scouring action. Thus, additional sediment removal on the river or slough side of the breach may be required to ensure that adequate hydraulic connectivity develops between the starter channel inside the levee and the river or slough. Enhanced breaches would include a 100-foot wide levee breach and up to 100 feet of pilot channel external to the levee, 50 feet wide by 5 feet deep. These breaches would be constructed to mate with starter channels on the interior side of the levee. The enhanced levee breaches would also be constructed using explosives.

TABLE 2-1
Approximate Dimensions of Restoration Design Elements

Design element	Top width (ft)	Key Elevations	Typical Side Slope[a] (H:V)	Length (ft)	Potential mid marsh area created
Breach	Approx. 100 [e]	Invert 3 to 5 ft below MLLW	5:1	NA	NA
Pilot Channel	~50	Minimum invert at least several feet below the marshplain	5:1	Varies	NA
Starter channel [f]	50 – 100	Longitudinal slope deepest near the breach (3 to 5 ft below MLLW) and shallower in the pond interior (1 ft above to 1 ft below MLLW)	5:1	Varies by option	NA
Berm[d]	Approx. 10	~MLHW to MHW at crest; no higher than +0.5 ft above MHHW	7:1	Varies by option	0.2 ac / 1000 ft
Ditch block[b]	40	~MHHW at crest	5:1	100	0.12 ac / block
Levee lowered to construct ditch block	30	~MHHW at crest	NA	330	0.23 ac / block
Additional levee lowering for high marsh restoration[c]	46	~MHHW at crest	NA	Varies by option	1.1 ac / 1000 ft

a- Side slopes will vary, depending on constructability.
b- 330 ft of levee will be lowered to provide material to construct a ditch block.
c- The width of the lowered levee will be 30 ft. Material from levee lowering will be used to fill a 16 ft width of borrow ditch, giving an effective width of 46 ft for potential marsh habitat
d- The width of berm for Option 4 will be sized to allow the berm to serve as an effective wave break and may be larger than the width shown here.
e- Width at mean higher high water.
f- Starter channels could be narrower and shallower, depending on cost and constructability constraints.

TABLE 2-2
Number and Length of Design Elements and Mid Marsh Habitat Created by Pond

	Pond 3	Pond 4	Pond 5	Ponds 4 and 5
Number and length of design elements				
Breaches (number)				
Ditch blocks (number)	9	7	6	13
Lowered levees[a] (ft)	10,000	4,600	7,600	12,200
Berms (ft)	11,200	8,500	7,900	16,300[c]
Starter channels (ft)	11,200	8,500	7,900	16,300[c]
Mid marsh area created by design feature (acres)				
Ditch blocks	1	1	1	2
Lowered levees[b]	9	4	7	11
Berms	3	2	2	4
Total	13	7	10	17

a- Includes 330 ft for each ditch block.
b- Includes area of partial borrow ditch fill, except when that fill is a ditch block.
c- Numbers do not add up due to rounding

APPENDIX 3
SPECIFIC PROJECT CONSTRAINTS

A detailed analysis of project constraints was conducted as part of the development of the proposed restoration plan for the site. These contrainsts included likely permit criteria and other restrictions imposed by various regulatory agencies, as well as biological, physical, and system constraints. In addition to the constraints that are discussed in the main portion of the text, the following constraints been addressed as part of the project planning effort:

1. Regulatory Constraints: Salinity reduction must not have a significant adverse impact on the water quality of the Napa River or San Pablo Bay. This includes the following specific constraints:
   - Effluent discharge limitations (for salinity, dissolved oxygen, temperature, nutrient load, heavy metals, and other criteria),
   - Mixing zone restrictions around discharge locations, and
   - Nutrient, DO, and heavy metals content of recycled water relative to pond water
   - Temperature differential between recycled water and pond water.

2. Biological Constraints: Salinity reduction and tidal marsh restoration must minimize impacts to the existing habitat and sensitive species in the area. This includes:
   - Avoiding of entrainment of organisms in discharges and diversions,
   - Minimizing loss of existing habitat in the ponds and loss of existing food sources (e.g., brine shrimp) during salinity reduction,
   - Complying with protection periods for listed species including salmonids, Delta Smelt, Clapper Rail, and Sacramento Split-Tail,
   - Avoiding construction noise within 250 feet of clapper rail habitat (Feb 1 to Aug 31), and
   - Minimizing loss of existing marsh along sloughs during construction and subsequent site evolution (due to erosion and enlargement of sloughs in response to increased tidal prism and/or excavation of pilot channels in marsh).

