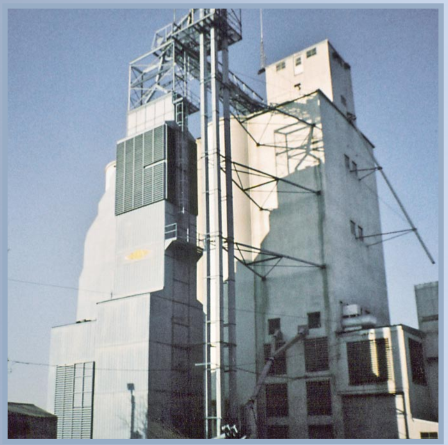


Draft
Environmental Impact Report

North Delta Flood Control and Ecosystem Restoration Project

VOLUME 3—APPENDICES

California Department of Water Resources
November 2007

Draft
Environmental Impact Report

North Delta
Flood Control and Ecosystem Restoration Project

Volume 3—Appendices

Prepared for:

California Department of Water Resources
901 P Street, 3rd Floor
P.O. Box 942836
Sacramento, CA 94236-0001
Contact: Dave Mraz
916/651-7017

Prepared by:

Jones & Stokes
2600 V Street
Sacramento, CA 95818-1914
Contact: Chris Elliott
916/737-3000

November 2007

Jones & Stokes. 2007. *Draft environmental impact report North Delta Flood Control and Ecosystem Restoration Project*. Volume 3—Appendices. November. (J&S 01268.01.) Sacramento, CA.

Appendix A
Public Scoping Report

U.S. Army Corps of Engineers
California Department of Water Resources

North Delta Improvements Project

Public Scoping Report

DRAFT 4/28/03
Date/Time: 6 to 9 p.m., February 19, 2003
Location: Jean Harvey Community Center
4273 River Road
Walnut Grove, Calif.

The following project team members were in attendance:

Curt Schmutte – DWR
Gwen Knittweis – DWR
Edward Schmidt – DWR
Tom Hall – DWR
Chris Kimball – DWR
Joel Dudas – DWR
Ed Schmit – DWR
James Martin – DWR
Collette Zemitis – DWR
Paul Bowers – USACE
Rebecca Wren – USACE
Bill Fleenor – UC Davis
Chris Hammersmark – UC Davis
Keith Whitener – The Nature Conservancy

Consultants:
Sam Garcia – Jones & Stokes
Don Trieu – MBK Engineers
Craig Moyle – Katz & Associates Inc.
Tamara White – Katz & Associates Inc.

Local Community Attendees

See Appendix C for scanned copies of original sign-in sheets. See Appendix B for documentation of public noticing.

Purpose

As part of its CEQA/NEPA compliance efforts, the North Delta Improvements Project program managers held two public meetings in February in Walnut Grove, Calif., and Sacramento, Calif. The purpose of the meetings was to receive comments from stakeholders and Agencies on well-integrated ecosystem restoration and flood control efforts in northern Sacramento-San Joaquin Delta, principally on and around Staten Island, Dead Horse Island, and McCormack Williamson Tract in a manner that would benefit aquatic and terrestrial habitats and alleviate flood-related problems in the North Delta area. This report represents comments, ideas and concerns presented at the Walnut Grove meeting.

Overview

The meeting opened at 6 p.m. with an open house, providing attendees the opportunity to review project information boards and talk one-on-one with subject-matter experts. The public comment session convened at approximately 6:45 p.m. Curt Schmutte welcomed the audience and provided an overview of the North Delta Improvements Project, its challenges, progress to date, as well as introduction of team members. Gwen Knittweis provided an overview of proposed North Delta Flood Control and Ecosystem Restoration Improvements with assistance of a PowerPoint presentation. Ms. Knittweis's presentation stated the reason for the meeting, and gave a brief description of each work station. Work stations included flood control, ecosystem restoration, hydrology, hydraulic modeling, recreation, land use, and a general project overview. Project components such as flood impact, ecosystem restoration, and proposed solutions were also examined. The meeting was facilitated by Craig Moyle. The meeting was adjourned at 8 p.m. Oral comments were recorded on computer by Tamara White. Written comments were provided by attendees on personal letter stock, public comment cards provided at the meeting, or on flip charts stationed near information booths.

Summary of Key Issues Discussed

Six issues and concerns were most frequently expressed during the meeting. Flooding was the most common comment/concern (9 comments/questions were expressed regarding flooding). The remaining five most expressed comments included, environment (8), dredging the river (7), finances (4), project time line (4), and sustaining the region's agriculture base (3). Listed below is a chronological account of public comments. See Appendix A for copies of all written comments received by the North Delta Flood Control and Ecosystem Restoration Improvements Project.

Flooding
- Single/Double Surge Protection (3)
- 100 year flood Protection (2)
- Threatens areas economic vitality
- Flood four islands
- 1986
- 1997

Environment
- Community standpoint
- Description of 'old delta'
- Disruption of dredging
- Nature of levee
- Environmental groups
- Money

Dredging
- Key in sustaining channel capacity (2)
- Beneficial reuse of dredge material
- Dredge delta sentiment is not polluted
- Channel has historically been dredged
- Urban areas in Northern California receive better maintaince, which allows dredging
- Will not harm the environment

Finances
- Cost benefit ration
- Congressional funding
- Economic impact of project on agriculture
- Project budget

Project Time Line
- Concern that more time is needed to work with engineers
- No definitive time line
- Concern that timeline is not definitive enough (2)

Sustaining regions agricultural base
- Agricultural base must be maintained
- Recreation and habitat must be maintained
- Enhancing of habitat should be done on publicly owned land

Public Comment Session

Facilitator: Asked for a show of hands regarding the number of growers attending. Of those attending:
- Approximately 75 percent were row and field crop growers
- Approximately 25 percent were permanent crop growers

Question – Attendee 1

Why is the Army Corps of Engineers involved in this project?

Answer – Paul Bowers

It takes a lot of people with different types of knowledge to get a project of this size started. We also would like community involvement to help formulate alternatives.

Statement – Christopher Lee, grower/ attorney

The staff assigned to NDIP must speak to community leaders such as Tim Wilson, John Beronick, Walt Hoppe, Topper Van Loben Sels and Steve Mello. These men know the land and understand the issues that will face the project and have solutions that will work.

Question – Topper Van Loben Sels

Will these projects give 100 year single surge protection? Double surge protection? Engineers need to look at these issues. Do we have more time to work with engineering firms to look at more than just the 1997 single surge flood?

Answer – Curt Schmutte

Yes, our goal is to address the issue properly. We do not have a definite time line.

Statement – Tom Herzug, Reclamation District 118

We must look at upstream dams. If you want to provide a solution that will give 100 year flood protection this is a great reference point to start at. These projects will give North East Delta meaningful flood protection if modeled correctly. We need to look to the 1986 flood to have a correct, working model. The water should be spread over area. No matter what will have to take into account upstream development taking away flood bypass areas.

Statement – Steve Jessett

There is definitely a dredging component, if you have a river that does not have the capacity it did 50 years ago. Short of channel capacity, the situation is getting worse. We need to look at sustainable ways to handle the problem. Dredging will be key either way. Look at the beneficial reuses of dredge material; permanent banks in farm areas, reduces soil oxidation. We must look at economic alternatives, what is the best cost benefit ratio? Speak to the five men mentioned earlier and they can provide insight in this area.

Response to Jessett – Curt Schmutte

What would community like from an environmental standpoint? What type of environmental restoration?

Response to Schmutte – Steve Jessett

The old delta flooded in winter and spring, during the summer it would dry up. During that time farm waste was dumped in the river, and the fish thrived. Keeping water high in levees now creates problems. We can't spray the wetlands and we must be careful in approach, to prevent the spread of new strains of encephalitis.

Response to Schmutte – Attendee 2

The reason salmon don't go down the river like they used to, is because the rivers silted up. Sand hill cranes love cattle fields. Somewhere the concept was instituted that the farmers don't know what's going on, and staff does. We don't put pesticides on crops because we think its fun. We don't like doing it, it's a hassle, it's expensive and we have to get permits to spray. We put as little on as possible. You all drove up here today; you say how beautiful it is. What we want is to continue to maintain the beauty of the area. Every 20 years a flood threatens economic vitality of the area. Local people are the most invested in this area and are the greatest form of input, use them.

Response to Schmutte – Steve Jessett

In terms of dredging, urban areas of Northern California are in the same boat as we are. However, their levees protect urban areas, which seem to be more of a priority. Dredge delta sentiment is assumed to be polluted…this is wrong. Throughout history we've dredged the channel. That material is clean. We can throw it over the side, to create habitat. Dredged channels transport water better than plugged up channels.

Question – Attendee 3

What is the reasoning behind not allowing us to dredge?

Answer – Paul Bowers

The reasoning behind not dredging is that it disrupts habitat, disrupts the fish, disrupt animals that fish eat, and pesticides pollute the soil….

Response to Bowers – Attendee 3

That is false. It is a matter of 1-2 years that a levee will be back to nature. The underbrush will grow back in. The water habitat will be disrupted but the delta will be back to normal in days. Our levees are sedimentary in nature. Setting levees back would be an engineering nightmare. Place inundated would have mercury. If an island in the delta flooded, there would be no habitat values other than fish species.

Statement/Question – Curt Schmutte

We must identify the biggest problems first. Consider what environmental groups will accept. These are complex issues; however we do have the right people involved in order to create a project that everyone can buy into. After that we will take the plan to Congress to get funding. My questions at this point are what is the position of growers regarding restoration, or combinations of it?

Response – Attendee 4

If you're going to enhance habitat do it on publicly owned land. The economic impact must be considered. One of the long term goals is that we have to maintain agriculture. We must maintain our recreational base, and habitat. Yet we do have a tremendous resource, about 17% of the land here is publicly owned.

Question – Attendee 5

In terms of budget how much are we talking about realistically?

Response – Gwen Knittweis

> It is hard to determine the budget until we have refined the proposed project alternatives and can make we detailed cost estimates. CALFED has been the recipient of large sums of funding. We may get some bond funds We may get funds through CALFED arrangements or project sharing

Statement – Attendee 6

> This has been a project needed until 1986. We don't need to study this anymore. We already know we won't get money out of Sacramento County. Before investing more time, please answer the question; are we going to study for 5 more years, or do something?

Statement – Attendee 7

> All big reclamation districts have engineering groups. These are a very valuable resource.

Statement – Attendee 8

> There is concern that nothing is different. Action has been going on since 1948. We want something definitive to happen.

Statement – Curt Schmutte

> We want to do adaptive management. We may want to start building and see how the structures work. We will monitor those structures, and either continue to build or not. We need to look at the schedule from state and federal perspective, and really push ACOE to move the project along. We're looking to finalize the Environmental Impact Report (EIR) draft by summer, and to have the final by fall of 2004.

Statement – Attendee 9

> CALFED said the ultimate goal was to transfer water down south. Most money has been spent on the environmental projects, and not water projects. Let's get a water project going and finished.

Response – Curt Schmutte

> True, we're trying to think outside the box to do some building.

<u>Written comments:</u>

No public comment cards received at the Walnut Grove meeting.

Anonymous public comments recorded on flip charts at the Walnut Grove meeting included:

"Take the four islands; Bouldin, Webb Tract, Baron, and Holland Tract, and flood during winter and spring floods. That's the quickest storage in the area available right now."

"Consider setting back levees on Dead Horse, Causeway on Staten northern tip."

"Dredge the south fork."

“Forget buying land, dredge the channels!”

“Dredging should be part of all alternatives. Levee setbacks, lower water surface elevations during low flow rendering siphons inoperable, pump bowls to high.”*

“You have to realize that we want to maintain our agriculture base. Is agriculture part of the restoration system?”

“Funding for conservation easements needed.”

“Seepage can affect surrounding properties and need to be monitored. The quality and the quantity of the water will leave the Delta. We deserve to keep our quality and quantity of water. Upstream development needs to be addressed. They need to mitigate their impact.”

*Pump Bowl descriptions:
When pump bowls are set high it prevents the water level from lowering. The level at which the bowl is set is very important as it controls water level. If the bowl is to high it costs energy and sucks air, to shallow it may suck sand.- **Jack Williams, Farm Advisor, UC Davis**
If a centrifugal pump is located on the top of the levee and the water level in the river becomes too low, the pump location may be too high above the water surface to provide sufficient suction to lift the water from the river surface to the pump intake. An excessive elevation difference can cause cavitation and reduce or stop the water flow. If a turbine pump is used (bowels of turbine pumps are submerged in the river), the elevation of a reduced water surface elevation may be below the elevation of the pump intake. **– Blaine Hanson, Irrigation and Drainage Specialist, UC Davis**

U.S. Army Corps of Engineers
California Department of Water Resources

North Delta Improvements Project

Public Scoping Report

DRAFT 4/28/03

Date/Time: 1:30 to 4 p.m., February 20, 2003

Location: Bonderson Building
901 P Street
Sacramento, Calif.

The following project team members were in attendance:

Curt Schmutte – DWR
Gwen Knittweis – DWR
Collette Zemitis – DWR
Chris Kimball – DWR
Tom Hall – DWR
Joel Dudas – DWR
Ed Schmit – DWR
James Martin – DWR
Kent Nelson – DWR
Herb Hereth – DWR
Paul Bowers – USACE
Rebecca Wren – USACE
Bill Fleenor – UC Davis
Chris Hammersmark – UC Davis
Keith Whitener – The Nature Conservancy

Consultants:
Sam Garcia – Jones & Stokes
Don Trieu – MBK Engineers
Craig Moyle – Katz & Associates Inc.
Amber Williams – Katz & Associates Inc.

Local Community Attendees:

See Appendix C for scanned copies of original sign-in sheets. See Appendix B for documentation of public noticing.

Purpose

As part of its CEQA/NEPA compliance efforts, the North Delta Improvements Project program managers held two public meetings in February in Walnut Grove, Calif., and Sacramento, Calif. The purpose of the meetings was to receive comments from stakeholders and Agencies on integrated flood control and ecosystem restoration efforts in northern Sacramento-San Joaquin Delta, principally on and around Staten Island, Dead Horse Island, and McCormack Williamson Tract. This report represents comments, ideas and concerns presented at the Sacramento meeting.

Overview

The meeting opened at 1:30 p.m. with an open house, providing attendees the opportunity to review project information boards and talk one-on-one with subject-matter experts. The public comment session convened at approximately 2:15 p.m. Curt Schmutte welcomed the audience and provided an overview of the North Delta Improvements Project, its challenges, progress to date, as well as introduction of team members. Gwen Knittweis provided an overview of proposed North Delta Flood Control and Ecosystem Restoration Improvements with assistance of a PowerPoint presentation. Knittweis' presentation stated the reason for the meeting and gave a brief description of each work station. Work stations included flood control, ecosystem restoration, hydrology, hydraulic modeling, recreation, land use, and a general project overview. Project components such as flood impact, ecosystem restoration, and proposed solutions were also examined. The meeting was facilitated by Craig Moyle. The meeting was adjourned at approximately 3:15 p.m. Oral comments were recorded on computer by Amber Williams. Written comments were provided by attendees on personal letter stock, public comment cards provided at the meeting, or on flip charts stationed near information booths.

Summary of Key Issues Discussed

Five issues and concerns were expressed during the public comment session, with dredging and CALFED as the most frequent at three comments. The remaining four were cost (2), and regulatory and science each receiving one comment. Listed below is a chronological account of public comments. See Appendix A for copies of all written comments received by the North Delta Flood Control and Ecosystem Restoration Improvements Project.

Dredging
▫ One of many alternatives
▫ If this is a viable alternative CALFED should take the lead
▫ Analysis of dredge material

CALFED
▫ Project approval
▫ Sacramento County sharing costs
▫ Taking lead in terms of dredging as an option

Cost
▫ Explanation of project as if cost is a non-issue
▫ Sacramento County would like to share cost with CALFED

Regulatory
▫ No clear regulatory process

Science
▫ Desire for a science based solution

Public Comment Session

Facilitator: Asked for a show of hands regarding attendees' primary interest in project:
- Flood Control - majority
- Eco-System - few
- Recreation - very few

Mike Eaton, The Nature Conservancy:
Comment, when asked about dredging: Throw away tradition/assumptions and think outside the box to be successful. Thinks we need to look at dredging, among other potential solutions.

Margit Aramburu, Delta Protection Commission:
How are we going to be able to use the CALFED way to get a project approved? CALFED previously funded a project to analyze dredge materials but funds were low causing the project to be stymied.

Facilitator: What if money weren't an issue?

Response – Margit Aramburu:
Exceeded ambient levels, so didn't reflect the levels.*(Pending clarification)*

Attendee 3:
No clear regulatory process.

Follow-up – Margit Aramburu:
Sedimentation comes with storm water.

Question – Attendee 4:
Is this an issue that CALFED would take the lead on? Seems like CALFED should take the lead if, indeed, dredging looks like an answer.

Follow-up – Margit Aramburu:
We want a clear science solution that incorporates environmental sensitivity, flood control … all the elements in harmony.

Statement – Craig Crouch, Sacramento County:
Would like to see Sacramento County project incorporated in the CALFED mission in a joint approach. People are concerned that Sacramento County is not environmentally sensitive. If costs are $150 million, we want to be a part of this project and bring our $13 million to the table. Quelling growth concerns together (Point Pleasant). The issue has changed dramatically with acquisition of Staten Island. Don't displace more flood-waters than are absolutely necessary. We want to see Department of Water Resources take the lead.

Response to Crouch – Mike Eaton:
This discussion should happen and we welcome Sacramento County's participation.

<u>Written comments:</u>

Public comment cards received at the Sacramento meeting included:

"I do not see reference to paleontological resources (fossils) in either the coping documents for this project or the PEIS/EIR. Have I missed it? CEQA checklist asks if the project would impact paleontological resources. Will the project specific EIS/EIR address impacts to paleontological resources?"

Dr. Lanny H. Fisk, PhD, RG
Paleo Resource Consultations
5325 Elkhorn Blvd., #294
Sacramento, CA 95842
916-339-9594, phone
Lanny@PaleoResource.com

“For flood control and fishery protection purposes consider the installation of a flow deflector at the confluence of Georgiana Sl. and the Mokelumne R The deflector would redirect what is now an upstream flow vector to the Mokelumne R. to a down stream vector.”

John Winther
925-283-4216, phone

Anonymous public comments recorded on flip charts at the Sacramento meeting included:

“Use trip weirs at Staten & McCormack timed to take the peak off flood events.”

State of California
Memorandum

The Resources Agency
Department of Boating and Waterways

Date: February 26, 2003

To: Gwen Knittweis
Department of Water Resources
901 P Street
Sacramento, CA 95814

From: David Johnson, Chief
Legislation, Public Information and Regulations

Subject: (NOP) North Delta Improvements Project SCH# 2003012112

This waterway complex contains many navigable waterways, rivers, and sloughs and the proposed project at some point, may have a negative impact on navigation or the navigability of waterways used by vessels, during the construction or implementation phase of these projects.

Therefore, it is recommended that the project proponent address possible impacts on navigation and mitigation measures needed, such as posting buoys or waterway markers, adopting regulations needed to control vessel speed or limit vessel access during construction or maintenance dredging, or the possibility of issuing local notices to mariners through the U.S. Coast Guard to advise vessel operators of such activities in the areas where the proposed work will take place.

For your information we have enclosed the following:

(1) A copy of Sections 660(a) and 662 of the Harbors and Navigation Code regarding the areas of boating regulations that may be adopted by political subdivisions of the state and the requirement to submit these regulations to the Department of Boating and Waterways (DBW) for review at least 30 days before the effective date is enclosed.

(2) A copy of Sections 7000 through 7007 of Title 14 of the California Code of Regulations, regarding the authorization to place waterway markers to warn or advise boaters and the requirement to notify DBW of the placement of such markers is enclosed.

(3) Telephone numbers for the U.S. Coast Guard for notifying boaters of projects that may effect navigation, through the Local Notice to Mariners i.e., Waterway Management Unit, U.S. Coast Guard in Alameda is (510) 437-3073 and Delta's Coast Guard Boating Safety Unit in Rio Vista, is (707) 374-2871.

If you have any questions regarding these comments, please contact Mike Sotelo of my staff at his number (916) 263-0787 propulsion, unless the person is accompanied in the vessel by a person who is at least 18 years of age and who is attentive and supervising the operation of the vessel.

(c) Subdivisions (a) and (b) do not apply to any of the following:

(1) A person who operates a vessel as a performer in a professional exhibition.

(2) A person engaged in an organized regatta, vessel race, or water ski race.

(3) A person engaged in a marine event authorized pursuant to Section 268.

(d) Any person who violates this section, and any person who permits any other person under 16 years of age to operate a vessel in violation of this section, is guilty of an infraction.

658.7. Ski flag. (a) Failure of the operator of a vessel involved in towing a skier to display or cause to be displayed a ski flag, as described in subdivision (a) of Section 7009 of Title 14 of the California Code of Regulations, to indicate any of the following conditions, is an infraction punishable by a fine not exceeding fifteen dollars ($15):

(1) A downed skier.

(2) A skier in the water preparing to ski.

(3) A ski line extended from the vessel.

(4) A ski in the water in the vicinity of the vessel.

(b) Subdivision (a) does not apply to a performer engaged in a professional exhibition or a person engaged in a regatta, vessel or water ski race or competition, or other marine event authorized pursuant to Section 268.

659. Uniform navigational marking of waters. The department may make rules and regulations for the uniform navigational marking of the waters of this state. Such rules and regulations shall not be in conflict with markings prescribed by the United States Coast Guard. No city, county, or person shall mark the waters of this state in any manner in conflict with the markings prescribed by the department.

660. Application of chapter to all waters; local boating regulations. (a) Any ordiance, law, regulation, or rule relating to vessels, which is adopted pursuant to provisions of law other than this chapter by any entity other than the department, including but not limited to any county, city, port authority, district, or any state agency other than the department shall, notwithstanding any other provision of law, pertain only to time-of-day restrictions, speed zones, special-use areas, and sanitation and pollution control, and the measure shall not conflict with this chapter or the regulations adopted by the department. Except as provided in subdivision (c), any measure relating to boats or vessels adopted by any governmental entity other than the department shall be submitted to the department prior to adoption and at least 30 days prior to the effective date thereof.