3. Constraints Imposed by Existing Structures/Facilities: Implementation of the project must avoid damaging or altering existing structures and facilities required by other, including the following:
   - Avoid increasing flooding risks on the Napa River,
   - Prevent adverse effects on operation of the existing Napa River navigation channel (e.g., due to increased velocities in response to increased tidal prism), and
   - Avoid or mitigate for impacts to existing PG&E towers (the only non-project infrastructure in the project area).

4. Physical constraints: Physical constraints affect both the salinity reduction phase and the habitat restoration phase.
   - Physical constraints that have been incorporated into the salinity reudction design include:
   - Tidal hydraulics in Napa River, local sloughs, and San Pablo Bay
   - Solution rate of precipitated salts/metals,
   - Ability to adequately resolubilize precipitated compounds,
   - Presence of other metals and organic chemicals in sediments and levees,
   - Evaporation rate/salt load of intake water,
   - Conditions of existing levees,
   - Construction Access – most ponds are on islands not accessible by land-based construction equipment or water craft (water levels in sloughs are too low most of the time), and
   - Locations of water intake and discharge points (placed in locations where marsh excavation is minimized).

- Physical constraints that have been incorporated into the habitat restoration design include:
  - Existing bathymetry/topography (ground elevations are subsided below vegetation colonization elevations and it will take time for natural estuarine sedimentation to raise site elevations),
  - Sedimentation rates in ponds opened up to tidal action (sediment budget for ponds is expected to be highest in Pond 3 and decrease with distance from Napa River and up Napa River),
  - Wind-wave resuspension limitations to sedimentation (high wind fetch and large waves could limit rates of sedimentation),
  - Erosion of sloughs due to increased tidal prism and scour leading to levee erosion; erosion of levees leading to impacts on adjacent properties and erosion around power line piers,
  - Transport of contaminants in mobilized sediments that are resuspended and deposited in the restoration area or existing marsh and sloughs, and
  - Limitations to natural channel formation within the salt ponds – borrow ditches can short-circuit tidal flow, drawing energy away from scour of the historic channels.

5. Regional Impacts. A number of restoration projects near the project are either in the conceptual or planning stage. These projects include the Sonoma Creek Flood Control Project, Cullinan Ranch, and Skaggs Island. Design of the project must avoid impacts to these potential projects, and vice-versa.

These constraints have been considered by the Conservancy, DFG, and the Corps as part of the feasibility study and CEQA/NEPA processes, and the project is being designed to minimize or mitigate for these constraints.

APPENDIX 4
DEVELOPMENT OF PROPOSED PROJECT APPROACH

The project team has conducted an extensive planning and project development process for the proposed NSMRP. This process is described in detail in the Feasibility Report, and is summarized in this appendix.

Data Collection and Modeling

Extensive data collection was performed for the project. Data collection included extensive physical, chemical and biological data. Physical data collection included topographical/bathymetric surveys of all the ponds, and water quality (temperature, turbidity, suspended sediment concentration, DO, salinity), and velocity, flow, and tidal data from multiple monitoring stations. In addition, physical data used for the project included salinity, temperature, pH, and DO data for the ponds, rainfall and evaporation data from CIMIS, and geotechnical data collected on pond sediments. A detailed levee walkover was conducted in the summer of 2001 to assess the conditions of all accessible levees (levees in several were not physically accessible due to the presence of vegetation). Much of the water quality data was collected by USGS and UC-Davis. DFG and USGS continue to monitor salinity, pH, and water elevation in the ponds.

Chemical data collection consisted of collecting multiple sediment and water samples from each pond, as well as background sediment and water samples from the Napa Slough, Napa River, and San Pablo Bay. Biological data collection consisted of extensive biological surveys of the ponds conducted in 1999 and 2000 by USGS. These surveys included bird counts and fish and invertebrate sampling in six of the ponds representing a range of salinities. Additional fish surveys in the North Bay area are conducted on a regular basis by DFG. In addition, bittern toxicity testing was conducted to evaluate the feasibility of adding hypersaline brine to bittern to reduce the toxicity of bittern. Finally, there has been extensive monitoring of the evolution Pond 2A, which was initially breached to tidal action in 1995.

Modeling conducted for the project was divided into two phases: salinity reduction modeling and habitat evolution modeling. Modeling was performed based on the data collected for the project, and other relevant data available for other restoration sites. Salinity reduction modeling was performed using MIKE11 for the River and Sloughs, and MIKE21 for the ponds. Additional modeling of the salinity plume and near-field effects will be conducted using a 2-D model of the River and sloughs, followed by specific simulations using CORMIX. Modeling of habitat evolution was based primarily on analytical relationships, as well as on data collected at other sites.