(b) The department may make special rules and regulations governing the use of boats or vessels on any body of water within the territorial limits of two or more counties, cities, or other political subdivisions if no special rules or regulations exist or if the department determines that the local laws regulating the use of boats or vessels on that body of water is not uniform and that uniformity is practicable and necessary.

(c) (1) Any entity, including but not limited to any county, city, port authority, district, or state agency, otherwise authorized by law to adopt measures governing the use and equipment, and matters relating thereto, of boats or vessels, may adopt emergency rules and regulations which are not in conflict with the general laws of the state relating to boats and vessels using any waters within the jurisdiction of the entity if those emergency rules and regulations are required to insure the safety of persons and property because of disaster or other public calamity.

(2) The emergency rules and regulations adopted under paragraph (1) shall become effective immediately upon adoption and may remain in effect for not to exceed 60 days thereafter. The emergency rules and regulations shall be submitted to the department on or before their adoption.

(3) After submission of emergency rules and regulations adopted pursuant to paragraph (1) to the department, the department may authorize the adopting entity to make the emergency rules and regulations effective for the period of time greater than 60 days that is necessary in view of the disaster or circumstances.

661. Limitation of liability of owner of a numbered vessel. (a) Every owner of an undocumented vessel numbered under this code is liable and responsible for the death of or injury to person or property resulting from negligence in the operation of such vessel, in the business of the owner or otherwise, by any person using and operating the same with the permission, express or implied, of the owner, and the negligence of such person shall be imputed to the owner for all purposes of civil damage. It shall be presumed that such vessel is being operated with the knowledge and consent of the owner if at the time of the injury, death or damage it is under the control of his or her spouse, father, mother, brother, sister, son, daughter, or other immediate member of the owner's family. Nothing contained in this chapter shall be construed to relieve any person from any liability which he would otherwise have, but nothing contained in this chapter shall be construed to authorize or permit any recovery in excess of injury or damage actually incurred.

(b) The liability of an owner for imputed negligence imposed by this section and not arising through the relationship of principal and agent or master and servant is limited to the amount of ten thousand dollars ($10,000) for the death of or injury to one person in any one accident and, subject to the limit as to one person, is limited to the amount of twenty thousand dollars ($20,000) for the death of or injury to more than one person in any one accident and is limited to the amount of ten thousand dollars ($10,000) for damage to property of others in any one accident.

(c) In any action against an owner on account of imputed negligence as imposed by this section the operator of the vessel whose negligence is imputed to the owner shall be made a party defendant if personal service of process can be had upon the operator within this State. Upon recovery of judgment, recourse shall first be had against the property of the operator so served.

(d) If there is recovery under this section against an owner based on imputed negligence, the owner is subrogated to all the rights of the person injured or whose property has been injured and may recover from the operator the total amount of any judgment and costs recovered against the owner.

(e) If the bailee of an owner with the permission, expressed or implied, of the owner permits another to operate the vessel of the owner, then the bailee and such operator shall both be deemed operators of the vessel of the owner within the meaning of subdivisions (c) and (d) of this section.

(f) Where two or more persons are injured or killed in one accident, the owner may settle and pay any bona fide claims for damages arising out of personal injuries or death, whether reduced to judgment or not, and the payments shall diminish to the extent thereof the owner's total liability on account of the accident. Payments aggregating the full sum of twenty thousand dollars ($20,000) shall extinguish all liability of the owner for death or personal injury arising out of the accident which exists by reason of imputed negligence, pursuant to this section, and did not arise through the negligence of the owner nor through the relationship of prinicipal and agent or master and servant.

(g) If a vessel is sold under a contract of conditional sale whereby the title to such vessel remains in the vendor, such vendor or his assignee shall not be deemed an owner within the provisions of this section relating to imputed negligence, but the vendee or his assignee shall be deemed the owner notwithstanding the terms of such contract, until the vendor or his assignee retakes possession of the vessel. A chattel mortgagee of a vessel out of possession is not an owner within the provisions of this section relating to imputed negligence.

(h) No action based on imputed negligence under this section shall abate by reason of the death of any injured person or of any person liable or responsible under the provisions of this section. In any action for physical injury based on imputed negligence under this section by the executor, administrator, or personal representative of any deceased person, the damages recoverable shall be the same as those recoverable under Section 956 of the Civil Code.

662. Filing of local boating regulations. A copy of the ordinances or local laws adopted pursuant to this chapter, and of any amendments thereto, shall be filed in the office of the department.

663. Enforcement by peace officers; authority to stop and board vessels. Every peace officer of this state or of any city, county, city and county, or other political subdivision of the state shall enforce this chapter and any regulations adopted by the department pursuant to this chapter and in the exercise of that duty shall have the authority to stop and board any vessel subject to this chapter, where the peace officer has probable cause to believe that a violation of state law or regulations or local ordinance exists.

663.1. Arrest without warrant. Notwithstanding any other provision of law, a peace officer may, without a warrant, arrest a person who is involved in an accident in the waters of this state involving a vessel when the officer has reasonable cause to believe that the person had been operating the vessel while under the influence of an alcoholic beverage or any drug, or under the combined influence of an alcoholic beverage and any drug.

663.5. Enforcement by harbor policemen; marking of police vessels. Within the territorial limits of a county, city, or district, a harbor policeman regularly employed and paid as such by the county, city, or district shall also enforce the provisions of this chapter and any rules or regulations adopted by the department pursuant to this chapter and the provisions of Chapter 2 (commencing with Section 9850) of Division 3.5 of the Vehicle Code.

In the exercise of his duties, a harbor policeman shall have the authority to stop any vessel subject to this chapter and to issue written notices to appear in court pursuant to Section 664. As used in Section 664, the term "officer" shall include a harbor policeman regularly employed and paid as such by a county, city, or district.

Every harbor policeman who is on duty for the purpose of enforcing the provisions of this chapter, and the rules and regulations adopted by the department pursuant to this chapter, shall wear a full distinctive uniform, and, if he uses a vessel, the vessel shall be painted a distinctive color and appropriately marked as specified by the department to identify it as a harbor police vessel.

663.6. Vessel shall stop on lawful order. Every vessel subject to this chapter, if under way and lawfully ordered to stop and lie to by a peace officer or harbor policeman authorized to enforce the provisions of this chapter who is either in a uniform of a law enforcement agency or the harbor police or in a vessel that is distinctly marked as belonging to a law enforcement agency or to the harbor police,

6698.2. Director's Authority for Restrictions or Closures.

(a) During emergency situations, such as actual or projected high water levels or flooding, and in the interest of preserving the safety of persons and property, the director, or his or her designee, may restrict or order the closure of all or any part of the waters in the Sacramento-San Joaquin Delta, its tributaries and distributaries, and Suisun Bay, Grizzly Bay, and Honker Bay and their tributaries and distributaries to recreational vessels.

(b) In accordance with Section 660 of the Harbors and Navigation Code, all emergency restrictions or closures issued by the Department shall be effective for no more than 60 days. However, the director, or his or her designee may issue new restrictions or closures when the emergency is expected to continue beyond the 60 day period, after a public hearing is held by the department to receive comments from the public.

(c) The director, or his or her designee, may rescind or modify the restrictions or closures based on the status of the emergency conditions and/or the information or testimony provided at the public hearing referenced in subsection (b) above.

(d) When the director, or his or her designee, determines that the emergency situation, such as high water levels or flooding, has diminished, a notice shall be issued to law enforcement agencies, marinas, and news organizations rescinding the restrictions or closure.

NOTE: Authority cited: Sections 63.9(e) and 660(b) and (c), Harbors and Navigation Code. Reference: Sections 33, 63.9(e), 650 and 660(b) and (c), Harbors and Navigation Code; Executive Order W-156-97; and Attorney General Opinion No. 97-307.

Article 6. Waterway Marking System

7000. Scope.

Pursuant to the authority vested in it by Section 659, Harbors and Navigation Code, the Department adopts rules and regulations for a uniform system for marking the State's waters; such rules and regulations to establish, (a) a system of regulatory markers for use on all waters of the State to meet needs not provided for by the U.S. Coast Guard system of navigational aids, and (b) a system of navigational aids for use on the waters of the State not marked by the U.S. Coast Guard and/or not determined to be United States navigable waters; provided that such rules and regulations shall not be in conflict with the markings prescribed by the U.S. Coast Guard.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7001. Definition (as used in this article).

(a) Waterway marker is any device designed to be placed in, on or near the water to convey an official message to a boat operator on matters which may affect health, safety, or well being, except that such devices of the United States or an agency of the United States are excluded from the meaning of this definition.

(b) Regulatory Marker is a waterway marker which has no equivalent in the U.S. Coast Guard system of navigational aids.

(c) State Aid to Navigation is a waterway marker which is the equivalent of a U.S. Coast Guard aid to navigation.

(d) Buoy is any device designed to float which is anchored in the water and which is used to convey a message.

(e) Sign is any device for carrying a message which is attached to another object such as a piling, buoy, structure or the land itself.

(f) A Display Area is the area on a sign or buoy needed for display of a waterway marker symbol.

(g) Symbols are geometric figures such as a diamond, circle, rectangle, used to convey a basic message.

(h) "Department" means the Department of Boating and Waterways.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7002. Waterway Markers Used on the Waters of This State Shall Be As Follows.

(a) State Aids to Navigation.

(1) A red buoy or sign shall indicate that side of a channel to be kept to the right of a vessel when entering the channel from the main water body or when proceeding upstream; a green buoy or sign shall indicate that side of a channel to be kept to the left of a vessel when entering the channel from the main water body or when proceeding upstream.

These buoys or signs shall normally be used in pairs and only for the purpose of marking a clearly defined channel.

(2) A red and white vertically striped buoy or sign shall indicate the center of a navigable waterway.

(3) A red and green horizontally striped buoy or sign shall indicate a junction in the channel, or a wreck or obstruction which may be passed on either side. If the top band is red, the preferred channel is to the left when proceeding upstream or leaving the main water body. If the top band is green the preferred channel is to the right when proceeding upstream or leaving the main water body.

(4) White buoys shall indicate anchorage areas.

(5) The shapes of state aids to navigation shall be compatible with the shapes established by Coast Guard regulations for the equivalent Coast Guard aids to navigation.

(6) When lights are placed on buoys as an aid to navigation, their characteristics shall be compatible with those designated by Federal Regu-

lations for federal aids to navigation. Red lights for this purpose shall be used only on red buoys and green lights only on green buoys.

(b) Regulatory Markers.

(1) A diamond shape of international orange with white center shall indicate danger. The nature of the danger may be indicated by words or well-known abbreviations in black letters inside the diamond shape, or above and/or below it on white background.

(2) A diamond shape of international orange with a cross of the same color within it against a white center without qualifying explanation shall indicate a zone from which all vessels are excluded.

(3) A circle of international orange with white center will indicate a control or restriction. The nature of the control or restriction shall be indicated by words, numerals, and/or well-known abbreviations in black letters inside the circle. Additional explanation may be given above and/or below it in black letters on white background.

(4) A rectangular shape of international orange with white center will indicate information, other than a danger, control or restriction, which may contribute to health, safety or well-being. The message will be presented within the rectangle in black letters.

(c) Letters or Numbers on Waterway Markers.

(1) Numbers, letters or words on a state aid to navigation or regulatory marker shall be placed in a manner to enable them to be clearly visible to an approaching or passing vessel. They shall be block style, well proportioned and as large as the available space permits. Numbers and letters on red or black backgrounds shall be white; numbers and letters on white backgrounds shall be black.

(2) State aids to navigation shall be numbered or lettered for identification. Red buoys and signs marking channels shall be identified with even numbers, and green buoys and signs marking channels shall be identified with odd numbers, the numbers increasing from the main water body or proceeding upstream. Buoys and signs indicating the center of a waterway or a channel junction shall be identified by letters of the alphabet. All numbers and letters used to identify state aids to navigation shall be preceded by the letters "CF."

(d) Reflectorized Material. Where reflectorized materials are used, a red reflector will be used on a red buoy, a green reflector on a green buoy, and white reflectors only will be used on all other waterway markers, except that orange reflectors may be used on orange portions of regulatory markers, and yellow reflectors may be used on Special Markers, as defined in Section 7002.1.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7002.1. Special Markers.

Special markers are not primarily intended to assist navigation, but are used to indicate a special area or feature (i.e., traffic separation, anchorage areas, dredging, fish net areas, etc.) whose nature may be apparent from reference to a chart or other nautical document.

(a) Aids used to mark these areas or systems will be all yellow.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650, 655.3, and 659, Harbors and Navigation Code.

7003. Authority to Place Markers.

(a) No waterway marker shall be placed on, in, or near the waters of the State unless such placement is authorized by the agency or political subdivision of the State having power to give such authorization, except that the provisions of this section shall not apply to private aids to navigation under the jurisdiction of the U.S. Coast Guard.

(b) Such agency or political subdivision of the State will, prior to authorizing placement, obtain the necessary clearances of any federal and state agencies concerned. Nothing herein contained shall be construed to require such prior clearance with the Department.

(c) The agency or political subdivision of the State authorizing the placement of a waterway marker will inform the Department of the following:

(1) Exact location of the marker, expressed in latitude and longitude, or in distance and direction from one or more fixed objects whose precise location is known.

(2) The description and purpose of the marker, including its identifying number, if any, as required by Section 7002(a)(5), above.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7004. Maintenance of Waterway Markers.

Waterway markers shall be maintained in proper condition, or be replaced or removed.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7005. Display of Waterway Markers.

(a) A waterway marker may be displayed as a sign on a fixed support, as a buoy bearing a symbol on its surface, or as a sign mounted on a buoy.

(b) When a buoy is used to carry a symbol on its surface, it will be white, with a band of international orange at the top and a band of international orange above the water line at the bottom.

(c) A buoy whose sole purpose is to carry a sign above it will be marked with three bands of international orange alternating with two bands of white, each band occupying approximately one-fifth of the total area of the buoy above the water line, except where the sign itself carries orange bands; however, nothing in these regulations will be construed to prohibit the mounting of a sign on a buoy which has been placed for a purpose other than that of carrying a sign.

(d) When symbols are placed on signs, a suitable white background may be used outside the symbol.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7006. Specifications for Waterway Markers.

(a) The size, shape, material, and construction of all markers, both fixed and floating, shall be such as to be observable under normal conditions of visibility at a distance such that the significance of the marker or aid will be recognizable in time to avoid danger.

(b) Waterway markers shall be made of materials which will retain, despite weather and other exposures, the characteristics essential to their basic significance, such as color, shape, legibility and position.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7007. Other Waterway Marking Devices.

(a) Mooring Buoys. In order that mooring buoys shall not be mistaken for aids to navigation or regulatory markers, they shall be white, with a blue band clearly visible above the waterline.

(b) Placement of markers such as mooring buoys and permanent race course markers will be processed in the same manner as waterway markers.

(c) Such markers shall not be of a color, shape, configuration or marking which could result in their confusion with any federal or state aid to navigation or any state regulatory marker, and shall not be placed where they will obstruct navigation, cause confusion, or constitute a hazard.

NOTE: Authority cited: Section 659, Harbors and Navigation Code. Reference: Sections 650 and 659, Harbors and Navigation Code.

7008. The Divers Flag.

(a) A red flag with a white diagonal running from the upper left hand corner to the lower right hand corner (from masthead to lower outside corner) and known as the "Divers Flag" shall when displayed on the water, indicate the presence of a person engaged in diving in the water in the immediate area.

(b) Recognition of this flag by regulation will not be construed as conferring any rights or privileges on its users, and its presence in a water area will not be construed in itself as restricting the use of the water area so marked.

(c) Operators of vessels will, however, exercise precaution commensurate with conditions indicated.

630-71
I+23

DEPARTMENT OF CONSERVATION

STATE OF CALIFORNIA

CALIFORNIA CONSERVATION

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET
SACRAMENTO
CALIFORNIA
95814

PHONE
916/324-0850

FAX
916/327-3430

TDD
916/324-2555

INTERNET
consrv.ca.gov

GRAY DAVIS
GOVERNOR

February 27, 2003

Ms. Gwen Knittweis
North Delta Project Manager
California Department of Water Resources
P.O. Box 94236
Sacramento, CA 94236-0001

State Clearinghouse
Office of Planning and Research
1400 10th Street
Sacramento, CA 95814

Subject: SCH# 2003012112 - Notice of Intent to Prepare an Environmental Impact Statement/Report for the North Delta Improvements Project

Dear Ms. Knittweis:

California Department of Conservation's (Department) Division of Land Resource Protection (DLRP) staff have reviewed the above-cited document. The Department of Water Resources (DWR) and the U.S. Army Corps of Engineers (Corps) are co-lead agencies in the preparation of an environmental impact statement/report for the implementation of flood control improvements in the northern Sacramento-San Joaquin Delta. These improvements would benefit aquatic and terrestrial habitats while alleviating flood-related problems. The Point Pleasant area, McCormack-Williamson Tract, Dead Horse Island, New Hope Tract, Brack and Canal Ranch Tracts and the Franklin Pond area have recent histories of levee failure and overtopping due to insufficient channel capacities.

The Alternatives section briefly describes six concepts that are being considered for implementation. We ask that the draft environmental document address the following comments:

- We recommend that the Department's DLRP's Land Evaluation and Site Assessment (LESA) model be used for each project alternative to ensure that potentially significant effects on the environment of agricultural land conversions are quantitatively and consistently considered in the environmental review process (Public Resources Code section 21095).

- Additionally, mitigation measures must be considered when there is an apparent impact to agricultural resources, and these mitigation measures must be consistent those identified in the CALFED Record of Decision (ROD), as appropriate for the plans and projects identified. The Division has compiled an annotated listing of approximately 30 "conservation tools" that have been used to conserve or mitigate project impacts on agricultural land. This compilation report is available upon request.

- The NOP indicates that DWR and the Corps will incorporate project elements into the EIS/R that support six CALFED objectives, one of which includes minimizing the conversion of prime, statewide-important and unique farmlands to NDIP uses. The EIS/R should provide a thorough discussion describing how this objective will be met when discussing each alternative. The document should note the location and quality of agricultural lands that may have already been acquired to support the project, as well as any additional agricultural lands to be acquired in the future. Also, potential locations for any less-than-fee-title acquisitions, such as habitat easement acquisitions which preclude agricultural uses should be identified.

We are available to assist the lead agencies in assuring that the environmental documentation prepared for these projects addresses the Division's concerns. Please send a copy of the draft environmental document when it becomes available for review. Thank you for the opportunity to review this NOP. Please contact Jeannie Blakeslee, Staff Environmental Scientist at (916) 323-4943 if you have any questions.

Sincerely,

Dennis J. O'Bryant

Dennis J. O'Bryant, Manager
Williamson Act Program

630.71
It 23.1

State of California

Memorandum

To: Ms. Gwen Knittweis
Department of Water Resources
901 P Street
Sacramento, CA 95814

Date: February 28, 2003

Place: Sacramento

Phone: (916) 657-4956

From: **Department of Food and Agriculture** Steve Shaffer, Director
Office of Agricultural and Environmental Stewardship

Subject: Notice of Preparation/Notice of Intent (NOP) of a Draft Environmental Impact Report/Statement (DEIR) on the North Delta Improvements Project -- **SCH #2003012112**

The California Department of Food and Agriculture (CDFA) has reviewed the NOP for the proposed flood control improvements project referenced above. CDFA's mission is to protect and promote California agriculture and the natural resources upon which agriculture depends. Towards this end, we offer the following suggestions for the DEIR.

The DEIR will be prepared to document the environmental impacts of the North Delta Improvements Project, a project that is part of the CALFED Bay-Delta Program. The project would result in flood control enhancements in the northern Sacramento-San Joaquin Delta, including Staten and Dead Horse Islands and the McCormack Williamson Tract. The purpose of the project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats on and around these areas and throughout the Delta. Consistent with the CALFED Bay-Delta Programmatic EIR/S, among the other objectives of the project will be to "minimize the conversion of prime, statewide-important, and unique farmland to NDIP uses."

CDFA participates on the interagency North Delta Advisory Team. Through the team's meetings, we have provided input on the project and its potential impacts on agricultural resources. The following comments comprise a reiteration and elaboration of our prior contributions.

<u>Setting – Regulatory</u>

Because federal funding and approvals will be part of this project, the regulatory setting description should address the requirements of the 1981 federal Farmland Protection Policy Act, which is intended to direct federal projects towards alternative designs and locations that have less adverse impacts on agricultural lands. Towards this end, the USDA Land Evaluation and Site Assessment will need to be conducted on components of the project to rank and compare project alternatives.

Similarly, CEQA directs lead agencies to use thresholds of significance in comparing project alternatives and determining whether project impacts merit mitigation. The CEQA guidelines advise that a California version of the federal Land Evaluation and Site Assessment be used for this purpose.

Setting – Environmental

The agricultural resource setting should be described using USDA soil survey and California Department of Conservation Important Farmland Series maps to document the nature and distribution of the land resource base. We recommend that county agricultural commissioner annual crop reports be used to describe the quality and quantity of current and historic crop production in the project area. Conditions that affect agricultural viability in the project area, such as the presence and condition of agricultural infrastructure, flooding constraints, levee maintenance, subsidence and salinity should also be described.

Environmental Impacts

Four kinds of impacts on agricultural resources should be discussed in the DEIR. First, the direct impacts of the project on the conversion of agricultural land should be quantified and described in terms of location and quality of soils and Important Farmland series definitions. Second, the indirect impacts on agricultural land use should be described. These include impacts on the quality and availability of agricultural water; seepage resulting from land use or water management changes on adjacent properties or waterways; impacts on agricultural infrastructure, such as roads and levees; wildlife depredation from restored habitat; restrictions on agricultural practices due to water quality, flood management, wildlife improvements of the project; trespass or vandalism from new recreational improvements; etc.

A number of projects have been implemented or are proposed under the auspices of CALFED and related programs that affect agricultural resources. For example, acquisition of agricultural property for its conversion to wildlife habitat, conversion of agricultural lands for project infrastructure, and the use of agricultural islands for water storage, threaten to take a cumulative toll on the viability of the Delta as an important agricultural production region of the State. Therefore, we recommend that the DEIR conduct an in-depth analysis of the cumulative agricultural impacts of the project, taking into account not only the impacts of past, current and foreseeable CALFED and related projects, but also the affects of urbanization.

Finally, we recommend that the DEIR discuss the growth-inducing impacts of the project on agricultural land. In particular, how the project's enhanced protection of currently flood-prone agricultural lands could increase the value of these lands for urban development, and lead to farmland conversion, should be documented.

In discussing all of these kinds of impacts, the presence of Williamson Act, Farmland Security Zone agreements and agricultural land conservation easements should be considered. The impacts of the project on lands protected by these contractual restrictions should be documented in consultation with the Department of Conservation, which provides statewide administration for these programs. Also, where Williamson Act land will need to be acquired for the project, CDFA should be notified in advance, via the Department of Conservation, for review and comment.

Mitigation and Project Alternatives

We recommend that where elements of the project will have adverse impacts on agricultural resources, alternatives that would lessen or avoid those impacts be considered.

Project elements that could impair continuing agricultural uses should be mitigated on a case-by-case basis. For example, installation of pumps to mitigate increased seepage impacts from newly created wetlands or the flooding of adjacent lands.

For a large-scale, long-term project, such as the one proposed, we recommend that an agricultural land conversion mitigation bank be created that takes a strategic and systematic approach to protecting the remaining agricultural lands in the project area. For example, the Department of Conservation's Farmland Conservancy Program account could be used as a deposit for agricultural land impact mitigation fees for subsequent use in acquiring easements on key agricultural lands in the Delta on a 1:1 basis for each acre of agricultural land that is converted or impaired as a result of the project. Mitigation funds could also be used to support wildlife friendly agriculture/agricultural friendly wildlife habitat projects in the Delta. Such projects should be considered as an project alternative to lessen the need, or mitigate the need for fee title acquisition and conversion of agricultural lands as part of this or related CALFED projects. The CALFED Working Landscape Subcommittee, for example, is working on the feasibility of establishing a USDA Conservation Reserve Enhancement Program area in the Delta. This program offers growers incentives to manage their lands in a manner that benefits wildlife and water quality. The program requires a state match in funding. Mitigation fees from project impacts on agricultural land could contribute towards this state match.

I look forward to working with you and the North Delta Advisory Team as you move ahead with developing the DEIR. Please feel free to contact me with any questions on our comments.

DEPARTMENT OF TRANSPORTATION
DIVISION OF TRANSPORTATION PLANNING, MS-32
1120 N STREET
P.O. BOX 942874
SACRAMENTO, CA 94274-0001
PHONE (916) 653-
FAX (916) 653-1447

630.71

Flex your power!
Be energy efficient!

March 4, 2003

Sandra White
Ecosystem Restoration Unit
Department of Fish and Game
4001 North Wilson Way
Stockton, CA 95205

Subject: Draft Delta Regional Area Land Use Designations and Ownership

Dear Ms. White:

Thank you for the opportunity to review and comment on this draft document. The California Department of Transportation's (Department) headquarters and districts 3 and 10 intergovernmental review (IGR) units have reviewed this draft document. In addition to districts 3 and 10 this Delta Regional Area includes land under the jurisdiction of the Department's District 4 office, Oakland. See the attached Department map for district boundaries. The Department has the following comments:

- The Department's principal land holdings lie within and along state highway right of way. The state highways located in this area of study include Interstate 5, highway 113, highway 12, Interstate 80, highway 160, highway 4, Interstate 205, Interstate 580, highway 120, and other state highways we might have overlooked in the Department's initial review of this project area. Please provide mapping clearly showing the state highways, structures (bridges, interchanges, over- and underpasses, etc.) and other transportation facilities relative to the area of this project's potential impacts.
- Prior to any wetlands or habitat restoration projects the Department recommends a thorough analysis of these areas to determine the potential for significant impacts to the Department's structures and highway facilities. These impacts might include hydraulic or water intrusion impacts causing soil expansion, contraction, washouts, etc. Much of the delta is peat type, highly absorptive soil that creates subsidence problems for highway maintenance and construction. Some of these areas require continuous or frequent pumping of water away from state highways, structures and facilities. Mitigations that might be necessary include buffer zones, realignments, infill, roadway elevation, water pumps, etc.

- Land use changes and ownership changes necessary to implement this project and other Delta Wetlands projects in this area might affect the Department's ownership/property rights, property management/maintenance responsibilities of the state transportation corridors, property acquisition, highways, structures and other transportation facilities. The Department looks forward to working with your department and other Delta Wetlands project proponents to improve the quality and quantity of the natural environment while concurrently improving, maintaining and enhancing the California State Transportation system and its associated facilities.
- Individual projects should be assessed for their individual and cumulative impacts to the state transportation system and the system's structures and associated facilities.
- Recently the Department reviewed and commented on the North Delta Improvements Project. Please clarify the differences in these two projects, their project land areas, their potential impacts, and potential mitigation similarities and differences. Are there several different projects in the same regional areas? It appears that there are. If so, how are these different projects, their different impacts and the need for different mitigations going to be met and addressed? The North Delta Improvements Project has recently circulated a Notice of Preparation of a Draft Environmental Impact Report. Are all the separate projects in this area going to be initiating different and individual environmental studies and reports?

Please provide our office with four copies of any future reports or environmental documents. We will subsequently send these reports and documents to the district 3, 4 and 10 offices. I look forward to working with you and your department to improve our natural environment while maintaining and enhancing the state transportation system. If you have any questions regarding these comments, please contact me at e-mail Bill.Costa@dot.ca.gov or (916) 653-9689.

Sincerely,

William J. Costa

William J. Costa, Manager
Department of Transportation
Intergovernmental Review Program

Attachment

c: Richard Felkins, HQ IGR
Jeff Pulverman and Ken Champion, D-3 IGR
Tom Dumas, Lynn O'Connor, Carolyn Yee, D-10 IGR
Tim Sable, D-4 IGR
Nick Burmas, HQ Structures Hyd.
Gwen Knittweis, HQ DWR

STATE OF CALIFORNIA
Business, Transportation and Housing Agency
Department of Transportation

JEFF MORALES
Director
California Department of Transportation
1120 N Street
P.O. Box 942874
Sacramento, CA 94274-0001*
Phone: (916) 654-2852
Calnet: 8-464-2852

District 1
1656 Union Street
P.O. Box 3700
Eureka, CA 95502-3770*
Phone: (707) 445-6600
Calnet: 8-538-6600

District 2
1657 Riverside Drive
P.O. Box 496073
Redding, CA 96049-6073*
Phone: (530) 225-3426
Calnet: 8-442-3426

District 3
703 B Street
P.O. Box 911
Marysville, CA 95901*
Phone: (530) 741-4211
Calnet: 8-457-4211

District 4
111 Grand Avenue
P.O. Box 23660
Oakland, CA 94623-0660*
Phone: (510) 286-4444
Calnet: 8-541-4444

District 5
50 Higuera Street
San Luis Obispo,
CA 93401-5415
Phone: (805) 549-3111
Calnet: 8-629-3111

District 6
1352 West Olive Avenue
P.O. Box 12616
Fresno, CA 93778-2616*
Phone: (559) 488-4020
Calnet: 8-422-4020

District 7
120 South Spring Street
Los Angeles, CA 90012
Phone: (213) 897-3656
Calnet: 8-647-3656

District 8
464 West Fourth Street
6th Floor
San Bernardino, CA 92401
Phone: (909) 383-4561
Calnet: 8-670-4561

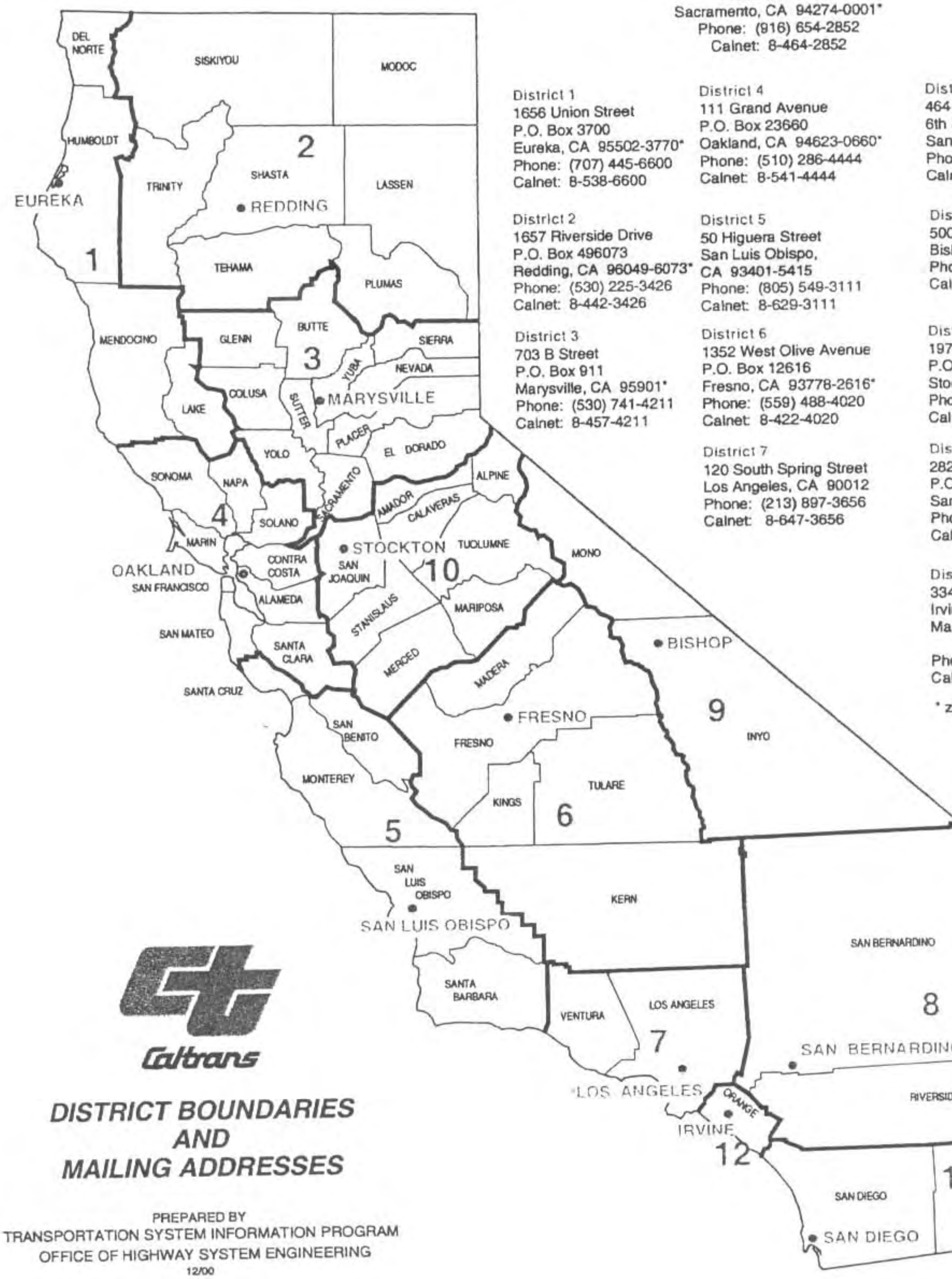
District 9
500 South Main Street
Bishop, CA 93514
Phone: (760) 872-0601
Calnet: 8-627-0601

District 10
1976 East Charter Way
P.O. Box 2048
Stockton, CA 95201
Phone: (209) 948-7543*
Calnet: 8-423-7543

District 11
2829 Juan Street
P.O. Box 85406
San Diego, CA 92186-5406*
Phone: (619) 688-6785
Calnet: 8-688-6785

District 12
3347 Michelson Drive, Suite 100
Irvine, CA
Mail: 3337 Michelson Drive, CN 380
Irvine, CA 92612
Phone: (949) 724-2000
Calnet: 8-655-2000

* zip code for P.O. Box



Caltrans

DISTRICT BOUNDARIES AND MAILING ADDRESSES

PREPARED BY
TRANSPORTATION SYSTEM INFORMATION PROGRAM
OFFICE OF HIGHWAY SYSTEM ENGINEERING
12/00

DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING – MS 32
1120 N STREET
P.O. BOX 942874
SACRAMENTO, CA 94274-0001

PHONE (916) 653-0808
FAX (916) 653-1447
TDD (916) 654-4014

February 26, 2003

Gwen Knittweis
Department of Water Resources
901 P Street
Sacramento, CA 95814

Subject: California Department of Transportation review of State Clearinghouse #2003012112 for Notice of Preparation and Notice of Intent to prepare a Joint Environmental Impact Statement and Environmental Impact Report for Proposed North Delta Improvements Project

Dear Gwen Knittweis:

Thank you for the opportunity to review and comment on this document. The California Department of Transportation (CDOT) District 3 and District 10 IGR/CEQA Branch have reviewed this notice and offer the following comments.

Please provide a more detailed map of the 197 square mile North Delta Area of the Sacramento-San Joaquin Estuary in the DEIR and show overlaid routes with bridge sites traversing this area for our further review. Include numeric designations of the affected State highways within the project boundaries to clarify the scope of the proposed project. On a Delta Wetlands project several years ago CDOT recognized the need to have adequate buffer zones between state delta highways and any adjacent wetland areas. As you probably know, most of the delta is peat type, highly absorptive soil which creates subsidence problems for highway maintenance and construction. Some of these areas require continuous or frequent pumping of water away from our facilities.

CDOT is hopeful that better flood management and containment would pose direct benefits to several State Routes within the delta region. Specifically, during El Nino wet years CDOT had to close segments of State Route (SR) 99 and Interstate 5 along the Cosumnes River and Beach Lake areas within Sacramento County because of flood waters crossing the roadways.

In the Cosumnes River area of Sacramento County we recently placed thrie beam barrier in the SR99 center median. We could not use concrete barrier because of an overtopping condition that we did not want to change or impact. Glare screens are not available on thrie beam guard rail. So, in summary, CDOT could benefit from better flood management in keeping the roadways open continuously and creating more safety options for the traveling public.

In the Morrison Creek area there have been times where Interstate 5, near the Beach Lake and Laguna Boulevard freeway exit, has experienced water encroachment on the off-ramp and outer mainline lane. Better flood management of Morrison Creek would be beneficial.

In the DEIR, CDOT would like clarifying information regarding what bridge structures within the scope of this project require reconstruction or replacement to mitigate potential flood impacts. We understand there may be actions to raise bridge decks above high water levels and actions to widen channels with new bridge approaches, piers and abutments. We are particularly interested in those bridge structures that may be located on State highways and those that involved federal funding for their prior construction. CDOT may have further comments once specific "targeted" structures, locations and actions are known.

If potential traffic disruption is an issue as a result of bridge work, CDOT is interested in an assessment of significance for each site's traffic pattern disruption, the estimated duration, and the recommended detour routes to be used at each bridge's reconstruction and/or replacement location.

CDOT needs to be consulted regarding any necessary State and/or Federal bridge standards, designs, specifications and procedures that should be used at bridge reconstruction sites. CDOT would obviously need to perform detail review regarding anything that involves modification or replacement of bridges with inherent State interests.

An assessment should be made to clarify whether there will be generated daily truck hauling trips from project activities, and whether roadways or barges will be used to transport bridge materials and unused soil off site in carrying out bridge construction, channel widening, dredging, etc. The daily volume of truck trips and haul routes used and required over size loads for such activities should also be provided in the environmental documentation.

A CDOT Encroachment Permit will be required for access to or any work conducted in the State right-of-way. This includes traffic control, culvert maintenance, changes in drainage patterns or other construction work. For permit assistance, please contact Bruce Capaul at (530) 741-4408.

In case by case reviews, CDOT would be concerned with setback levee locations and other channel treatments and their effect on water channel velocities and structures. The hydraulic model results of the project's six alternatives, that include setback levees, should be provided in the documentation. We are particularly interested in the alternatives and comparative model results that have the least structural impacts.

CDOT is concerned with dredging near our structures and requests precautionary measures be taken to protect the structural footings.

Coordination and consultation with CDOT should be maintained through all planning and construction stages near our facilities to ensure that traffic safety and quality standards are met on existing corridors and that they do not conflict with our future transportation corridor improvement plans.

Please provide our office with a copy of the DEIR and the requested information for our review. If you have any further questions regarding these comments, please contact Richard Felkins at (916) 653-0808.

Sincerely,

Richard Felkins

Richard Felkins, Coordinator
CDOT Intergovernmental
Review Program

cc: Ken Champion, District 3, IGR/CEQA
Carolyn Yee, District 10, IGR/CEQA

DELTA AD HOC RECREATION COMMITTEE
c/o Delta Protection Commission
P.O. Box 530
Walnut Grove, CA 95690

January 4, 2000

Steve Ritchie, Acting Executive Director
CALFED
1416 Ninth Street, Room 1155
Sacramento, CA 95814

Subject: Comments on Recreation in the North Delta Bundle of Stage IA Actions

Dear Mr. Ritchie:

The Sacramento-San Joaquin Delta contains around 700 miles of navigable channels, providing a variety of recreational opportunities including boating, fishing, hunting, camping, wildlife viewing, and other day-use activities. According to a recreation survey conducted in 1997, around 23 percent of all registered boaters and licensed anglers in California recreated in the Delta in 1996. Of the boaters and anglers recreating in the Delta, most reside in the Delta counties of Sacramento, San Joaquin, Contra Costa, and Solano, but many travel from as far away as the Bay Area, Stanislaus County, and Los Angeles County. According to an economic analysis of only boating and fishing in the Delta (i.e., not including people who camp, hunt, view wildlife, or recreate at day-use facilities such as parks and picnic areas), it is estimated that the Delta supports well over 14 million recreational user days per year, resulting in over $250 million in expenditures (yielding over $455 million in total expenditures and over 8,000 jobs) in the Delta region.

It is because recreation plays such an integral role in the land use and economy of the Delta region that it is recognized, along with agriculture and wildlife/fisheries habitat, as a land use which needs to be protected by the State of California under the Delta Protection Act of 1992. In light of the tremendous amounts of proposed ecosystem restoration and water quality actions proposed under the CALFED Program for the Delta over the next 30 years, the Delta Ad Hoc Recreation Committee (Committee), which is made up of representatives of several State agencies, boating and recreational fishing groups, and local government recreation managers, was convened to discuss the possible impacts to and future role of recreation activities in these proposed actions.

Recreation in the Delta is focused on the unique attributes of the region – the many waterways, the vegetation, and the fish and wildlife. The proposed ecosystem restoration will support and enhance Delta recreation. The water quality program will enhance water contact recreation opportunities as well as providing enhanced aquatic habitat.

The goal of this Committee is, in an active advisory role, to assist CALFED in identifying unique opportunities to go beyond mitigation requirements and provide new recreational opportunities that tie in with or benefit from the proposed CALFED actions. This strategy of not only mitigating impacts to recreation, but working with the Committee to identify and assist in the development of needed recreation enhancements in the Delta, will help build support for the overall CALFED program from a broader spectrum of the public. The Committee is currently undergoing its own process to identify potential recreation opportunities associated with boating in the Delta and will be providing more information to the CALFED Program as it becomes available. In addition, the Department of Boating and Waterways is preparing a boating needs assessment which will be completed in May 2000. Hopefully, this new information will, with the assistance of the Committee, be incorporated into the CALFED planning process.

Proposed North Delta Bundle of Actions:

The Ad Hoc Committee met with CALFED staff to review the proposed North Delta bundle of actions. CALFED staff described the key projects including: resolution of the local flooding associated with the Cosumnes and Mokelumne Rivers, and habitat restoration along Georgiana Slough and on McCormack Williamson Tract downstream of the confluence of the Cosumnes and Mokelumne Rivers. In addition, studies will be started evaluating the possibility of a new intake on the Sacramento River near Hood and delivering water in the non-flood seasons to the Mokelumne River. These studies will also evaluate operation of the Delta Cross Channel gates.

Existing Recreation in the North Delta Area:

There are a number of marinas in the Walnut Grove area on the Sacramento River and on the Mokelumne River. In addition, there is a public fishing access site (Sacramento County) on Georgiana Slough, and the Delta Meadows State River Park is on Snodgrass Slough (between Locke and McCormack Williamson Tract), including about 250 acres of water-covered lands just acquired by State Parks. These water-covered lands are very popular for summer mooring by houseboats and other boats. The North Delta study area is also popular for fishing from shore and from boats, and canoeing. The Stone Lakes National Wildlife Refuge is within the study area; the Refuge has no permanent facilities for public use but does provide docent-guided access from time to time.

Comments of the Ad Hoc Recreation Committee:

The Committee urges CALFED, in cooperation with the Committee and other interested entities, to work with local, State and federal agencies and non-profit organizations to enhance recreation on public and private landholdings in the North Delta study area. The Committee would like CALFED to address the following general and specific comments.

General Comments:

- Protect existing travel routes for boats; navigability of North Delta channels must be maintained.
- Protect against unreasonable and inappropriate speed zones and other restrictions on recreational boating.
- Develop, in cooperation with specific Committee recreation planning efforts, a Deltawide recreation vision/master plan.
- Strive to fully understand existing recreation activities, facilities, and uses in the North Delta planning area, by utilizing the experience and knowledge of the Committee in the recreational planning processes for the North Delta bundle of actions.
- Ensure that proposals that would impact surface water elevations will not adversely impact recreational uses, existing recreation facilities, water quality, or water temperatures.
- Protect and enhance the water quality in the Delta for aquatic habitat and for water contact recreation.
- Take advantage of publicly owned lands and publicly owned facilities to provide facilities for the general public.
- Partner with private facility owners/managers to provide needed facilities for the public, with the private facility owners/mangers providing oversight and maintenance.
- Partner with private interests, local governments, and special districts to provide needed recreational facilities in the North Delta, noting that local governments do not have adequate funds for operation and maintenance of recreation facilities. CALFED could provide assistance in establishing an endowment fund or a regional entity to utilize in operating and maintaining recreation facilities.
- Coordinate between water quality actions proposed under the CALFED Program and water quality improvement efforts of recreational boaters, such as funding pumpouts, waste disposal facilities, and restrooms.
- Ensure that plans to enhance habitat for a single species would not be detrimental to other species of fish.
- Protect and enhance the habitat of important warm water game fish in the North Delta, such as Black Bass, Striped Bass, and Catfish.