Development of Salinity Reduction, Water Delivery, and Habitat Restoration Options

Due to the complexity of the project, development of proposed project alternatives was divided into a three-step process. The first step consisted of the identification and screening of various salinity reduction, wate delivery, and habitat restoration measures. These measures were screened to eliminate those that would not meet project goals and objectives, or were not feasible for other reasons. From the various measures that were potentially suitable for the project, the project team assembled a range of salinity reduction options, water delivery options, and habitat restoration options. Each option is composed of a combination of measures. Twenty-five salinity reduction options, three water delivery options, and seven habitat restoration options were considered at the screening stage.

Twenty-one salinity reduction options, two water delivery options, and three habitat restoration options were eliminated from further analysis following the screening process. Salinity reduction options were screened by conducting water balance calculations and/or performing preliminary hydrologic modeling runs to evaluate the feasibility of the various options. Water delivery options were screened by determining their institutional feasibility (i.e., the likelihood of the cognizant regulatory or water supply agency allowing the water to be used by the project). Habitat restoration options were screened by characterizing the evolution of the site over time. The most viable options from each category were carried forward as potential project options. The various options were also presented to the Napa Sonoma Marsh Restoration Group for review and input, and some of the options were modified to reflect suggestions provided by the group. The project options are described in more detail below.

Salinity Reduction Options
Four salinity reduction options (Salinity Reduction Options 1A, 1B, 1C, and 2) were evaluated in detail. Common elements include widening the existing breaches between Ponds 4 and 5, and Ponds 6 and 6A to 4 100-foot breaches for each set of ponds. For the purposes of desalination, the ponds are then treated as one pond. For all options, water intakes will be constructed from Napa Slough to Pond 7A, and from Mud Slough to Pond 8. The existing "donut" at Ponds 7/7A will be reconfigured to serve as a mixing chamber for brine coming from Ponds 7, 7A, and 8, and will also allow the use of recycled water.

Adaptive management would be implemented for all salinity reduction options. Monitoring would be conducted to ensure that saline brine releases are not causing adverse effects in the receiving waters, and to ensure that circulation is adequate in the ponds (i.e., that all ponds are desalinated and that no stagnant areas are created). If necessary, saline brine releases could be reduced and/or water control structures could be modified to ensure that permit conditions are met.

<u>Options 1A through 1C.</u> Salinity reduction options 1A through 1C all include desalination of Ponds 3 through 6A to the Napa River, and desalination of Ponds 7, 7A, and 8 to Napa Slough. The differences among the three suboptions are whether ponds are desalinated via water control structures, breaches, or a combination of both. The salinity reduction process for Ponds 6, 6A, 7, 7A, and 8 is the same for all three salinity reduction options. For Ponds 6 and 6A, an intake is constructed from Napa Slough into Pond 6A, water is circulated from Pond 6A into Pond 6, and water is discharged from Pond 6 through the siphon to Pond 5. For Ponds 7, 7A, and 8 water is discharged from the mixing chamber to Napa Slough. The specific differences are associated with salinity reduction in Ponds 3 though 5, which varies as follows:

- Option 1A: Use water control structures to desalinate Ponds 3, 4, and 5. Pond 3 is desalinated separately from Ponds 4 and 5; desalination for all ponds will begin at the same time.
- Option 1B: Breach Pond 3, but use water control structures on Ponds 4 and 5 to reduce salinities prior to breaching. Desalination of Ponds 4 and 5 begins after desalination of Ponds 3 is complete (this expected to require approximately 1 month).
- Option 1C: Breach Ponds 3, 4, and 5 for salinity reduction. Breaches will be conducted during a typical 2-year flood event to increase dilution of the brine. Salinity reduction could occur sequentially for Pond 3 and then for Ponds 4 and 5, or could be conducted simultaneously (leading to somewhat higher salinities in the Napa River).

Option 2. Salinity Reduction Option 2 desalinates Ponds 3 through 5 to the Napa River, and Ponds 6 through 8 to San Pablo Bay. In stead of being discharged to Napa Slough, water from the mixing chamber at Ponds 7/7A is transferred to Pond 6A via the siphon under Napa Slough. From there, the water moves through Pond 6, via a new siphon from Pond 6 to Pond 2, and from there via Ponds 1 and 1A to San Pablo Bay. Water control structures are used for salinity reduction in Ponds 3, 4, and 5. After Pond 3 has reached ambient or near-ambient salinity, it is used as a mixing chamber for Ponds 4 and 5. Outlets are not required for Pond 4, as the discharge from Pond 4 would be through the siphon to Pond 3.