Specific Comments:

- Encourage and possibly assist in the funding of improvements at existing Sacramento County facilities at Georgiana Slough (better restroom; fishing access; picnic facilities; trails); the County could manage improvements.
- Encourage and possibly assist in the funding of public facilities at McCormack-Williamson Tract (wildlife viewing; trail; fishing access; restrooms); Nature Conservancy could manage improvements.
- Encourage and possibly assist in the funding of public facilities at Delta Meadows River Park (small boat launch ramp; boating trails; pumpout facility; fishing access; trails; restroom; parking lot; camping areas; mooring areas); improvements could be managed by the State Park.

- Encourage and possibly assist in the funding of public facilities at Stone Lakes National Wildlife Refuge (visitor's center; parking lot; restrooms; trails; wildlife viewing; educational programs); Fish and Wildlife Service could manage improvements.
- Coordinate with Sacramento County's effort to update its regional trails concept plan, which identifies possible multi-use trails that could be constructed in the North Delta area, and possibly assist in the funding of some of these improvements; Sacramento County could manage new trails and facilities.
- Encourage and possibly assist in the funding of a bicycle/pedestrian trail and restrooms around the Delta Loop; Delta Loop business owners or Sacramento County could manage improvements.
- Encourage and possibly assist in the funding of docks/landings in Delta waterfront communities to allow access from the waterways to the communities and their visitor-serving facilities; local communities could manage improvements.

The Delta Ad Hoc Recreation Committee looks forward to working with the CALFED staff to provide new recreation enhancements in the Delta as part of the North Delta bundle of actions. The Committee appreciates CALFED staff's assistance in this cooperative effort, and looks forward to continuing this working relationship.

Sincerely,

Bill Curry, Chairman
Delta Ad Hoc Recreation Committee

cc: Rob Cooke

CALIFORNIA FARM BUREAU FEDERATION

NATURAL RESOURCES AND ENVIRONMENTAL DIVISION

2300 RIVER PLAZA DRIVE, SACRAMENTO, CA 95833-3293 · PHONE (916) 561-5665 · FAX (916) 561-5691

February 27, 2003

Ms. Becky Wren
Environmental Manager
U.S. Army Corps of Engineers, CESPK-PD-R
1325 J Street
Sacramento, CA 95814-2822

RE: Environmental Impact Statement and Environmental Impact Report for the North Delta Improvements Project, Scoping

Dear Ms. Wren:

The California Farm Bureau Federation ("Farm Bureau") appreciates this opportunity to provide comments and suggestions pertaining to the pending Environmental Impact Statement/Environmental Impact Report ("EIS/R") for the North Delta Improvements Project ("NDIP"). The Farm Bureau represents 53 county farm bureaus, and through them, more than 95,000 members. It is a non-profit, voluntary membership corporation whose purpose is to work for the protection of agriculture and the rural environment in the State of California, and to find solutions to the problems of the farm, the farm home, and the rural community of the state.

After reviewing the Army Corps of Engineer's ("Corps") February 5, 2003 Federal Register Notice, 68 FR 5001, the Farm Bureau has reservations about how impacts to agricultural resources will be addressed in the upcoming environmental review. First and foremost, we are concerned that the Corps may fail to recognize that agricultural land and water resources are a part of the physical environment, thus consideration of impacts to agricultural resources must be included as part of a proper National Environmental Policy Act ("NEPA") and California Environmental Quality Act ("CEQA") review.

AGRICULTURAL RESOURCES MUST BE CONSIDERED IN A LEGALLY DEFINSIBLE NEPA REVIEW

In determining "significance" under NEPA, the discussion in the NPID EIS/R should focus on the "context" and the "intensity" of the impacts.[1] Context under NEPA, "means that the significance of an action must be analyzed in several contexts such as society as whole (human, national), the affected regions, the affected interests, and the locality.[2] Intensity is measured, in part, by considering: (1) unique characteristics of a geographic area such as proximity to historic or cultural resources, parkland, prime *farmlands*, wetlands, wild and scenic rivers, or ecological critical areas; (2) the degree which the effects on the quality of the human environment are likely to be highly controversial; (3) the degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principal about a future consideration; (4) *whether the action is related to other actions with individually insignificant but cumulatively significant impacts*; (5) whether the actions threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.[3]

We want to caution the Corps against overlooking its obligation to consider impacts to agricultural resources as many federal agencies have made this mistake in the past. On August 30, 1976 the Council on Environmental Quality ("CEQ") issued a memorandum to federal agencies informing them of the need to consider farmland loss as a potentially significant environmental impact. The On August 20, 1980, the CEQ issued the following additional guidance to the heads of agencies regarding losses of agricultural lands because:

> Approximately one million acres of prime and unique agricultural lands are being converted irreversibly to non-agricultural uses each year. Actions by federal agencies such as construction activities, development grants and loans, and **federal land management decisions** frequently contribute to the loss of prime and unique agricultural lands directly and indirectly. Often these losses are unintentional and are not necessarily related to accomplishing the agency's mission.
> (45 F.R.59189, *emphasis added* (attached))

For this reason, the CEQ advised:

> If an agency determines that a proposal significantly affect[s] the quality of the human environment, it must initiate the scoping process [cite omitted] to identify those issues, including effects on prime or unique agricultural lands, that will be analyzed and considered, along with the

[1] 40 C.F.R § 1508.27.
[2] *Id.*
[3] *Id.*

> alternatives available to avoid or mitigate adverse effects… The effects to be studied include 'growth inducing effects and other effects related to inducing changes in the patterns of land use…cumulative effects…mitigation measures…to lessen the impact on…agricultural lands.
> (Id., *emphasis added* (attached))

Clearly in light of this guidance, the Corps must consider agricultural resources as part of the physical environment when undertaking its NEPA analysis of alternatives, direct and indirect impacts, cumulative impacts and mitigation alternatives for the NDIP EIS/R.

AGRICULTURAL RESOURCES MUST BE CONSIDERED IN A LEGALLY DEFENSIBLE CEQA REVIEW

Since the environmental review for the NDIP will result in a joint state and federal environmental document, the Corps must consider the fact that CEQA also recognizes agricultural land and water resources as a part of the physical environment.

In CEQA, "[s]ignificant effect on the environment" means, "a substantial, or potentially substantial, adverse change in the environment."[4] The CEQA Guidelines make it clear the "environment" in question encompasses, "any physical conditions within the area affected by the project including land, air, water, minerals, flora, fauna, ambient noise and objects of historic or aesthetic significance."[5] For further guidance as to the exact meaning of "significance," the CEQA Guidelines provide a list of 29 general effects that will cause a project to "normally have a significant effect on the environment."[6]

Of particular relevance is CEQA Guidelines, section II, Agricultural Resources, which states the following:

> In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agriculture Land Valuation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optimal model to use in assessing impacts on agriculture and farmland. Would the project:
> (a) convert prime farmland, unique farmland, or farmland of state-wide importance . . . to non-agricultural use?
> (b) conflict with existing zoning for agricultural use or a Williamson Act contract?

[4] Cal. Pub. Res. Code § 21068.
[5] Cal. Pub. Res. Code § 21068.
[6] CEQA Guidelines, Appendix G.

(c) involve other changes in the existing environment which, due to their location or nature, could result in conversion of farmland to non-agricultural use?

Accordingly, the responsible state agency must also consider agricultural resources as part of the existing environment in completing the required CEQA review for this project.

THE AGRICULTURAL IMPACTS OF THE NORTH DELTA IMPROVEMENTS PROJECT MAY BE SIGNIFICANT

Farm Bureau believes that at least one island that is a part of the NDIP, the McCormack-Williamson Tract, was in agricultural production when it was purchased by the CALFED program. To our knowledge no environmental review was ever completed for the purchase and conversion of the island's agricultural land and water resources. The proper time to have completed the environmental review for this conversion was when the island was purchased. But at the very least, if the NDIP will determine the island's ultimate destiny[7], then the impacts of the initial agricultural conversion must be completed as part of this EIS/R. Similarly, the Corps should investigate the agricultural values of the other islands that will be a part of this project and evaluate impacts to those resources.

The conversion of agricultural resources attributed to the use of these islands for this project also could have significant cumulative impacts since the CALFED Program and other governmental and private actions have converted significant portions of the Delta's agricultural resources in recent years. Moreover, future conversions of agricultural resources in this region are expected to be significant in light of refuge construction, urban development, agricultural water purchases, Endangered Species Act requirements and habitat conservation plans. The growth inducing impacts associated with the loss of agricultural infrastructure and impacts to the domestic food supply also should be considered. Project alternatives and mitigation plans should be developed with these potential impacts in mind.

---

[7] It appears the February 5, 2003 Federal Register Notice, 68 F.R. 5001, that the McCormack-Williamson Tract will be flooded. The notice states, "(a) Whole/Partial Island Flood Detention Areas – Whole and partial island flood detention areas have been proposed for Staten Island, Dead Horse Island, and McCormack-Williamson Tract."

THE PROJECT PURPOSE MAY BE TOO NARROWLY DEFINED

The Farm Bureau also is concerned about the Army's stated project purpose:

> The purpose of the NDIP is to implement flood control improvements in a manner that benefits aquatic and terrestrial species[8].

We are concerned that the project's purpose is too narrowly defined. The NDIP recognizes levee failures that could "[r]esult in flooding of Delta communities, farmland, habitat, key roads and highways" as the "need for the project[9]", yet the flood control improvements are only being completed in a manner that benefits aquatic and terrestrial species, not the protection of agricultural resources, in particular, and other aspects of the human environment, generally.

Finally, to assist the Corps in meeting its obligations, the Farm Bureau believes the Corps should closely coordinate with the Delta Protection Commission as they are statutorily charged with protecting the resources of the Delta[10].

The Farm Bureau appreciates this opportunity to provide scoping comments regarding the NDIP EIS/R. If you have any questions, feel free to contact me at (916) 561-5667.

Sincerely,

Becky Sheehan

Becky Sheehan

cc: Bill Pauli
George Gomes

---

[8] 68 FR 5001

[9] *Id.*

[10] Cal. Pub. Res. Code § 29700, *et al.*

Mclean, Shelly

From: Sheehan Rebecca
Sent: Wednesday, February 26, 2003 3:04 PM
To: Mclean, Shelly
Subject: to attach to comment letter

-----Original Message-----
From: LexisNexis(TM) Print Delivery
[mailto:lexisnexis@prod.lexisnexis.com]
Sent: Wednesday, February 26, 2003 2:38 PM
To: Sheehan Rebecca
Subject: LexisNexis(TM) Email Request (1841:0:81930363)

110QWX

Print Request: Current Document: 1
Time of Request: February 26, 2003 05:37 PM EST
Number of Lines: 209
Job Number: 1841:0:81930363
Client ID/Project Name:

Research Information:
FR - Federal Register
council on environmental

Focus:
agricultural and date(geq (9/8/80) and leq (9/8/80))

Note:

FOCUS - 1 of 3 DOCUMENTS

COUNCIL ON ENVIRONMENTAL QUALITY

45 FR 59189

September 8, 1980

Publishing of Three Memoranda for Heads of Agencies

TEXT: August 20, 1980.

The Council on Environmental Quality is publishing three Memoranda for Heads of Agencies.

The first memorandum, dated August 11, 1980, on Analysis of Impacts on Prime and Unique Agricultural Lands in Implementing the National Environmental Policy Act was developed in cooperation with the Department of Agriculture. It updates and supersedes the Council's previous memorandum on this subject of August 1976.

The second memorandum, dated August 11, 1980, requests information on agency agriculatural land policies and other information related to the implementation of the first memorandum.

The third memorandum, dated August 10, 1980, on Interagency Consultation to

Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory is intended to assist federal agencies in meeting their responsibilities under the President's August 2, 1979 directive.

Edward L. Strohbehn, Jr.,

Executive Director.

Executive Office of the President,

Council on Environmental Quality,

722 Jackson Place, NW., Washington, D.C.

August 11, 1980.

Memorandum for Head of Agencies

Subject: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act

Approximately one million acres of prime or unique agricultural lands n1 are being converted irreversibly to nonagricultural uses each year. Actions by federal agencies such as construction activities, development grants and loans, and federal land management decisions frequently contribute to the loss of prime and unique agricultural lands directly or indirectly. Often these losses are unintentional and are not necessarily related to accomplishing the agency mission.

n1 As used in this memorandum, prime and unique agricultural land is cropland, pastureland, rangeland, forest land or other land, but not urban built-up land, which is capable of being used as prime and unique farmland as defined by the Department of Agriculture (see attachement) [The attachment to this memorandum was § 657.5 of title 7 CFR.]

On August 30, 1976, CEQ, in cooperation with the Department of Agriculture, issued a memorandum to the heads of federal agencies on the need for analysis of prime or unique farmlands in the preparation and review of environmental impact statements. The memorandum also recommended steps for agencies to take in making such analyses. Since that memorandum was issued, federal agencies' environmental impact statements have begun to include references to the presence of prime or unique farmlands that would be affected by the propsed federal action. Moreover, they have clearly indicated that many federal and federally assisted projects have direct and indirect adverse impact on prime or unique farmlands.

Recent studies by the Council and the General Accounting Office indicate that federal agencies have not adequately accounted for the impacts of their proposed actions on agricultural land through the environmental assessment process. Furthermore, agency project plans and decisions have frequently not reflected the need and opportunities to protect these lands. The purpose of this memorandum is to alert federal agenices to the need and the opportunities to analyze agricultural land impacts more effectively in the project planning process and under the National Environmental Policy Act (NEPA).

Agencies can substantially improve their analysis of impacts on prime or unique agricultural lands by following closely our recently established NEPA regulations (40 CFR 1500-1508, Nov. 29, 1978). The regulations apply to these lands in several specific respects. Determining the effects of a proposed federal agency action on prime or unique agricultural lands must be an integral part of the environmental assessment process, and must be a factor in deciding whether or not to prepare an environmental impact statement. For examle, when an agency begins planning any action, it should, in the development of alternative actions, assess whether the alternatives will affect prime or unique agricultural lands. Then, recognizing the importance of these lands and any significant impacts that might affect them, it must study, develop, and describe appropriate alternative uses of available resources. (Sec. 1501.2(c).)

In determining whether to prepare an environmental impact statement, the regulations note that the "Unique characteristics of the geographic area such as * * * prime farmlands * * *" (Sec. 1508.27(b)(3)) must be considered, among others. If an agency determines that a proposal significantly affect the quality of the human environment, it must initiate the scoping process (Sec. 1501.7) to identify those issues, including effects on prime or unique agricultural lands, that will be analyzed and considered, along with the alternatives available to avoid or mitigate adverse effects, An environmental impact statement must include a description of the area that will be affected by the proposed action (Sec. 1502.15) and an analysis of the environmental consequences of the proposal, including a discussion of "natural or depletable resource requirements and conservation potential or various alternative and mitigation measures" (Sec. 1502.16(f)). These resource requirements include prime or unique agricultural lands. The effects to be studied encompass indirect effects that may include "growth inducing effects and other effects related to induced changes in the pattern of land use * * *" (Sec. 1508.8(b)). The cumulative effects of a proposal must be studied (Secs. 1508.7, 1508.8(b)), as must any mitgation measures that could be taken to lessen the impact on prime or unique agricultural lands (Secs. 1505.2(c), 1508.20). Agencies must also cooperate with state or local governments in their efforts to help retain these lands (Secs. 1502.16(c), 1506.2(d).)

Federal agencies with technical data on the occurence, value, or potential impacts of federal actions on these lands will provide the lead agency with data that may be useful in preparing environmental assessments or impact statements. The U.S. Department of Agriculture will cooperate with all agencies in planning projects or developments, in assessing impacts on prime or unique agricultural lands, and in defining alternatives. Technical data as assistance regarding agricultural land may be obtained by contacting the Chairperson of the USDA Land Use Committee (list attached) or any USDA office. In addition to providing technical data and assistance, the USDA will continue to emphasize the review of EISs on federal actions likely to have significant effects on prime and unique farmlands. Under Section 1504 of the regulations, USDA should refer to CEQ those proposed federal actions which it believes will be environmentally unsatisfactory because of unacceptable effects on prime or unique farmlands. CEQ will review such referrals, and take necessary steps in accordance with Section 1504 of our regulations.

Because prime and unique agricultural lands are a limited and valuable resource, the Council urges all agencies to make a particularly careful effort to apply the goals and policies of the National Environmental Policy Act to their actions and to obtain necessary assistance in their planning processes so that these lands will be maintained to meet our current national needs and the needs of future generations of Americans.

Gus Speth,

Chairman.

Attachments.

U.S. Department of Agriculture State Land Use Committee Chairpersons

Mr. William B. Lingle, State Conservationist, Soil Conservation Service, P.O. Box 311, Auburn, Alabama 36830

Mr. Marvin C. Meier, Director, State and Private Forestry, 2221 E. Northern Lights Blvd., Box 6606, Anchorage, Alaska 99502

Mr. Thomas G. Rockenbaugh, State Conservationist, Soil Conservation Service, Federal Bldg., Rm. 3008, 230 N. First Street, Phoenix, Arizona 85025

Mr. M. J. Spears, State Conservationist, Soil Conservation Service, P.O. Box 2323, Little Rock, Arkansas 72203

Mr. James H. Hansen, State Resource Conservationist, Soil Conservation Service, 2828 Chiles Road, P.O. Box 1019, Davis, California 95616

Mr. Sheldon G. Boone, State Conservationist, Soil Conservation Service, P.O. Box 17107, Denver, Colorado 80217

Ms. Maria Maiorana Russell, Assistant Director, Community Resource & Staff Dev., Cooperative Extension Service, University of Connecticut, Storrs, Connecticut 06268

Mr. Otis D. Fincher, State Conservationist, Soil Conservation Service, 204 Treadway Towers, 9 East Lockerman Street, Dover, Delaware 19901

Mr. William E. Austin, State Conservationist, Soil Conservation Service, P.O. Box 1208, Gainesville, Florida 32601

Mr. Dwight Treadway, State Conservationist, Soil Conservation Service, P.O. Box 832, Athens, Georgia 30601

Mr. Jack P. Kanalz, State Conservationist, Soil Conservation Service, P.O. Box 50004, Honolulu, Hawaii 96850

Mr. Randall Johnson, Farmers Home Administration, U.S. Department of Agriculture, 304 North Eighth Street, Boise, Idaho 83702

Mr. Warren J. Fitzgerald, State Conservationist, Soil Conservation Service, P.O. Box 678, Champaign, Illinois 61820

Mr. Robert Bollman, Assistant State Conservationist, Soil Conservation Service, 5610 Crawfordsville Road, Suite 2200, Indianapolis, Indiana 46224

Mr. Rollin Swank, Assistant State Conservationist, Soil Conservation Service, 693 Federal Bldg., 210 Walnut Street, Des Moines, Iowa 50309

Mr. John W. Tippie, State Conservationist, 760 South Broadway, P.O. Box 600, Salina, Kansas 67401

Mr. Glen E. Murray, State Conservationist, Soil Conservation Service, 333 Waller Avenue, Lexington, Kentucky 40504

Dr. Floyd L. Corty, Ag. Econ. & Agribusiness, Louisiana State University, Baton Rouge, Louisiana 70803

Mr. Eddie L. Wood, State Conservationist, Soil Conservation Service, USDA Bldg., Univ. of Main, Orono, Maine 04473

Mr. Gerald R. Calhoun, State Conservationist, Soil Conservation Service, Rm. 522, Hartwick Bldg., 4321 Hartwick Road, College Park, Maryland 20740

Dr. Gene McMurtry, Assoc. Dir., Coop. Ext. Service, Stockbridge Hall, Rm. 211, University of Massachusetts, Amherst, Massachusetts 01003

Dr. Raleigh Barlowe, 323 Natural Resources Bldg., Michigan State University, East Lansing, Michigan 48824

Mr. Harry M. Major, State Conservationist, Soil Conservation Service, 316 North Robert Street, St. Paul, Minnesota 55101

Mr. Billy C. Griffin, Deputy State Conservationist, Soil Conservation Service, P.O. Box 610, Jackson, Mississippi 39205

Mr. Kenneth G. McManus, State Conservationist, Soil Conservation Service, 555 Vandiver Drive, P.O. Box 459, Columbia, Missouri 65201

Mr. Van K. Haderlie, State Conservationist, Soil Conservation Service, Federal Bldg., P.O. Box 970, Bozeman, Montana 59715

Mr. Russell Schultz, Soil Conservation Service, Federal Bldg., U.S. Courthouse, Rm. 345, Lincoln, Nebraska 68508

Mr. Gerald C. Thola, State Conservationist, Soil Conservation Service, P.O. Box 4850, Reno, Nevada 89505

Mr. Roger Leighton, James Hall, University of New Hampshire, Durham, New Hampshire 03824

Mr. Plater T. Campbell, State Conservationist, Soil Conservation Service, 1370 Hamilton Street, P.O. Box 219, Somerset, New Jersey 08873

Mr. Thomas G. Schmeckpeper, Deputy Regional Forester, U.S. Forest Service, Rm. 5424, Federal Bldg., 517 Gold Avenue, S.W., Albuquerque, New Mexico 87102

Mr. Robert L. Hilliard, State Conservationist, Soil Conservation Service, U.S. Courthouse & Federal Bldg., 100 South Clinton St., Rm. 771, Syracuse, New York 13260

Mr. Mitchell E. Clary, Assistant State Conservationist, Soil Conservation Service, P.O. Box 27307, Raleigh, North Carolina 27611

Mr. Sylvester C. Ekart, Chairman, North Dakota Land Use Comm., Federal Bldg., P.O. Box 1458, Bismarck, North Dakota 58501

Mr. Robert R. Shaw, State Conservationist, Soil Conservation Service, Federal Bldg., Rm. 522, 200 N. High Street, Columbus, Ohio 43215

Mr. Bobby T. Birdwell, Soil Conservation Service, Agricultural Center Office Bldg., Farm Road & Brumley Street, Stillwater, Oklahoma 74074

Mr. Guy Nutt, State Conservationist, Soil Conservation Service, Federal Bldg., 16th Floor, 1220 SW Third Avenue, Portland, Oregon 97204

Mr. Thomas B. King, Associate Director, Cooperative Extension Service, The Pennsylvania State University, 323 Agricultural Admin. Bldg., University Park, Pennsylvania 16802

Mr. Richard F. Kenyon, State Executive Director, Agricultural Stabilization and Conservation Service, 222 Quaker Lane, West Warwick, Rhode Island 02893

Mr. K. G. Smith, State Director, Farmers Home Administration, 240 Stoneridge Drive, Columbia, South Carolina 29210

Mr. Wayne D. Testerman, State Executive Director, Agricultural Stabilization and Conservation Service, 200 Fourth Street, SW., Federal Bldg., Rm. 210, Huron, South Dakota 57350

Dr. M. Lloyd Downen, Director, Agricultural Extension, University of Tennessee, P.O. Box 1071, Knoxville, Tennessee 37901

Mr. George C. Marks, State Conservationist, Soil Conservation Service, P.O. Box 648, Temple, Texas 76501

Mr. Reed Page, State Director of the Farmers Home Administration, 125 South State St., Rm. 5434, Salt Lake City, Utah 84138

Mr. Coy Garrett, State Conservationist, Soil Conservation Service, One Burlington Square, Suite 205, Burlington, Vermont 05401

Mr. Manly S. Wilder, State Conservationist, Soil Conservation Service, 400 North Eighth Street, P.O. Box 10026, Richmond, Virginia 23240

Mr. Lester N. Liebel, Ext. Rural Development Coord., Cooperation Extension Service, Washington State University, 417, Ag. Phase II, Pullman, Washington 99163

Mr. Craig M. Right, State Conservationist, Soil Conservation Service, P.O. Box 865, Morgantown, West Virginia 26505

Mr. Jerome C. Hytry, State Conservationist, Soil Conservation Service, 4601 Hammersley Road, Madison, Wisconsin 53711

Mr. Robert W. Cobb, Assistant State Conservationist, Soil Conservation Service, P.O. Box 2440, Casper, Wyoming 82601

Executive Office of the President,

Council on Environmental Quality,

722 Jackson Place, NW., Washington, D.C.

August 11, 1980.