Water Delivery Options
Only one water delivery option was considered to be both institutionally feasible, and capable of delivering a sufficient quantity of water to be useful. Water Delivery Option 1 consists of the delivery of approximately 6,000 to 7,000 acre feet per year (afy) to the project. The water would be delivered by three agencies: The Sonoma Conty Water Agency, the Napa Sanitary District, and the City of American Canyon. A combination of new and existing infrastructure would be used to transfer the water to the site. The recycled water would be used to accelerate the desalination of Pond 7 (the bittern pond). Bittern has aquatic toxicity and requires a dilution of as much as 100:1 prior to discharge. Monitoring would be conducted to ensure that there is no adverse effect on the receiving water from the recycled water (e.g., eutrophication), and use of recycled water would be reduced or discontinued if adverse effects are identified. The use of recycled water at the proposed rate would reduce the estimated desalination time

for Pond 7 from 50 to 30 years. When the water is no longer required by the project, it would be made available to agricultural users in the area.

Habitat Restoration Options
All habitat restoration options retained for further consideration provide a mix of tidal wetland and managed pond habitat. Habitat restoration that consist of entirely managed pond or wetland habitat (i.e., species-focused options) were rejected because they do not meet the project objectives. The four options that were carried forward share some common elements. For all optoins, Ponds 3 and 4 are restored to tidal wetlands, and Ponds 1, 1A, 7, 7A, and 8 are retained as managed ponds. Ponds 1 and 1A are already well-functioning habitat, and all five of these ponds are relatively small (easier to manage). The extent of tidal wetland restoration at the remaining ponds (Ponds 2, 5, 6, and 6A) and the rate at which they are opened to tidal action differ among the four options.

All four options rely on adaptive management as a means of achieving project objectives. A substantial monitoring budget has been included in the project estimate, and monitoring is proposed to continue for at least ten years after the start of restoration in each pond. The four habitat restoration options carried forward for detailed consideration are summarized below.

- Option 1 - Mix of Managed Ponds and Tidal Marsh: Ponds 3, 4, and 5 (2,904 acres) will be opened to the tidal prism in an orderly manner depending on accretion rates and sediment budget. Design features (borrow ditch blocks, levee lowering, creation of starter channels and berms) will be used as needed for improved accretion rates and habitat evolution. Ponds 1, 1A, 2, 7, 7A, and 8 (2,406 acres) will be kept as managed ponds, with levee repair and water control improvements as needed. Ponds 6/6A (1,146 acres) will be managed as ponds for 10 to 20 years. Depending upon success of restoration in Ponds 3 through 5, availability of waterfowl and shorebird habitat in the region, and availability of funds for management, Ponds 6/6A will continue to be managed as ponds or will be restored to tidal marsh.
- Option 2 - Tidal Marsh Emphasis: Ponds 3, 4, 5, 6 and 6A, plus eastern half of 2 (4,373 acres) will be opened to the tidal prism in an orderly manner depending on accretion rates and sediment budget. Design features (borrow ditch blocks, levee lowering, creation of starter channels and berms) will be used as needed for improved accretion rates and habitat evolution. Ponds 1, 1A, western half of 2, 7, 7A, and 8 (2,080 acres) will be kept as managed ponds, with levee repair and water control improvements as needed. A new levee will be built down the middle of Pond 2.
- Option 3 - Managed Pond Emphasis: Ponds 3 and 4 (2,162 acres) will be opened to the tidal prism in an orderly way depending on accretion rates and sediment budget. Design features (borrow ditch blocks, levee lowering, creation of starter channels and berms) will be used as needed for improved accretion rates and habitat evolution. Ponds 1, 1A, 2, 5, 6, 6A, 7, 7A, and 8 (4,294 acres) will remain as managed ponds, with levee repair and water control improvements as needed.
- Option 4 – Accelerated Marsh Restoration: Same as Option 1, with two additional design features to accelerate tidal habitat restoration: placement of up to100 acres of fill in Pond 4 (or a similar location with historically low channel density) and additional creation of starter channels and berms.

Development and Screening of Alternatives
Salinity reduction options and habitat restoration options were combined to create a range of alternatives for evaluation. The water delivery option was included in most alternatives, as reuse of recycled water was included in the project objectives. Eighteen preliminary alternatives were developed. Six alternatives, all including use of recycled water, were carried forward for analysis in the Feasibility Report. For completeness, a seventh alternative that does not include use of recycled water was included for evaluation in the EIS/EIR. A recommended alternative will be chosen after public input is received. The project elements covered by this grant application are included in all project alternatives other than the no action alternative, and do not bias the proposed project to favor any specific alternative.