Memorandum for Heads of Agencies

Subject: Prime and Unique Agricultural Lands and the National Environmental Policy Act (NEPA)

The accompanying memorandum on Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act was developed in cooperation with the Department of Agriculture. It updates and supersedes the Council's previous memoradnum on this subject of August 1976.

In order to review agency progress or problems in implementing this memorandum the Council will request periodic reports from Federal agencies as part of our ongoing oversight of agency implementation of NEPA and the Council's regulations. At this time we would appreciate receiving from your agency by November 1, 1980, the following information:

-- identification and brief summary of existing or proposed agency policies, regulations and other directives specifically intended to preserve or mitigate the effects of agency actions on prime or unique agricultural lands, including criteria or methodology used in assessing these impacts.

-- identification of specific impact statements and, to the extent possible, other documents prepared from October 1, 1979 to October 1, 1980 covering actions deemed likely to have significant direct or indirect effects on prime or unique agricultural lands.

-- the name of the policy-level official responsible for agricultural land policies in your agency, and the name of the staff-level official in your agency's NEPA office who will be responsible for carrying out the actions discussed in this memorandum.

Gus Speth,

Chairman.

Executive Office of the President,

Council on Environmental Quality,

722 Jackson Place, NW., Washington, D.C.

August 10, 1980.

Memorandum for Heads of Agencies

Subject: Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory

In his second Message on the Environment, issued in August 1979, the President underscored the need to strengthen the National Wild and Scenic Rivers System and to take particular care not to harm rivers which may qualify for inclusion in the System.

The President issued a directive on August 2, 1979 in conjunction with his Message which required that:

"Each Federal agency shall, as part of its normal planning and environmental review process, take care to avoid or mitigate adverse effects on rivers identified in the Nationwide Inventory prepared by the Heritage Conservation and Recreation Service in the Department of the Interior. Agencies shall, as part of their normal environmental review process, consult with the Heritage Conservation and Recreation Service prior to taking actions which could effectively foreclose wild, scenic, or recreational river status on rivers in the Inventory."

This memorandum is intended to assist your agency in meeting its responsibilities under the President's directive. A brief set of procedures is attached which provides guidance on how to integrate these responsibilities with your normal environmental analysis process under the National Environmental Policy Act (NEPA). The objective is to ensure that the President's directive is met promptly and efficiently.

Development along our rivers continues to outpace our ability to protect those rivers that might qualify for designation in the National Wild and Scenic Rivers System. The Heritage Conservation and Recreation Service (HCRS) in the Department of the Interior has been preparing a Nationwide Inventory of river segments that, after preliminary review, appear to qualify for inclusion in the System. It is therefore essential that federal agencies proceed carefully and limit any adverse effects of their actions on rivers identified in the Nationwide Inventory. Otherwise, the Inventory could be depleted before the identified rivers can be fully assessed to determine the desirability of including them as components of the National Wild and Scenic Rivers System.

Although the President's directive does not prohibit an agency from taking, supporting or allowing an action which would adversely affect wild and scenic values of a river in the Inventory, each agency is responsible for studying, developing and describing all reasonable alternatives before acting, and for avoiding and mitigating adverse effects on rivers identified in the Inventory. Where agency action could effectively foreclose the designation of a wild, scenic, or recreational river segment, the President has directed the agency to consult with HCRS. It is difficult to restore a river and its immediate environment once its wild and scenic qualities have been lost.

The purpose of this consultation requirement, which is meant to be part of the normal environmental analysis process, is to provide the opportunity for HCRS experts to assist other agencies in meeting program objectives without irreparably damaging potential wild, scenic, and recreational river areas. Consultation with HCRS should encourage better planning at an early stage in order to reduce resource management conflicts or to avoid them altogether. The consultation requirement also provides an opportunity to seek early resolution of problems by policy-level officials if necessary.

Completed portions of the Nationwide Inventory -- those for the Eastern half of the country -- were sent to you from HCRS Director Chris T. Delaporte on November 13, 1979. Forthcoming portions of the Inventory will be transmitted as they are completed. You should ensure that the list of rivers in the Inventory and the attached procedures receive wide distribution in your agency.

Copies of orders, guidance, or memoranda which you use to adopt or to transmit the attached procedures within your agency should be sent to the Council on Environmental Quality (Attention: Larry Williams) and to the Interagency Wild and Scenic Rivers Study Group (Attention: Jack Hauptman, HCRS, 440 G Street, N.W., Washington, D.C. 20243).

Gus Speth,

Chairman.

Attachment.

Procedures for Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory

These procedures are designed to assist federal officials in complying with the President's directive (attached) to protect rivers in the Nationwide Inventory through the normal environmental analysis process. NEPA, E.O. 11514, CEQ's NEPA Regulations, and agency implementing procedures should be used to meet the President's directive.

Although the steps outlined below pertain to wild and scenic river protection, they also fit clearly within agencies' existing environmental analysis processes. Agencies are already required: to identify and analyze the environmental effects of their actions; to consult with agencies with jurisdiction by law or special expertise (in this case, HCRS); to develop and study alternatives; and to use all practicable means and measures to preserve important historic, cultural, and natural aspects of our national heritage.

The procedures outlined below simply link the appropriate elements of the normal environmental analysis process with the President's directive "to take care to avoid or mitigate adverse effects on rivers identified in the Nationwide Inventory." Federal officials should promptly take steps to incorporate the actions specified below into their planning and decisionmaking activities and the conduct of their environmental analyses.

1. Determine whether the proposed action could affect an Inventory river.

Check the current regional Inventory lists to determine whether the proposed action could affect an Inventory river.

If an Inventory river could be affected by the proposed action, an environmental assessment or an environmental impact statment may be required depending upon the significance of the effects.

If the action would not affect an Inventory river, no further action is necessary under these procedures. (The agency is still required to fulfill any other responsibilities under NEPA).

2. Determine whether the proposed action could have an adverse effect on the natural, cultural and recreational values of the Inventory river segment.

Using the Guide for Identifying Potential Adverse Effects, which is appended to these procedures, you should determine whether the proposed action could adversely affect the natural, cultural, or recreational values of the Inventory river segment. Adverse effects on inventoried rivers may occur under conditions which include, but are not limited to:

(1) Destruction or alteration of all or part of the free flowing nature of the river;

(2) Introduction of visual, audible, or other sensory intrusions which are out of character with the river or alter its setting;

(3) Deterioration of water quality; or

(4) Transfer or sale of property adjacent to an inventoried river without adequate conditions or restrictions for protecting the river and its surrounding environment.

If you have prepared a document which finds that there would be no adverse effects -- such as a Finding of No Significant Impact under the CEQ NEPA regulations -- you should send a courtesy copy to the HCRS field office in your region.

3. Determine whether the proposed action could foreclose options to classify any portion of the Inventory segment as wild, scenic or recreational river areas.

In some cases, impacts of a proposed action could be severe enough to preclude inclusion in the Wild and Scenic Rivers System, or lower the quality of the classification (e.g. from wild to recreational). If the proposed undertaking would effectively downgrade any portion of the Inventory segment you should consult with HCRS.

Proposed actions (whether uses or physical changes), which are theoretically reversible, but which are not likely to be reversed in the short terms, should be considered to have the effect of foreclosing for all practical purposes wild and scenic river status. This is because a river segment, when studied for a possible inclusion in the Wild and Scenic River System, must be judged as it is found to exist at the time of the study, rather than as it may exist at some future time.

If a proposal, including one or more alternatives, could have an adverse effect on a river in the Inventory, an environmental assessment or, if the effects are significant, an environmental impact statement must be prepared. HCRS staff is available to assist you in determing the significance or severity of the effects in connection with your assessment, scoping process, and EIS, if one is needed. A detailed analysis of each of the rivers in the Inventory is available from HCRS for your use.

You should request assistance in writing from HCRS, as early as you can, providing sufficient information about the proposal to allow HCRS to assist you in determining whether any of the alternatives under consideration would foreclose designation. HCRS will in turn provide you with an analysis of the impacts on natural, cultural and recreational values which should enable you to make a determination as to whether or not designation would be foreclosed. HCRS is available to assist you in developing appropriate avoidance/mitigation measures.

When environmental assessments are prepared on proposals that affect Inventory rivers, copies should be sent in a timely fashion to the HCRS field office in your area before a proposed action is taken and while there is still time to avoid or mitigate adverse effects. When environmental impact statements are prepared on proposals that affect Inventory rivers the lead agency should request HCRS and the affected land managing agency to be cooperating agencies as soon as the Notice of Intent to prepare an EIS has been published.

If HCRS does not respond to your request for assistance within 30 days, you may proceed with completing preparation and circulation of the environmental assessment or EIS as planned. Even where HCRS has been unable to comment on the environmental assessment or Draft EIS, you are still obligated by the President's directive to ". . . take care to avoid or mitigate adverse effects on rivers identified in the Nationwide Inventory . . ."

4. Incorporate avoidance/mitigation measures into the proposed action to maximum extent feasible within the agency's authority.

Any environmental documents prepared on the proposed action should identify the impacts on natural, cultural and recreational values, address the comments submitted by HCRS, and state the avoidance/mitigation measures adopted. Any disagreements will be resolved through existing procedures. For projects requiring environmental impact statements, the record of decision must adopt appropriate avoidance/mitigation measures and a monitoring and enforcement program as required by the CEQ regulations. (40 CFR 1505.2(c)).

A Note on the Meaning of "Federal Actions"

The above procedures are meant to apply to all federal actions that could adversely affect a river in the Nationwide Inventory (see Section 1508.18 of CEQ's NEPA Regulations (40 CFR 1508.18) for the meaning of "major federal actions"). For actions which are known in advance to require an environmental assessment or environmental impact statement these procedures would be followed in the normal course of NEPA compliance. If a federal action would not normally require an environmental assessment or an environmental impact statement, but could adversely affect a river in the Nationwide Inventory, the action should either (1) not be "categorically excluded" under agency implementing procedures, or (2) be considered an "extraordinary circumstance" in which a normally excluded action must be subjected to environmental analysis (see Section 1508.4 of NEPA Regulations).

The above procedures should be used for any proposals (including the evaluation of alternative courses of action) for which the NEPA process is not yet completed. The above procedures should therefore also be applied to a proposed modification or supplement to a previously authorized or implemented action.

For Futher Information or Guidance

The HCRS regional office will usually provide the best source of information on rivers in the Nationwide Inventory and on specific ways that these rivers could be protected. For general assistance on policy and procedural matters, please contact the Chairman of the Interagency Wild and Scenic Rivers Study Group (202/343-4793), or contact the Council on Environmental Quality (202/395-4540).

Appendix I.

Guide for Identifying Potential Adverse Effects

The impact of a propose action should be assessed in relation to the eligibility and classification criteria of the Wild and Scenic Rivers Act, 16 U.S.C. 1271-1287, as amended.

In order to be eligible for inclusion in the National System, a river must:

1. Be "free-flowing," i.e., "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway. The existence, however, or low dams, diversion works, and other minor structures at the time any river is proposed for inclusion in the national wild and scenic rivers system shall not automatically bar its consideration for such inclusion: Provided, That this shall not be construed to authorize, intend, or encourage future construction of such structures within components of national wild and scenic rivers system." (16 U.S.C. Sec. 1286)

2. Possess "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." (16 U.S.C. Sec. 1271)

Eligible river segments are classified according to the extent of evidence of man's activity as one of the following:

1. "Wild river areas -- Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America."

2. "Scenic river areas -- Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads."

3. "Recreational river areas -- Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past." (16 U.S.C. Sec. 1273(b))

Any action which could alter the river segment's ability to meet the above eligibility and classification criteria should be considered an adverse impact. Actions which diminish the free-flowing characteristics or outstandingly remarkable values of a river segment could prevent the segment from qualifying for inclusion in the national system. Actions which increase the degree of evidence of man's activity, i.e., level of development, could change the classification of the river segment.

The effect of all proposed developments within the river corridor should be assessed in terms of severity of effect and extent of area affected. Development outside the corridor which would cause visual, noise, or air quality impacts on the river corridor should also be examined.

Only proposed new construction or proposed expansion of existing developments need be considered in assessing impacts. Repair or rehabilitation of existing structures would not have a negative impact except if the action would result in significant expansion of the facility or if the construction process itself would cause an irreversible impact on the environment.

Placement of navigation aids such as buoys and channel markers will not be considered as causing adverse effects.

The following are examples of types of developments which would generally require consultation with HCRS because of the potential for adverse effects on the values of a potential wild, scenic, or recreational river. The list is not exhaustive. Small bulkhead Clearing and snagging Drainage canal, culvert or outfall Irrigation canal Levee or dike Rip-rap, bank stabilization or erosion control structure Small reservoir Increase in commercial navigation Dredging or filling Run-of-the-river dam or diversion structure Road Railroad Building (any type) Pipeline, transmission line Bridge or ford Gas, oil or water well Sub-surface mine opening Quarry Power substation Recreation area Dump or junkyard Change in flow regime Clear-cut timber harvest Radio tower, windmill

The following are examples of types of development which appear most likely to cause serious adverse effects if they are constructed adjacent to or in close proximity to an Inventory river. Such development proposals will almost always require consultation with HCRS because their effects are likely to conflict with the values of a potential wild, scenic or recreational river. These effects could be severe enough to foreclose designation of the affected river segment. This list is not exhaustive. Channelization Instream or surface mining Lock and dam Airport Landfill Factory Gas or oil field Major highway Railroad yard Power plant Sewage treatment plant Housing development Shopping center Industrial park Marina Commercial dock

Appendix II

[For a memorandum from the President on Wild and Scenic Rivers and National Trails dated August 2, 1979, see the Weekly Compilation of Presidential Documents (Vol. 15, page 1379).]
[FR Doc. 80-27023 Filed 9-5-80; 8:45 am]

BILLING CODE 3125-01-M

110QWX

********** Print Completed **********
Time of Request: February 26, 2003 05:37 PM EST
Print Number: 1841:0:81930363
Number of Lines: 209
Number of Pages: 1

STATE OF CALIFORNIA—THE RESOURCES AGENCY

GRAY DAVIS, *Governor*

DELTA PROTECTION COMMISSION
14215 RIVER ROAD
P.O. BOX 530
WALNUT GROVE, CA 95690
Phone (916) 776-2290
FAX (916) 776-2293
E-Mail: dpc@citlink.net Home Page: www.delta.ca.gov

March 6, 2003

Gwen Knittweis
Department of Water Resources
901 P Street
Sacramento, CA 95814

Subject: Notice of Preparation, North Delta Improvements Project; SCH # 2003012112

Dear Ms. Knittweis:

I am writing regarding the Notice of Preparation (NOP) for the North Delta Improvements Project, a project included in the CALFED Record of Decision dated August 28, 2000. The project will proceed as described in the 1990 Draft Environmental Impact Report and will provide flood control relief and associated ecosystem restoration in the area above, at, and below the confluence of the Cosumnes and Mokelumne Rivers in Sacramento and San Joaquin Counties. The Commission itself has not had the opportunity to review the NOP, so these are staff comments only. The comments are, however, based on the policies of the Commission's adopted Regional Land Use Plan.

The Commission has been briefed on the project several times and current and past Commissioners and staff have participated in meetings regarding the proposed project since mid 1998. It is quite exciting that the project has progressed to the point of circulating the NOP. The flood control project has long been identified as a critical need in the region and substantial CALFED funds have already been expended on projects within the study area including acquisition of McCormack Williamson Tract and Staten Island.

Role of the Delta Protection Commission in Review of the Proposed Project:
The Commission is the only State agency with regional land use planning responsibilities in the Delta area. The Commission is also a CALFED agency, past participant on the Policy Group and current member of the Management Group of CALFED.

The Commission would like to continue its role as the forum for public discussion and input to CALFED agencies regarding project development in the Delta area. To that end, DWR and the Corps, North Delta Improvements Project sponsors, should continue to brief the Commission, its Committees, and its staff on the proposed North Delta Improvements Project and to present the project at a public meeting of the Commission at the appropriate time in the project development process for public and Commissioner review and comment.

Need for Current Data for Project Evaluation:

Over the past several years, the Commission and active and interested members of the affected community have passed on to Department of Water Resources (DWR) and CALFED comments regarding the need for thorough and careful modeling to help guide the decision-making process. The modeling process has been underway for some time and DWR will have the required data in hand to analyze various project alternatives. The results of the modeling should be part of a presentation to the Delta Protection Commission.

Impacts to Agriculture:

The proposed study area includes several thousand acres of agricultural land in the Delta Primary Zone. Two islands have been purchased by The Nature Conservancy (TNC) with CALFED grant funds--McCormack Williamson Tract and Staten Island. Both Islands will be evaluated for improved flood conveyance and for enhanced wildlife habitat.

As required in the ROD, the environmental document should evaluate potential loss of agriculture associated with the various alternatives and should site and align features to avoid or minimize effects on agriculture, examine structural and nonstructural alternatives to achieve project goals in order to avoid effects on agricultural land, implement features that are consistent with local and regional land use plans, restore existing degraded habitat as a priority before converting agricultural land, focus habitat restoration efforts on developing new habitat on public lands before converting agricultural land, develop buffers, and implement seepage controls on the project sites (not on adjacent properties in private ownership), and support California Farmland Conservancy Program in acquiring easements on agricultural land to prevent conversion to urbanized uses and increase farm viability.

Recreation:

DWR and CALFED staff have briefed the Commission's Recreation Citizens Advisory Committee (aka Ad Hoc Recreation Committee) on the proposed project. The Committee prepared general and specific comments on recreation opportunities within the study area for analysis as the proposed project is developed. A copy of the January 4, 2000 letter is enclosed.

The NOP states the project will "minimize impacts to recreation use in the NDIP project area". The CALFED ROD states "Incorporate project-level recreation improvements and enhancements." The project should incorporate recreation improvements as well as minimize impacts to recreation in the project area. In addition, the ROD directs that recreation be managed to minimize or avoid adverse effects on sensitive habitats, wildlife use areas, and special status species.

Wildlife Habitat:

The NOP states the proposed project will recommend ecosystem restoration and science actions in the project area consistent with the CALFED Ecosystem Restoration Program's strategic goals and objectives.

CALFED has funded acquisition of Staten Island with the stated intention of preservation and enhancement of the wildlife habitat values of the Island for migratory waterfowl and bird species, particularly the Sandhill Crane. McCormack Williamson Tract will be evaluated for habitat enhancement potential as part of project development.

The ROD includes a number of mitigation measures that will ensure that restoration of wildlife habitat will not impact nearby and adjacent, existing land uses such as incorporation of buffers and seepage control. The environmental document should identify measures that will be incorporated into the proposed project to meet the mitigation measures in the ROD.

Flood Control and Levees:

The proposed project may include construction of new levees, reconstruction of existing levees, re-direction of flood waters, and other actions that might impact Delta levees.

The ROD includes a number of mitigation measures, listed under Flood Control, which support appropriate levee maintenance, and improvements to levees and slope protection. The proposed project and the environmental document should address the mitigation measures outlined in the ROD.

Thank you for requesting the Commission's comments on the NOP. The Commission and staff look forward to working with DWR and the Corps on the North Delta Improvements Project in the future.

Sincerely,

Margit Aramburu

Margit Aramburu
Executive Director

Cc: Delta Protection Commissioners
Patrick Wright, Executive Officer, CALFED

MWD
METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Executive Office

February 24, 2003

Ms. Gwen Knittweis
North Delta Project Manager
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

Dear Ms. Knittweis:

Notice of Preparation/Notice of Intent to Prepare a Joint Environmental Impact
Statement/Environmental Impact Report for the Proposed North Delta Improvements Project

The Metropolitan Water District of Southern California (Metropolitan) has received and reviewed a copy of the Notice of Preparation/Notice of Intent (NOP/NOI) to Prepare a Joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Proposed North Delta Improvements Project (NDIP). The project would implement flood control improvements in the northern Sacramento-San Joaquin Delta, principally on and around Staten Island, Dead Horse Island, and McCormack-Williamson Tract, in a manner that would benefit aquatic and terrestrial habitats and alleviate flood-related problems in the North Delta area. The U.S. Army Corps of Engineers (Corps) is acting as the Lead Agency under the National Environmental Policy Act (NEPA), and the California Department of Water Resources (DWR) is acting as the Lead Agency under the California Environmental Quality Act (CEQA). The Corps and DWR are initiating the NDIP Feasibility Study for a portion of the Sacramento-San Joaquin Delta, and will closely coordinate the development of the Feasibility Study with the draft EIS/EIR, which will document existing conditions, project actions, and project effects. This letter contains Metropolitan's response as a potentially affected agency to the NOP/NOI.

Background

The joint state-federal CALFED Bay-Delta Program (CALFED) was formed to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The CALFED Programmatic EIS/EIR (PEIS/EIR) and Programmatic Record of Decision (ROD) were issued in July and August 2000, respectively. The CALFED ROD identifies, as a component of conveyance actions, the NDIP, which is to design and construct floodway improvements in the North Delta (such as on the lower Mokelumne River and Georgiana Slough) to provide conveyance, flood control, and ecosystem benefits. The CALFED ROD also identified other improvements to the North Delta, including potential changes in the operation of the Delta Cross Channel and an evaluation of a through-Delta facility on the Sacramento River. The NDIP will not be addressing these improvements.

Water Quality

The summary of the scoping process included in the NOP/NOI indicates that the "...short term effects on water quality associated with excavation and dredging in bodies of water..." will be addressed in the draft EIS/EIR for the NDIP. Metropolitan requests that the draft EIS/EIR include a full evaluation of the potential water quality effects of the proposed project, both long-term and short-term, negative and positive, on municipal water supplies obtained from the Delta. In particular, the analysis of project alternatives should include evaluation of the impacts on organic carbon levels (measured as dissolved organic carbon [DOC] and/or total organic carbon [TOC]) at the export locations in the south Delta. We suggest that the Corps and DWR consult two sources of information in performing this evaluation. The first source of information that should be considered is ongoing studies supported by the CALFED Ecosystem Restoration and Science programs that investigate the role of wetlands in carbon production in the Delta and the processes driving organic carbon concentrations at the Delta export locations. The second source of information that should be considered is the In-Delta Storage Program investigations currently being conducted by DWR, which include evaluation of organic carbon loading from flooded Delta islands.

In addition to evaluation of organic carbon, Metropolitan requests that the analysis of project alternatives in the draft EIS/EIR include evaluation of impacts on salinity and bromide levels at the export facilities in the south Delta resulting from changes in hydrodynamics and seawater intrusion due to physical modification of the system. This evaluation should include consideration of both seasonal and year-type variation.

Relationship to Other CALFED Program Elements

The summary of the scoping process included in the NOP/NOI indicates that the draft EIS/EIR will address "...the cumulative impacts of implementation of alternatives in conjunction with other past, present, and reasonably foreseeable future actions." Metropolitan believes the evaluation of cumulative impacts is very important since there are currently many proposed actions in the Delta being studied and considered by CALFED. We recommend that the draft EIS/EIR include evaluation of the cumulative effects of implementing the NDIP in conjunction with other Delta improvements currently being considered and studied by CALFED. In particular, the operational studies for the Delta Cross Channel, the evaluation of a through-Delta facility, the evaluation of flooded island reclamation in the Delta (such as Franks Tract), levee

Ms. Gwen Knittweis
Page 3
February 24, 2003

improvements, In-Delta storage, and ecosystem restoration in the Delta should be considered in the evaluation of cumulative impacts.

We appreciate the opportunity to provide input to your planning process and we look forward to receiving future environmental documentation on this project. If we can be of further assistance, please contact Ms. Lynda Smith at (916) 650-2632.

Very truly yours,

(for) Laura J. Simonek
Manager, Asset Management
and Facilities Planning Unit

JAH/rdl
(Public Folders/EPU/Letters/24-FEB-03A.doc – Gwen Knittweis)

Reclamation District No. 2086
P.O. Box 456
Woodbridge, CA 95258

Telephone: (209) 810-2708
Fax: (209) 368-4165
Email: wdarsie@attbi.com

March 6, 2003

Ms. Gwen Knittweis
Mr. Paul Bowers
North Delta Improvements Project
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

Re: North Delta Improvements Project
Public Scoping Meeting, February 19 & 20, 2003

Dear Gwen & Paul,

On behalf of Reclamation District No. 2086, Canal Ranch, I would like to submit the following comments relative to the North Delta Improvements Project, EIR/EIS Public Scoping Meetings. It was indicated at both meetings that comments from knowledgeable individuals with an understanding of the area was of particular interest. Accordingly, I have also provided a brief background on my experience with Delta water and Flood Control issues.

ISSUES

- Historically, the fundamental flood dynamics have not changed, and the solution principals, from a flood control aspect, remain the same. The difficulty in developing a solution comes from more recent changes in environmental needs and legal issues, development issues in South Sacramento County, the creation and development of CALFED, and it's taking over of the program. Funding for this program has always been an underlying issue.

CONCERNS

- EIR/EIS
  - The EIR/EIS becomes the springboard for the much needed improvements needed in the North Delta region
  - Release of an EIR/EIS that does not adequately detail alternatives that have met the test of stakeholder review has the potential to result in delays at the time of implementation. (lawsuits, political issues, internal bickering between agencies and stakeholders)
- Modeling
  - Past efforts in finding solutions to flood issues were made difficult, as a good hydraulic model did not exist. We now have a good model that can

be used to measure the effects of various solutions on the affected stakeholders.

- Several alternatives that include long term "worst case" scenarios need to be run through the model with input provided by the affected stakeholders. (global warming, 100 & 200 year events, massive upstream improvements that would cause more water to come down the Cosumnes etc).
- The scenarios must be realistic and be run without artificial inputs that could skew the results to favor one stakeholder over another.
- All scenarios must include solutions and modeling to the area well within the "Delta Pool" area of the delta.
- For staged work, the scenarios must be run with all downstream work occurring first and associated modeling included. To force flows and associated impacts downstream is contrary to well designed flood control projects. Moving the bottleneck does not relieve flood issues, and in the delta, the lower in elevation you move the problem, a higher chance of levee failure occurs, Additionally, water quality impacts may be greater due to higher degree of salt intrusion.
- The scenarios should not be biased for political, environmental, or cost considerations. All stakeholders understand that some sacrifices will need to be made to provide a benefit to the system. Also, other alternatives may become apparent as a result.
- Once the best flood solutions are achieved, alternative selection can take place.

❑ Environmental

- Once a suite of flood control alternatives are achieved, CALFED ecosystem restoration components can be added as necessary, and the resulting effects to the flood control can be modeled and adjusted for accordingly.
- Dredging has become a controversial issue due to a fundamental misunderstanding about the natural processes in the delta. The delta is an engineered system. It has been drastically manipulated since prior to the gold rush and hydraulic dredging and levee construction drastically altered the area for the last 100 years plus. Issues regarding natural channel processes and flow regimes do not apply in the delta. We are essentially the toilet bowl for the entire Central Valley, and as such, cleaning needs to take place on a regular basis to maintain a healthy system. An example of this is the exotic vegetation growth that takes place in areas that historically had deeper water and have now silted up from upstream sediment migration caused by floods and various types of development (housing, agricultural, infrastructure etc.) Once an environmentally acceptable process can be developed, routine maintenance dredging should be considered as a cost effective and beneficial practice. Discussions with Biologists familiar with the Delta agree that this is a real

possibility. Dredging should be actively explored as an alternative and immediate research should be initiated.

- The impacts of Boating should be further explored. The current research seems to be skewed, and does not fully account for the impacts that we know is happening to both the environment and

SOLUTIONS

- ❑ Active input from stakeholder representatives should be sought prior to including an alternative into the EIR/EIS.
- ❑ Alternatives must be identified in the EIR/EIS, along with anticipated adaptive management potentials and solutions.
- ❑ Flood control needs to be addressed first. Water conveyance should, almost automatically, benefit from better flood carrying capacity increases.
- ❑ Once the stakeholders agree upon acceptable flood control alternatives, environmental components should be added that do not detract from the flood control and water conveyance benefits.
- ❑ In order to meet the deadlines envisioned for this project, funding to accelerate modeling of alternatives and stakeholder scoping needs to be made available immediately.

W.G. DARSIE PERSONAL BACKGROUND

- ❑ BS degree in Agronomy (plant and soil science), Minor in Biology
- ❑ 3rd generation delta farmer, born and raised in Walnut Grove, personally operated Canal Ranch and Egbert Ranch for 15 years (4700 acres) plus assisted in management of additional 7000 acres in the delta and other areas in California).
- ❑ Have been a trustee of multiple Reclamation Districts and other Special Districts
- ❑ 10 years as private consultant managing agricultural properties and reclamation districts
- ❑ Director of California Central Valley Flood Control Association for over 10 years
- ❑ Currently working as a senior assistant engineer / project manager with Kjeldsen, Sinnock and Neudeck, Inc., a Stockton based consulting engineering and land survey firm representing numerous Delta interests
- ❑ Have been personally involved with every major Delta flood event since 1964
- ❑ Have been actively involved in North Delta solutions since 1986 when the North Delta Program was initiated by DWR under the direction of Stein Buer

I appreciate the opportunity to provide comments and welcome any questions that you might have. Please do not hesitate to call if you should have any questions.

Sincerely,
RECLAMATION DISTRICT NO. 2086

William G. Darsie, Trustee/Secretary

cc: Trustees
Gilbert Cosio, Jr.

-----Original Message-----
From: Waldo Holt [mailto:waldoh@LYCNET.COM]
Sent: Sunday, March 16, 2003 5:09 PM
To: Knittweis, Gwen
Cc: deltakeep@aol.com; kfoley@inreach.com; David Yee; rowoth@sbcglobal.net; staten@citlink.net; meaton@tnc.org; kwhitener@tnc.net
Subject: NOP for DEIR for NDIP

Ms. Gwen Knittweis
North Delta Improvements Project
California Department of Water Resources
P.O. Box 942836
Sacramento CA 94236-0001

Re: NOP for NDIP

{via e-mail, hard copy to follow}

March 16, 2003

Dear Ms. Knittweis,

The San Joaquin Audubon Society has a deep interest in the North Delta Improvements Project. We are concerned that proposed elements of the NDIP will have major deleterious effects to the environment. We are dismayed that we did not receive any notice of the release of the NOP for the NDIP. We are concerned because we have been told that our comments are beyond the deadline and that they will not be included in the public record for the Notice Of Preparation for the Draft Environmental Impact Report for the NDIP, (e-mail correspondence below).

We are also aware that the Cosumnes River Preserve of The Nature Conservancy was unaware of the release and deadline for comments to the NOP. We are also aware that Deltakeeper was unaware of the release and deadline for comments to the NOP. This is not as it should be. Not having received the NOP, our familiarity with the project is limited to a brief view of exhibits and a short discussion of the project at a “workshop” held one evening in the fourth week of February in Walnut Grove. No printed material and no public statements at that meeting indicated that the NOP had been released. None the less, we will herewith provide our comments with the request that they be included in the public record for the NOP for the NDIP DEIR.

1) The NDIP is a piecemeal portion of a larger project. The DEIR will be fatally flawed if it does not place the NDIP in its proper place as a component of the larger Calfed project. The NDIP together with the South Delta Improvement Project and the Delta Cross Channel Project are designed to convey and export more and higher quality water from Northern California to Southern California. Therefore, the environmental impacts that the DEIR must address are not limited

to the NDIP but include the full range of environmental impacts that are generated by the complete Calfed water export project.

2) The NDIP project is incorrectly described as merely a “flood control” project. Flood control may be an aspect of the contemplated project, however, water conveyance and export are the motivating factors behind the entire NDIP. The ambitious scope of work being considered obviously contemplates a level of public monetary expense that is out of scale to the benefits the general public will derive if only the “flood control” aspects of the project are a part of the equation. The public assets being “saved” from a potential flood appears to be dwarfed by the financial involvement the project requires from the public coffers. Dredging, levee setbacks, “flood” detention basins, etc. are very expensive items. We assert that there is an additional use contemplated for the various components in the NDIP. The combination of a bigger gate at the Delta Cross Channel to direct Sacramento River water at one end and the dredged channels and bigger pumps being proposed for the SDIP at the other end finds the NDIP’s dredged and widened channels conveniently placed to increase the amount and quality of water which can be pumped from Northern California to Southern California. Also, the flood detention basin on Staten Island would conveniently provide a source of “new” water that could be exported south. The DEIR project description needs to encompass the complete purpose of the proposed project. The full and complete range of environmental impacts associated with this larger intent of the NDIP need to be addressed in the DEIR.

3) Therefore, a full range of alternatives in the DEIR must include one designed to achieve improved water management flexibility and water supply reliability with no net increase in Delta diversions. This is an alternative that is consistent with the ROD.

4) In order to evaluate water quality impacts in the DEIR, Calfed must ensure that adequate baseline data is collected. NDIP activities, including dredging and changes in flow patterns, could have significant impacts on contaminant levels and cause increased water quality problems. The adequacy of present water quality data is insufficient to evaluate the impacts of the proposed project. A Calfed science program should convene a group to evaluate the adequacy of existing delta water quality data to assist Calfed in designing and implementing a program to ensure adequate collection and analysis of the potential project impacts on the full range of bacterial, organic and inorganic constituents in the estuary.

5) Waters impounded in a flood detention basin on Staten Island will likely contain various pollutants. The reaction of impounded waters with the soils of the detention basin will likely result in the increased absorption of organic and inorganic pollutants. The Delta has no more assimilative capacity for pollutants. The DEIR needs to analyze the potential impacts to water quality such as: low dissolved oxygen, high electrical conductivity, high temperature, heavy metals, etc. that are likely to be discharged into the Delta from the proposed Staten Island Flood Detention Basin.

6) Tail water pollution resulting from routine agricultural activities on Staten Island is presently exempt from regulation under the federal Clean Water Act. The transformation of that island into a flood control facility will void that agricultural exemption from Clean Water Act regulation. We note that the Delta is

listed as an impaired water body on the EPA 3(d) list for a variety of pollutants: heavy metals, electrical conductivity, pesticides, low D.O., etc. Waters impounded in a flood detention basin on Staten Island will likely contain various pollutants. The Delta has no more assimilative capacity for these pollutants. A NPDES permit will likely be required for the discharge of pollutants from the proposed Staten Island Flood detention Basin. The DEIR needs to include and analyze the extra costs associated with the operation of a flood control facility resultant from the loss of an exemption from the Clean Water Act. This cost analysis should include the expense of treating to tertiary standards, all water discharged into the Delta from the proposed Staten Island Flood Detention Basin.

7) We include, as an attached spreadsheet, data collected on Christmas Bird Counts on Staten Island. The San Joaquin Audubon society has been conducting a Christmas Bird Count in the Delta for over forty years. Since 1986 Staten Island has been a discrete unit of that count. We are able to provide data that pertains to Staten Island exclusively from December 1986 through December 2002. This data was collected on one day only each year during the third week in December no matter the weather. Christmas count compilers David Yee and Jim Rowoth have overseen the entire count. Primary investigators on Staten Island include team leaders Arvil Parker, Mark Cudney, and Pierre de Lastre. Among many participants, the most frequent have been: Joe Ceriani, Tim Fitzer, Jeff Mangum, Tim Steurer. During this seventeen-year period 143 species of birds have been recorded on Staten Island on this one-day event. We do not believe that there is another comparable inland location, near this latitude, worldwide that can match the bird diversity we have found on Staten Island. NDIP proposals to convert Staten Island into a "flood" detention basin will strongly motivate the membership of the San Joaquin Audubon Society to actively oppose the NDIP.

Again, we wish our comments to be placed in the public record for the NDIP NOP. We feel that if we have missed the deadline, that fault is not ours.

Sincerely,
Waldo Holt
Conservation Chair, San Joaquin Audubon Society
C/o 3900 W. River Dr.
Stockton Ca 95204-1120

----- Original Message -----
From: Knittweis, Gwen
To: Waldo Holt
Sent: Tuesday, March 11, 2003 10:59 AM
Subject: RE: NDIP
Waldo,
We are very interested in receiving your Agency's comments. There are several avenues for you to provide comment. Comments from the Public scoping sessions are welcome until March 15, 2003. Comments received after March 15 will be considered, but will not be included in the record of Public Scoping comments. DWR filed the NOP with the

State Clearinghouse on January 30, 2003 and the Clearinghouse subsequently distributed the NOP to public agencies for comment within 30 days, so that deadline has expired. However, there will be opportunity to comment on the public Draft EIR/EIS and Final EIR/EIS and we also encourage your involvement and input with the North Delta Improvements Group, a stakeholder and Agency outreach group that meets the first Thursday of every month as warranted. The next meeting is scheduled for Thursday, April 3 from 9:30-11:30 at Jones and Stokes offices on 26th and V Streets, Sacramento. Please call me at (916) 651-7015 if you have any questions or would like to discuss your concerns. Thanks. Gwen Knittweis

-----Original Message-----
From: Waldo Holt [mailto:waldoh@LYCNET.COM]
Sent: Friday, March 07, 2003 8:44 AM
To: Knittweis, Gwen
Subject: NDIP

Dear Ms K,

I am the conservation chair of the San Joaquin Audubon Society. My organization is very much interested in commenting on the NOP for the NDIP. We were unaware that the NOP for the NDIP had been released for comment. We attended the meeting in late February in Walnut Grove where we did not hear anyone mention that the NOP had been released. In conversations with: TNC, Deltakeeper, and even Bay-Delta branch of CDFG it seems that these organizations were also unaware that the NOP had been released for comment. We would like to know when the deadline for comments on the NOP is? I will be out of the state all of next week (week of March 10) which will complicate our organization's ability to meet any imminent deadline. Thank you,

Waldo Holt
conservation chair
San Joaquin Audubon Society
c/o 3900 West River Drive
Stockton CA 95204-1120
209/462-4438

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
pied-billed grebe	2		12	6	16	12	18	13	29	25	5	24	27	2	3	10	25
horned grebe								1				4					
eared grebe	2												1			1	
western grebe						3	2		2	3		3	7		1	5	
Clark's grebe												1	2				
American white pelican																	
double-crested cormorant			1	258	167	16	12	16	21	10	32	30	49	2	61	27	50
American bittern			3		2		2					1			1		1
great blue heron	4	6	5	3	9	5	11	9	4	4	11	6	15	5	16	13	8
great egret	14	28	12	41	66	48	75	63	81	40	32	55	33	6	50	32	30
snowy egret				4	3	1	15	35	2	1	1	5	4	1	16	2	2
cattle egret				2	13	16	21	12	5	6			1		2		1
black-crowned night-heron					75	50	200	1	150	60	60		40				
tundra swan													958	6614	5200	1317	285
greater white-fronted goose	1200	260	1600	468	460	5000	1250	803	44	2500	160	1970	1398	298	150	4747	369
snow goose		20	60	1	202	500	824	75	12	50	30	500	1052		72	263	16
Ross' goose				3	8	2	62		4		1	50	10	7		2	
Canada goose	138	720	5777	194	159	120	919	127	325	150	45	150	888	729	105	949	4841
wood duck			2										4				
green-winged teal													127	413	21	13	10
mallard													404	573	120	454	429
northern pintail													1770	5367	70	364	1470
cinnamon teal														9		1	2
northern shoveler													1485	713	750	136	333
gadwall			26	115	20	5	7	4	5	12	42	10	2	63		2	2
American wigeon													10	25	2	7	12
canvasback	44		9		4		73	47	11	600	6	250	1001	55	149	276	433
ring-necked duck					6	1	11	10		6		2					
common goldeneye							2					1		1		6	1
bufflehead							4	1	1	80			6	1		9	
ruddy duck	100	124	36	16	1	6	232	287	160	300	310	90	106		2	8	
turkey vulture													1	8	13	7	1
white-tailed kite													1	8	11	11	4
northern harrier	6	9	35	18	66	10	42	22	36	15	34	20	16	6	27	20	24
sharp-shinned hawk					4		4	1	3	1		3	1		3	1	1
Cooper's hawk				1	5	2	6	4	4	3	1	2	2		2	2	1
red-sholdered hawk				4	1	2	2	2	1					1		1	1
Swainson's hawk															15		
red-tailed hawk	15	18	27	10	45	35	87	51	48	15	27	19	33	11	61	52	37
feruginous hawk							1									1	
rough-legged hawk	3	4	21	1	5	5	1	1	1	1	4	5		1	10	6	2
golden eagle			1	1													
American kestrel	20	9	9	12	42	25	27	61	17	12	12	9	9	9	29	15	10
merlin													2				1
peregrine falcon									2			1			1		1
prarie falcon				1	3	2	2	1				1			1		
ring-necked pheasant													18	3	79	11	1
California quail																16	4
sora														3			
common moorhen													1		5		
American coot	1140	350	117	2067	688	93	633	2350	1174	700	4006	1100	1450	1642	199	631	1417
sandhill crane	2665	3920	5194	5393	2444	3500	2000	3542	902	2500	4432	4100	2950	8162	6750	3640	1914
killdeer													39	8	33	37	15
black-necked stilt													34	25		7	
greater yellowlegs													6	27	18	23	5
lesser yellowlegs													2		4	2	1
long-billed curlew						1								3		1	2
marbled godwit				1													
western sandpiper													2			7	3
least sandpiper													194	129	95	165	73
dunlin	200	5	7500	1627	263	175	917	717	34	300	61	500	312	156	70	39	21
short-billed dowitcher														1			
long-billed dowitcher	150	300	5200	545	359	118	684	351	41	300	7	240	73	64	40	120	81
Wilson's snipe													11	85	40	12	44
little gull			1														
Bonaparte's gull			14	5		1	1				12	10			8	2	8
mew gull				2	1		1									1	
ring-billed gull		5	21	496	19	75	291	441	13	16	74	95	111	44	29	23	8
California gull	40	200	44	170	47	26	18	5	9	2	6	300	13	19	99	12	34
herring gull			35	4	109	32	24	77	6	30	27	32	13	37	16	22	20
Thayer's gull			1														
western gull					1												

glaucous-winged gull					1												
Forster's tern													16		3	1	1
rock dove	100	26	38	49	193	95	57	32	95	25	10	20	122	26	60	11	5
mourning dove	23	78	5	9	13	176	250	40	14	60	37	100	44	15	260	96	58
barn owl													2		2	1	1
great horned owl													2	1	1	1	2
burrowing owl														1	2	2	1
short-eared owl																	
Anna's hummingbird	1	2			2		5				3	1	1			2	1
belted kingfisher													4	4	3	6	5
Nuttall's woodpecker													1		2	5	2
downy woodpecker														2		1	
northern flicker	3	1	7	9	20	6	21	21	32	12	11	13	9	5	6	5	6
black phoebe													10	13	9	17	4
Say's phoebe													2		1	3	
horned lark													75	35	14	15	6
tree swallow													8	41		4	1
western scrub-jay	3	4	5	20	13	5	20	20	3	8	9	7	14	3	9	15	8
yellow-billed magpie													2		4	4	1
American crow	5	10	8	6	74	72	10	149	31	23	112	100	30	61	86	49	13
bushtit	50			57			26			3					10		11
bewick's wren													3		2	1	2
house wren														3	1	2	
marsh wren													6	12	11	11	1
golden-crowned kinglet													16		15		
ruby-crowned kinglet													9	3	6	7	5
western bluebird						2									2		2
hermit thrush													1		2	1	
American robin													6	20	6	11	2
wrentit																2	
northern mockingbird													1	4	4	4	3
American pipit													175	99	130	258	432
cedar waxwing													20			10	
loggerhead shrike													1	3	1	5	
European starling													7450	1885	450	127	516
orange-crowned warbler													1		1	2	
yellow-rumped warbler													10	27	6	4	4
common yellowthroat													6	7	4	3	1
spotted towhee													5	6	9	23	8
California towhee													4		6	4	2
lark bunting																	1
savannah sparrow													110	47	350	110	183
vesper sparrow																	
fox sparrow													2	4	4	3	1
song sparrow													13	15	195	138	18
Lincoln's sparrow													2	34	9	10	1
golden-crowned sparrow													223	4	155	59	40
white-crowned sparrow													476	89	324	465	136
dark-eyed junco		12		101	12	1	60	87	54	4	12	30	45		25	18	
red-winged blackbird	12	405	90	7454	6800	200	1415	4002	3595	3000	1121	100	259	2092	3450	1315	2155
tricolored blackbird				1	32	34		1	18				2		55	1	8
western meadowlark													138	92	290	613	965
yellow-headed blackbird				2	3			1							2	2	
Brewer's blackbird	2019	4200	7810	3063	5745	15000	3251	2610	5661	400	1015	820	882	124	11000	4023	3880
brown-headed cowbird			1		3	22	2	201	200		2		4	3	13	3	4
house finch	221	80	544	382	52	350	764	1220	3735	300	489	224	1090	53	3200	1437	2372
pine siskin																	
lesser goldfinch	6			10	6	6	3	2							2		10
American goldfinch	16	40		3	10	6	442	51	35	35		40	29	21	160	45	19
house sparrow													84	39	49	165	53

U.S. Department
of Transportation

**United States
Coast Guard**

Commander
Eleventh Coast Guard District

Bldg. 50-6, Coast Guard Island
Alameda, CA 94501-5100
Staff Symbol: (oan)
Phone: (510) 437-3516
Fax: (510) 437-5836
Email:

16591
Sacramento - San Joaquin
Ser: 074-03
18 Feb 2003

MEMORANDUM

From: DAVID H. SULOUFF
Chief, Bridge Section

Reply to Attn of: Bridge Section
(510) 437-3516

To: U.S. Army Corps of Engineers, ATTN CESPK-PD-R, 1325 J. Street, Sacramento CA
Attention: Ms. Becky Wren

Subj: PROPOSED NORTH DELTA IMPROVEMENT PROJECT

Ref: (a) Federal Register, Vol. 68, No 21/ Friday, January 31, 2003/ Pages 5001-5004

1. The referenced Federal Register announced proposed waterway improvements that may affect navigational clearances through bridges. The U.S. Coast Guard exercises jurisdiction for bridges over navigable waters of the U.S., including several of the waterways listed in reference (a).

2. Proposed flood or waterway improvement projects should also include funding and provisions for alteration of bridges, if necessary, to preserve the reasonable needs of existing and prospective future navigation on the waterway.

3. There may be bridge permitting issues under Section 9 of the River and Harbor Act. The Coast Guard should be provided the opportunity to participate as a cooperating agency for NEPA, and included in the distribution of the draft environmental document using the following mailing address:

   Commander (oan)
   Eleventh Coast Guard District
   Building 50-6, Coast Guard Island
   Alameda, CA 94501-5100
   Attn: Bridge Section

4. I can be contacted by telephone at (510) 437-3516 to discuss this project.

#

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:
PPN 2953

March 4, 2003

Ms. Becky Wren
Environmental Manager
U.S. Army Corps of Engineers, CESPK-PD-R
1325 J Street
Sacramento, California 95814-2922

Dear Ms. Wren:

Thank you for the opportunity to review the Notice of Intent to prepare an Environmental Impact Statement for the North Delta Improvements Project located within the Sacramento-San Joaquin River Delta (Delta). The enclosures are intended to assist you in your continued environmental review of this proposal. Because the proposed action would implement flood control improvements, facilitate water supply reliability and conveyance, and ecosystem restoration measures consistent with the goals of CALFED, future consultation with the U.S. Fish and Wildlife Service (Service) may be required under the Fish and Wildlife Coordination Act and the Endangered Species Act.

Enclosure A provides a list of sensitive species that may occur in or near the project site. The Service recommends that surveys be completed by a qualified biologist on the proposed project site to confirm the presence or absence of special-status species or their habitats. Enclosure B recommends general guidelines for identifying and mitigating project impacts to fish, wildlife, and their habitats. The Council on Environmental Quality developed regulations for implementing the National Environmental Policy Act, and defines mitigation to include: (1) avoiding the impact; (2) minimizing the impact; (3) rectifying the impact; (4) reducing or eliminating the impact over time; and (5) compensating for impacts. The Service supports and adopts this definition of mitigation and considers the specific elements to represent the desirable sequence of steps in the mitigation planning process. Accordingly, we maintain the best way to mitigate adverse biological impacts is avoidance when at all possible.

We encourage you to use these guidelines to develop a comprehensive environmental document that addresses these needs. If you have any questions regarding these comments, please contact Mark Littlefield (Watershed Planning Branch) in the Sacramento Fish and Wildlife Office, at (916) 414-6581.

Sincerely,

David L. Harlow
Acting Field Supervisor

Enclosures

cc:
AES, Portland, OR
RM, CDFG, Region 2, Rancho Cordova, CA (w/o enclosures)

ENCLOSURE A

Endangered and Threatened Species that May Occur in or be Affected by Projects in the Sacramento/San Joaquin River Delta of California

February 27, 2003

Listed Species

Amphibians

California red-legged frog, *Rana aurora draytonii* (T)

California tiger salamander, *Ambystoma californiense* (C/E)

Birds

California clapper rail, *Rallus longirostris obsoletus* (E)

California least tern, *Sterna antillarum (=albifrons) browni* (E)

bald eagle, *Haliaeetus leucocephalus* (T)

Fish

Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha* (T)

Central Valley steelhead, *Oncorhynchus mykiss* (T)

Critical habitat, delta smelt, *Hypomesus transpacificus* (T)

Critical habitat, winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

Sacramento splittail, *Pogonichthys macrolepidotus* (T)

delta smelt, *Hypomesus transpacificus* (T)

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

Invertebrates

Conservancy fairy shrimp, *Branchinecta conservatio* (E)

Critical habitat, delta green ground beetle, *Elaphrus viridis* (T)

Lange's metalmark butterfly, *Apodemia mormo langei* (E)

delta green ground beetle, *Elaphrus viridis* (T)

longhorn fairy shrimp, *Branchinecta longiantenna* (E)

valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

vernal pool fairy shrimp, *Branchinecta lynchi* (T)

vernal pool tadpole shrimp, *Lepidurus packardi* (E)

Mammals

San Joaquin kit fox, *Vulpes macrotis mutica* (E)

riparian (San Joaquin Valley) woodrat, *Neotoma fuscipes riparia* (E)

riparian brush rabbit, *Sylvilagus bachmani riparius* (E)

salt marsh harvest mouse, *Reithrodontomys raviventris* (E)

Plants

Antioch Dunes evening-primrose, *Oenothera deltoides ssp. howellii* (E)

Colusa grass, *Neostapfia colusana* (T)

Contra Costa goldfields, *Lasthenia conjugens* (E)

Contra Costa wallflower, *Erysimum capitatum ssp. angustatum* (E)

Critical Habitat, Contra Costa wallflower, *Erysimum capitatum ssp. angustatum* (E)

Critical habitat, Antioch Dunes evening-primrose, *Oenothera deltoides ssp. howellii* (E)

Critical habitat, large-flowered fiddleneck, *Amsinckia grandiflora* (E)

Solano grass (=Crampton's tuctoria), *Tuctoria mucronata* (E)

large-flowered fiddleneck, *Amsinckia grandiflora* (E)

palmate-bracted bird's-beak, *Cordylanthus palmatus* (E)

showy Indian clover, *Trifolium amoenum* (E)

slender Orcutt grass, *Orcuttia tenuis* (T)

soft bird's-beak, *Cordylanthus mollis ssp. mollis* (E)

succulent (=fleshy) owl's-clover, *Castilleja campestris ssp. succulenta* (T)

Reptiles

Alameda whipsnake, *Masticophis lateralis euryxanthus* (T)

Critical habitat, Alameda whipsnake, *Masticophis lateralis euryxanthus* (T)

giant garter snake, *Thamnophis gigas* (T)

Proposed Species

Birds

mountain plover, *Charadrius montanus* (PT)

Invertebrates

Critical habitat, vernal pool invertebrates, *See Federal Register 67:59883* (PX)

Plants

Critical habitat, vernal pool plants, *See Federal Register 67:59883* (PX)

Candidate Species

Fish

Central Valley fall/late fall-run chinook salmon, *Oncorhynchus tshawytscha* (C)

Critical habitat, Central Valley fall/late fall-run chinook, *Oncorhynchus tshawytscha* (C)

green sturgeon, *Acipenser medirostris* (C)

Species of Concern

Amphibians

foothill yellow-legged frog, *Rana boylii* (SC)

western spadefoot toad, *Spea hammondii* (SC)

Birds

Aleutian Canada goose, *Branta canadensis leucopareia* (D)

Allen's hummingbird, *Selasphorus sasin* (SC)

American peregrine falcon, *Falco peregrinus anatum* (D)

Bell's sage sparrow, *Amphispiza belli belli* (SC)

California thrasher, *Toxostoma redivivum* (SC)

Costa's hummingbird, *Calypte costae* (SC)

Lawrence's goldfinch, *Carduelis lawrencei* (SC)

Lewis' woodpecker, *Melanerpes lewis* (SC)

Nuttall's woodpecker, *Picoides nuttallii* (SLC)

Suisun song sparrow, *Melospiza melodia maxillaris* (SC)

Swainson's hawk, *Buteo Swainsoni* (CA)

Vaux's swift, *Chaetura vauxi* (SC)

bank swallow, *Riparia riparia* (CA)

black rail, *Laterallus jamaicensis coturniculus* (CA)

black swift, *Cypseloides niger* (SC)

ferruginous hawk, *Buteo regalis* (SC)

greater sandhill crane, *Grus canadensis tabida* (CA)

little willow flycatcher, *Empidonax traillii brewsteri* (CA)

loggerhead shrike, *Lanius ludovicianus* (SC)

long-billed curlew, *Numenius americanus* (SC)

marbled godwit, *Limosa fedoa* (SC)

oak titmouse, *Baeolophus inornatus* (SLC)

rufous hummingbird, *Selasphorus rufus* (SC)

tricolored blackbird, *Agelaius tricolor* (SC)

western burrowing owl, *Athene cunicularia hypugaea* (SC)

white-faced ibis, *Plegadis chihi* (SC)

white-tailed (=black shouldered) kite, *Elanus leucurus* (SC)

Fish

Kern brook lamprey, *Lampetra hubbsi* (SC)

Pacific lamprey, *Lampetra tridentata* (SC)

longfin smelt, *Spirinchus thaleichthys* (SC)

river lamprey, *Lampetra ayresi* (SC)

Invertebrates

Antioch Dunes anthicid beetle, *Anthicus antiochensis* (SC)

Antioch andrenid bee, *Perdita scitula antiochensis* (SC)

Antioch cophuran robberfly, *Cophura hurdi* (SC)

Antioch efferian robberfly, *Efferia antiochi* (SC)

Antioch mutillid wasp, *Myrmosula pacifica* (SC)

Antioch sphecid wasp, *Philanthus nasilis* (SC)

California linderiella fairy shrimp, *Linderiella occidentalis* (SC)

Ciervo aegialian scarab beetle, *Aegialia concinna* (SC)

Hurd's metapogon robberfly, *Metapogon hurdi* (SC)

Middlekauf's shieldback katydid, *Idiostatus middlekaufi* (SC)

Midvalley fairy shrimp, *Branchinecta mesovallensis* (SC)

Ricksecker's water scavenger beetle, *Hydrochara rickseckeri* (SC)

Sacramento anthicid beetle, *Anthicus sacramento* (SC)

San Joaquin dune beetle, *Coelus gracilis* (SC)

curved-foot hygrotus diving beetle, *Hygrotus curvipes* (SC)

molestan blister beetle, *Lytta molesta* (SC)

yellow-banded andrenid bee, *Perdita hirticeps luteocincta* (SC)

Mammals

Pacific western big-eared bat, *Corynorhinus (=Plecotus) townsendii townsendii* (SC)

San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (SC)

San Joaquin pocket mouse, *Perognathus inornatus* (SC)

Suisun ornate shrew, *Sorex ornatus sinuosus* (SC)

Yuma myotis bat, *Myotis yumanensis* (SC)

fringed myotis bat, *Myotis thysanodes* (SC)

greater western mastiff-bat, *Eumops perotis californicus* (SC)

long-eared myotis bat, *Myotis evotis* (SC)

long-legged myotis bat, *Myotis volans* (SC)

small-footed myotis bat, *Myotis ciliolabrum* (SC)

Plants

Boggs Lake hedge-hyssop, *Gratiola heterosepala* (CA)

Brewer's dwarf-flax (=western flax), *Hesperolinon breweri* (SC)

California croton, *Croton californicus* (SLC)

Carquinez goldenbush, *Isocoma arguta* (SC)

Diablo helianthella (=rock-rose), *Helianthella castanea* (SC)

Ferris's milk-vetch, *Astragalus tener var. ferrisiae* (SC)

Gairdner's yampah, *Perideridia gairdneri ssp. gairdneri* (SC)

Hall's bush mallow, *Malacothamnus hallii (=M. fasciculatus)* (SLC)

Heckard's pepper-grass, *Lepidium latipes var. heckardii* (SLC)

Hoover's cryptantha, *Cryptantha hooveri* (SLC)

Lemmon's jewelflower, *Caulanthus coulteri var lemmonii* (SLC)

Livermore tarplant, *Deinandra bacigalupii* (SC)

Mason's lilaeopsis, *Lilaeopsis masonii* (SC)

Mt. Diablo fairy-lantern, *Calochortus pulchellus* (SLC)

San Joaquin spearscale (=saltbush), *Atriplex joaquiniana* (SC)

Suisun Marsh aster, *Aster lentus* (SC)

adobe lily, *Fritillaria pluriflora* (SC)

alkali milk-vetch, *Astragalus tener var. tener* (SC)

bearded allocarya (popcorn-flower), *Plagiobothrys hystriculus* (SC)

big tarplant, *Blepharizonia plumosa ssp. plumosa* (SC)

brittlescale, *Atriplex depressa* (SC)

caper-fruited tropidocarpum, *Tropidocarpum capparideum* (SC)

delta coyote-thistle (=button-celery), *Eryngium racemosum* (CA)

delta tule-pea, *Lathyrus jepsonii var. jepsonii* (SC)

diamond-petaled California poppy, *Eschscholzia rhombipetala* (SC)

fragrant fritillary (= prairie bells), *Fritillaria liliacea* (SC)

heartscale, *Atriplex cordulata* (SC)

hispid bird's-beak, *Cordylanthus mollis ssp. hispidus* (SC)

legenere, *Legenere limosa* (SC)

little mousetail, *Myosurus minimus ssp. apus* (SC)

recurved larkspur, *Delphinium recurvatum* (SC)

showy (=golden) madia, *Madia radiata* (SC)

slough thistle, *Cirsium crassicaule* (SC)

valley sagittaria (=Sanford's arrowhead), *Sagittaria sanfordii* (SC)

water sack (=saline) clover, *Trifolim depauperatum var. hydrophilum* (SC)

Reptiles

California horned lizard, *Phrynosoma coronatum frontale* (SC)

San Joaquin coachwhip (=whipsnake), *Masticophis flagellum ruddocki* (SC)

northwestern pond turtle, *Clemmys marmorata marmorata* (SC)

silvery legless lizard, *Anniella pulchra pulchra* (SC)

southwestern pond turtle, *Clemmys marmorata pallida* (SC)

KEY:

(E)	*Endangered*	Listed (in the Federal Register) as being in danger of extinction.
(T)	*Threatened*	Listed as likely to become endangered within the foreseeable future.
(P)	*Proposed*	Officially proposed (in the Federal Register) for listing as endangered or threatened.
(PX)	*Proposed Critical Habitat*	Proposed as an area essential to the conservation of the species.
(C)	*Candidate*	Candidate to become a *proposed* species.
(SC)	*Species of Concern*	May be endangered or threatened. Not enough biological information has been gathered to support listing at this time.
(SLC)	*Species of Local Concern*	Species of local or regional concern or conservation significance.
(D)	*Delisted*	Delisted. Status to be monitored for 5 years.
(CA)	*State-Listed*	Listed as threatened or endangered by the State of California.
NMFS	NMFS species	Under the jurisdiction of the National Marine Fisheries Service. Contact them directly.
(*)		Possibly extirpated from all or part of this area.
(**)		Possibly extinct.
	Critical Habitat	Area essential to the conservation of a species.

ENCLOSURE B

The goal of the U.S. Fish and Wildlife Service is to conserve, protect and enhance fish, wildlife, and their habitats by timely and effective provision of fish and wildlife information and recommendations. To assist us in accomplishing this goal, we would like to see the items described below addressed in your environmental documents for the proposed project.

Project Description

The document should very clearly state the purposes of, and document the needs for, the proposed project so that the capabilities of the various alternatives to meet the purposes and needs can be readily determined.

A thorough description of all permanent and temporary facilities to be constructed and work to be done as a part of the project should be included. The document should identify any new access roads, equipment staging areas, and gravel processing facilities which are needed. Figures accurately depicting proposed project features in relation to natural features (such as streams, wetlands, riparian areas, and other habitat types) in the project area should be included.

Affected Environment

The document should show the location of, and describe, all vegetative cover types in the areas potentially affected by all project alternatives and associated activities. Tables with acreage of each cover type with and without the project for each alternative would also be appropriate. We recommend that all wetlands in the project area be delineated and described according to the classification system found in the Service's Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). The Service's National Wetland Inventory maps would be one starting point for this effort, but updated information may be needed.

The document should present and analyze a full range of alternatives to the proposed project. In an effort to fully comply with the Clean Water Act and meet the Federal government's goal of no net loss of wetlands, at least one alternative should be designed to avoid all impacts to wetlands, including riparian areas. Similarly, within each alternative, measures to minimize or avoid impacts to all habitats (wetlands, riparian areas, grasslands, oak woodlands, etc.) should be included.

Lists of fish and wildlife species expected to occur in the project area should be in the document. The lists should also indicate for each species whether it is a resident or migrant, and the time of year it would be expected in the project area.

Environmental Consequences

The sections on impacts to fish and wildlife should discuss impacts from vegetation removal (both permanent and temporary), filling or degradation of wetlands, interruption of wildlife migration corridors, and disturbance from trucks and other machinery during construction and/or operation. These sections should also analyze possible impacts to streams from construction of outfall structures, pipeline crossings, and filling. Impacts on water quality, including nutrient loading, sedimentation, toxins, biological oxygen demand, and temperature in receiving waters should also be discussed in detail along with the resultant effects on fish and aquatic invertebrates. Discussion of indirect impacts to fish, wildlife, and their habitats, including impacts from growth induced by the proposed project, should also be addressed in the document. The impacts of each alternative should be discussed in sufficient detail to allow comparison between the alternatives.

The cumulative impacts of the project, when viewed in conjunction with other past, existing, and foreseeable projects, needs to be addressed. Cumulative impacts to fish, wildlife and habitats, including water quality, should be included.

Mitigation Planning.
Under provisions of the Fish and Wildlife Coordination Act, the Service advises and provides recommendations to Federal agencies planning water development activities or permitting such activities. These Federal agencies are to consult with the Service and give equal consideration to the conservation and rehabilitation of fish and wildlife resources with other project purposes. When reviewing proposed activities, the Service generally does not object to projects meeting the following criteria:

1. They are ecologically sound;

2. The least environmentally damaging reasonable alternative is selected;

3. Every reasonable effort is made to avoid or minimize damage or loss of fish and wildlife resources and uses;

4. All important recommended means and measures have been adopted, with guaranteed implementation to satisfactorily compensate for unavoidable damage or loss consistent with the appropriate mitigation goal; and

5. For wetlands and shallow water habitats, the proposed activity is clearly water dependent and there is a demonstrated public need.

The Service may recommend the "no project" alternative for those projects which do not meet all of the above criteria, and where there is likely to be a loss of fish and wildlife resources.

When projects impacting fish and wildlife resources are deemed acceptable to the Service, we recommend full mitigation for any impacts to fish and wildlife habitat. The Council on Environmental Quality regulations for implementing the National Environmental Policy Act define mitigation to include: 1) avoiding the impact; 2) minimizing the impact; 3) rectifying the impact; 4) reducing or eliminating the impact over time; and 5) compensating for impacts. The Service supports and adopts this definition of mitigation and considers the specific elements to represent the desirable sequence of steps in the mitigation planning process. Accordingly, we maintain that the best way to mitigate for adverse biological impacts is to avoid them altogether.

Project documentation should include a mitigation plan that describes all measures proposed to avoid, minimize, or compensate for impacts to fish and wildlife and their habitats. The measures should be presented in as much detail as possible to allow evaluation of their probable effectiveness.

To determine mitigation credits available for unavoidable impacts, future conditions on the mitigation site, absent any mitigation, are estimated and then compared to conditions expected to develop as a result of implementing the mitigation plan.

Mitigation habitat should be equal to or exceed the quality of the habitat to be affected by the project. Baseline information would need to be gathered at the impact site to be able to quantify this goal, such as plant species diversity, shrub and tree canopy cover, number of stems per acre, tree height, etc. Judging the ultimate success of the project should include success of mitigation, which should use these same measurements at the mitigation site as standards of comparison. Mitigation success criteria should aim toward equaling or exceeding the quality of the highest quality habitat to be affected. In other words, the mitigation effort would be deemed a success in relation to this goal if the mitigation site met or exceeded target habitat measurements (plant cover, density, species diversity, etc.).

Criteria should be developed for assessing the progress of mitigative measures during their developmental stages as well. Assessment criteria should include rates of plant growth, plant health, and evidence of natural reproduction.

The plan should present the proposed ground elevations at the mitigation site, along with elevations in the adjacent areas. A comparison of the soils of the proposed mitigation and adjacent areas should also be included in the plan, and a determination made as to the suitability of the soils to support habitats consistent with the mitigation goals.

Because of their very high value to migratory birds, and ever-increasing scarcity in California, our mitigation goal for wetlands (including riparian and riverine wetlands) is no net loss of in-kind habitat value or acreage, whichever is greater. As a result of their high value and reliance on suitable hydrological conditions, wetlands require development of additional information on the predicted hydrology of the mitigation site. The plan should describe the depth of the water table, and the frequency, duration, areal extent, and depth of flooding which would occur on the site. The hydrologic information should include an analysis of extreme conditions (drought, flooding) as well as typical conditions.

A mitigation plan must include a timeframe for implementing the mitigation in relation to the proposed project. We recommend that mitigation be initiated prior to the onset of construction. If there will be a substantial time lag between project construction and completion of the mitigation, a net loss of habitat values would result, and more mitigation would be required to offset this loss.

Generally, monitoring of the mitigation site should occur annually for at least the first five years, biennially for years 6 through 11, and every five years thereafter until the mitigation has met all success criteria. Remedial efforts and additional monitoring should occur if success criteria are not met during the first five years. Some projects will require monitoring throughout the life of the project. Reports should be prepared after each monitoring session.

The plan should require the preparation of "as-built" plans. Such plans provide valuable information, especially if the mitigation effort fails. Similarly, a "time-zero" report should be mandated. This report would describe exactly what was done during the construction of the mitigation project, what problems were encountered, and what corrections or modifications to the plans were undertaken.

The plan should detail how the site is to be maintained during the mitigation establishment period, and how long the establishment period will be. It will also be important to note what entity will perform the maintenance activities, and what entity will ultimately own and manage the site. In addition, a mechanism to fund the maintenance and management of the site should be established and identified. A permanent easement should be placed on the property used for the mitigation that would preclude incompatible activities on the site in perpetuity.

Finally, in some cases, a performance bond may be required as part of the mitigation plan. The amount of the bond should be sufficient to cover the costs of designing and implementing an adequate mitigation plan (and purchasing land if needed) should the proposed plan not succeed.

Reference:

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C. 103 pp.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

February 28, 2003

Becky Wren
U.S. Army Corps of Engineers
Sacramento District, Attn: CESPK-PD-R
1325 J Street
Sacramento, CA 95814

Dear Ms. Wren:

The Environmental Protection Agency (EPA) has reviewed the Notice of Intent (NOI) to prepare a Draft Environmental Impact Statement (DEIS) for North Delta Improvements Project. Our review is pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

The Corps of Engineers (Corps) and the California Department of Water Resources (DWR) are considering several potential actions to improve flood control and restore habitat in the North Sacramento-San Joaquin Delta area. The NOI identifies several possible actions to be evaluated in the General Re-evaluation Report/Environmental Impact Statement (GRR/EIS) including flood detention areas, parallel levee bypasses, setback levees, bridge replacement, and maintenance dredging. Alternatives are scheduled to be better defined through the scoping process. EPA recommends that the DEIS examine a range of alternatives, including non-structural measures, to meet the flood damage reduction and restoration goals of the project.

We appreciate the opportunity to review this NOI. Our attached comments provide further information on issues to consider in preparing the DEIS. Please send three (3) copies of the DEIS to this office at the same time it is officially filed with our HQ Office of Federal Activities. If you have any questions, please call me at (415) 972-3851.

Sincerely,

Shanna W. Draheim
NEPA Reviewer

cc: Gwen Knittweis, California Department of Water Resources
Donna Garcia, Bureau of Reclamation, Mid-Pacific Region
Dan Meier, Bureau of Reclamation, Mid-Pacific Region

Purpose and Need for the Proposed Action

We recommend the Draft Environmental Impact Statement (DEIS) for the North Delta Improvements Project (NDIP) include a clear description of the basic project purpose and need. The DEIS should clearly state what *needs* the Corps is responding to in this action (i.e. degradation of the hydrogeomorphic system, significant flood damage, loss of significant habitat, threats/damage to cultural resources, erosion). A clearly defined purpose and need will help identify the best range of alternatives to be considered.

Information on baseline conditions for relevant resources in the watershed is a critical step in defining the purpose and need. The DEIS should clearly describe existing conditions, including information on existing management systems, surface water quality, hydrogeomorphic functions, biological resources, cultural resources, and recreational opportunities. Discuss the extent to which water quality and sensitive or unique habitats, if any, can be protected and improved. The DEIS should thoroughly discuss the project's relationship to the state-federal CALFED Bay-Delta Program (CALFED).

Alternatives

The Notice of Intent (NOI) lists several measures the Corps is considering to meet the project goals, including flood detention areas, parallel levee bypasses, setback levees, bridge replacement, and maintenance dredging. EPA strongly recommends that the DEIS also examine alternatives which employ non-structural measures to meet the flood damage reduction and ecosystem restoration goals of the project, and would compliment the various natural and cultural resources of the project area. To this end, EPA encourages the Corps to take a system-wide approach to developing solutions. For each of the alternatives, the DEIS should:

- Address the possibilities for enhancement of fish and wildlife habitat along the riparian corridor;
- Reflect awareness that not all recreational and cultural activities are compatible with restoration of terrestrial and aquatic habitats. The DEIS should outline strategies for reducing human impacts in restoration and sensitive habitat areas;
- Identify opportunities for improving geomorphic conditions in the watershed; and
- Protect water quality and beneficial uses.

Environmental Impacts

The DEIS should identify potential impacts to the environment from any proposed actions and potential mitigation for these impacts. The evaluation of environmental impacts among alternatives should be presented in comparative form, thus sharply defining the issues and providing a clear basis for choice among options for the decision maker and the public (40 CFR 1502.14).

In addition to direct impacts, the National Environmental Policy Act (NEPA) also requires evaluation of indirect and cumulative effects which are caused by the action (40 CFR 1508.8(b) and 1508.7). This includes consideration of impacts from other capital projects in the watershed, including the Delta Cross Channel and the through-Delta facility on the Sacramento River. CEQ regulations also state that the EIS should include the "means to mitigate adverse environmental effects." (40 CFR 1502.16(h)). This provision applies to indirect and cumulative effects, as well as direct effects.

The NOI states that components of the Delta Cross Channel and the through-Delta facility on the Sacramento River, which are also identified in the CALFED Record of Decision, will not be addressed through the NDIP. While the NDIP is separate from these projects, the DEIS should still consider the impacts of changes at the Delta Cross Channel or the proposed Through Delta Facility on the success of the NDIP. While the flood control portions of those projects may not impact the NDIP because those facilities could be closed during flood conditions, changes in flow through the Delta Cross Channel and the through-Delta facility could affect NDIP's ecosystem restoration efforts. The DEIS should thoroughly discuss the relationship of these projects, and the potential direct, indirect, and cumulative impacts of the NDIP in conjunction with these other planned projects.

Wetlands/Clean Water Act (CWA) Section 404:

The DEIS should identify potential impacts to wetlands and other aquatic resources protected under the CWA Section 404 , including requirements and any compliance measures. EPA will review the proposed action for compliance with the Federal Guidelines for Specification of Disposal Sites for Dredged or Fill Materials (40 CFR 230)[Guidelines], promulgated pursuant to Section 404(b)(1) of the CWA, which require that no discharge of dredged or fill material can be permitted if there is a practicable alternative that is less damaging to the aquatic environment.

Environmental Justice

In keeping with Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898), the EIS should describe the measures taken by the Corps to: 1) fully analyze the environmental effects of the proposed Federal action on minority communities, and 2) present opportunities for affected communities to provide input into the NEPA process. The intent and requirements of EO 12898 are clearly illustrated in the President's February 11, 1994 Memorandum for the Heads of all Departments and Agencies.

-----Original Message-----
From: William O. Beatty [mailto:beatty@jps.net]
Sent: Wednesday, March 12, 2003 1:33 PM
To: Knittweis, Gwen
Subject: N. Delta Impr. Comments.

I'm sorry I was unable to attend either public scoping meeting. I did hear that at one of those meetings staff mentioned that plans were being developed to limit boat speed and access on some waterways in order to reduce levee erosion. I am involved in boating, agriculture and Delta protection so have a fair perspective of the problem. While boat wakes certainly contribute to levee erosion boating restrictions need to be accomplished in a way that involves boaters in order for the restrictions to be effective and acceptable. I would strongly encourage you to involve boating organizations in any planning process that restricts boating. A few organizations that could help you accomplish this are Delta Chamber of Commerce, Pacific Inter Club Yachting Association, Recreational Boaters of CA., and the many Delta Marinas, and Yacht and boating clubs.

THE NORTH DELTA IMPROVEMENT PROJECT AND ITS RELATIONSHIP TO FLOOD IMPROVEMENTS FOR THE FRANKLIN POND-BEACH /STONE LAKE/POINT PLEASANT AREA

FRANKLIN POND

The Cosumnes and Mokelumne Rivers did not flood north of Desmond Road under natural 1850 un-levied conditions. Levees constructed to protect low lying downstream Swamp and Overflow land now create backwater which flood the upstream area creating what is now called the Franklin Pond. The record stage of 19.31’ msl experienced in the Franklin Pond area in 1997 could not occur had it not been for the initial levee projects combined with improvements after the 1986 flood. Even with downstream levees the great flood of March 1907 only recorded of peak stage at Bensons Ferry of 13.9’ msl.

POINT PLEASANT

The Point Pleasant area also was not in the floodplain under natural conditions. Historically, the entire watershed on the east side of the Sacramento River from the City of Sacramento to Lambert Road drained to the Sacramento River. The area now designated Point Pleasant did not flood nor was it designated Swamp or Overflow lands. This changed with the construction of Swampland District 2’s levees after 1861. Swampland District 2 encompassed the Swamp and Overflow lands on the east bank of the Sacramento River from the American River to the Mokelumne River. To drain the area after Swampland District 2’s Sacramento River levee was constructed a canal was dug by Sacramento County from the City of Sacramento to Snodgrass Slough. This canal was designated the Sacramento Drainage Canal and was completed in 1870. Recognizing the backwater potential, the State Statue authorizing its construction states that levees and floodgates shall be constructed to prevent backwater from entering the upstream area. This canal, with slight modifications, is still the primary drainage facility for the entire Morrison Creek watershed.

The flooding that now occurs in the Point Pleasant area is a direct result of downstream swampland reclamation combined with upstream urbanization. Levees constructed to protect the low-lying swampland areas displace floodwaters to the un-levied Point Pleasant area. The inability of the diversion canal to contain and convey upstream drainage and the inability of the Lambert Road floodgates to prevent downstream backwater from entering the upstream area is the major contributing factor.

STATE OF CALIFORNIA

Throughout the history of reclamation, the State of California has participated by either legislating, funding or constructing levee projects. Many of these State supported projects negatively impact the Franklin Pond/ Point Pleasant areas. Mitigation of impacts has not been required.

What is the State of California’s present role as related to this flood problem? I believe the State of California, the County of Sacramento and the local landowners would all benefit if the State and County were to combine their individual projects and work together to resolve this flood problem before it is forced to litigation.

Thank you,
Walter Hoppe
11556 Fogg Road
Elk Grove, CA.

February 16, 2003

Ms.Gwen Knittweis
North Delta Project Manager
California Department Of Water Resources
1400 Ninth Street
Sacramento, California 95814

Dear Gwen,

As a resident of the Franklin Pond I am quite concerned that the flood control alternatives presented at your meeting on the North Delta Model provided no meaningful flood control assistance for our area. In fact some of the alternatives discussed at the January 9, 2003 meeting will aggravate our situation.

Wouldn't it be better to consider a wider range of alternatives; especially in light of the Aiken's case, which signaled a change in the legal systems approach to flood suits? I am sure you know the Aiken's case sought to determine liability for flood damages based on whether the victims were in the historical flood plain. A simple look at ground elevations or the 1907 flood is enough to prove the Franklin Pond is not a historical flood area. Our house is at elevation 15 while much of the area behind the Thornton levee is at elevation 1. The flood of 1907 only reached a height of 13.9' at Benson's Ferry; not enough to flood our property.

The alternatives you presented appeared to be based on preconceived projects rather than a goal such as lowering the flood level at Benson's Ferry by six feet. I believe that a goal based approach is much more appropriate considering the Aiken's case and the California Environmental Quality Act. The alternatives to be considered should start with the pre 1859 conditions, to show a baseline and include the 1907 flood because of the available data and its significance in the design of the levee system.

Sincerely,

William G. Kirkham
6600 Twin Cities Road
Elk Grove, California

-----Original Message-----
From: Lester, Aric
Sent: Wednesday, March 05, 2003 9:09 AM
To: Zemitis, Collette
Subject: RE: North Delta Scoping Meeting

Hi Collette:

My answer to the first question would be:
Focus on habitats that 1) benefit species that are native to the area and 2) are sustainible without frequent human intervension.

Answer to the second would be:
Uncertain if creation of dendritic habitat is necessary to improve tidal/floodplain habitat for native species and it may even diminish habitat value. There is no naturally occurring dendritic habitat in the McCormack Williamson Tract area. Suggest creating dendritic habitat in some areas and not in others and assess use by native and non-native species, including plants and inverts.

Thanks. -Aric-

-----Original Message-----
From: Zemitis, Collette
Sent: Tuesday, March 04, 2003 4:18 PM
To: Lester, Aric
Cc: Knittweis, Gwen
Subject: North Delta Scoping Meeting

Hi Aric,
You asked me some questions during our scoping meeting in Sac, which I neglected to record on the easel. Would you mind me recording your comments/questions in our scoping report? I do not need to specify your name if you want. More importantly, I'd be interested in your suggestions for habitat you'd like to see in the area, see my questions below. Thanks. Collette
Aric Lesters comments:

Where is example of dendritic habitat in the area?
Why create it here?
Will you dig all the channels?

Questions for Aric
Which habitat would you like to see/prefer?
What problems do you see with dendritic habitat?

CAREL D. VAN LÖBEN SELS
P. O. BOX 7
WALNUT GROVE, CA 95690
916-776-1223

DATE: FEBRUARY 27, 2003

TO: PAUL BOWERS, U.S. ARMY CORPS OF ENGINEERS

FROM: TOPPER VAN LOBEN SELS

RE: COMMENTS REGARDING CALFED NORTH DELTA FLOOD/ECOSYSTEM IMPROVEMENTS SCOPING

THE GOAL FOR THE NORTH DELTA FLOOD CONTROL PROJECT MUST BE **100 YEAR FLOOD PROTECTION** FROM A SINGLE SURGE 100 YEAR EVENT AND 100 YEAR PROTECTION FROM A 1986 TYPE TWO SURGE FLOOD EVENT.

TO ACHIEVE THE ABOVE GOAL, THE CONCEPTUAL ALTERNATIVES MAY HAVE TO BE COMBINED. AFTER RUNNING THE ABOVE TWO FLOOD SCENARIOS THROUGH THE MODEL, THE RESULTS MAY SHOW THAT **A COMBINATION OF DREDGING, LEVEE SETBACKS, AND A STATIN ISLAND RETENTION BASIN** WILL GIVE THE NORTH DELTA 100 YEAR FLOOD PROTECTION.

THERE IS ONE CONCEPTUAL ALTERNATIVE THAT MUST BE INCLUDED AND REVIEWED AS PART OF ANY NORTH DELTA AREA FLOOD CONTROL PLANNING PROCESS. THE NASHVILLE DAMN OR ANY OTHER **UPSTREAM RETENTION AREAS ON THE COSUMNES RIVER** WOULD HAVE TREMENDOUS POSITIVE IMPACTS ON AQUATIC AND TERRESTRIAL HABITATS AND AT THE SAME TIME PROVIDE FLOOD CONTROL AND WATER STORAGE. DURING THE SUMMER MONTHS PARTS OF THE COSUMNES RIVER GO DRY. THE EXPERTS AT THE NATURES CONSERVANCY AGREE THAT SUMMER WATER RELEASES IN THE COSUMNES SYSTEM WOULD BE A BIG IMPROVEMENT OVER THE STATUS QUO.

WHEN A PREFERRED ALTERNATIVE IS CONSTRUCTED, THE ONLY WAY TO MEET THE GOAL OF 100 YEAR FLOOD PROTECTION IS TO INCLUDE A **MAINTENANCE GUARANTEE** THAT MUST BE PART OF THE CALFED FLOOD SOLUTION. THE DESIGN AND FLOW RATES OF THE PROJECT MUST BE MAINTAINED OVER TIME. AN EXAMPLE IS ONGOING DREDGING OF THE SOUTH AND NORTH FORKS OF THE MOKELUMNE RIVER.

WITH PROPER PLANNING, CONSTRUCTION, AND MAINTENANCE THE 100 YEAR FLOOD PROTECTION IS ACHIEVABLE PROVIDED THAT CALFED OR SOME OTHER GOVERNMENT AGENCY **CREATE AND ENFORCE A NO NET GAIN IN FLOOD ELEVATION POLICY**. WE MUST ADDRESS THE CUMULATIVE IMPACT OF SACRAMENTO, ELK GROVE, GALT, AND LODI DEVELOPMENTS AND ASSOCIATED RUN-OFF.

630.71

CAREL D. VAN LÖBEN SELS
P. O. BOX 7
WALNUT GROVE, CA 95690
916-776-1223

DATE: FEBRUARY 27, 2003

TO: D.W.R. NORTH DELTA IMPROVEMENT GROUP

FROM: TOPPER VAN LOBEN SELS

RE: COMMENTS REGARDING CALFED NORTH DELTA FLOOD/ECOSYSTEM IMPROVEMENTS SCOPING

THE GOAL FOR THE NORTH DELTA FLOOD CONTROL PROJECT MUST BE **100 YEAR FLOOD PROTECTION** FROM A SINGLE SURGE 100 YEAR EVENT AND 100 YEAR PROTECTION FROM A 1986 TYPE TWO SURGE FLOOD EVENT.

TO ACHIEVE THE ABOVE GOAL, THE CONCEPTUAL ALTERNATIVES MAY HAVE TO BE COMBINED. AFTER RUNNING THE ABOVE TWO FLOOD SCENARIOS THROUGH THE MODEL, THE RESULTS MAY SHOW THAT **A COMBINATION OF DREDGING, LEVEE SETBACKS, AND A STATIN ISLAND RETENTION BASIN** WILL GIVE THE NORTH DELTA 100 YEAR FLOOD PROTECTION.

THERE IS ONE CONCEPTUAL ALTERNATIVE THAT MUST BE INCLUDED AND REVIEWED AS PART OF ANY NORTH DELTA AREA FLOOD CONTROL PLANNING PROCESS. THE NASHVILLE DAMN OR ANY OTHER **UPSTREAM RETENTION AREAS ON THE COSUMNES RIVER** WOULD HAVE TREMENDOUS POSITIVE IMPACTS ON AQUATIC AND TERRESTRIAL HABITATS AND AT THE SAME TIME PROVIDE FLOOD CONTROL AND WATER STORAGE. DURING THE SUMMER MONTHS PARTS OF THE COSUMNES RIVER GO DRY. THE EXPERTS AT THE NATURES CONSERVANCY AGREE THAT SUMMER WATER RELEASES IN THE COSUMNES SYSTEM WOULD BE A BIG IMPROVEMENT OVER THE STATUS QUO.

WHEN A PREFERRED ALTERNATIVE IS CONSTRUCTED, THE ONLY WAY TO MEET THE GOAL OF 100 YEAR FLOOD PROTECTION IS TO INCLUDE A **MAINTENANCE GUARANTEE** THAT MUST BE PART OF THE CALFED FLOOD SOLUTION. THE DESIGN AND FLOW RATES OF THE PROJECT MUST BE MAINTAINED OVER TIME. AN EXAMPLE IS ONGOING DREDGING OF THE SOUTH AND NORTH FORKS OF THE MOKELUMNE RIVER.

WITH PROPER PLANNING, CONSTRUCTION, AND MAINTENANCE THE 100 YEAR FLOOD PROTECTION IS ACHIEVABLE PROVIDED THAT CALFED OR SOME OTHER GOVERNMENT AGENCY **CREATE AND ENFORCE A NO NET GAIN IN FLOOD ELEVATION POLICY**. WE MUST ADDRESS THE CUMULATIVE IMPACT OF SACRAMENTO, ELK GROVE, GALT, AND LODI DEVELOPMENTS AND ASSOCIATED RUN-OFF.

Russell van Loben Sels
P.O. Box C
Courtland, CA 95615
(916) 439-3291
Fax: (916) 775-1941
Email: russellvls@yahoo.com

2/24/03

Re: Comments regarding North Delta Improvements Project

The project must incorporate meaningful and maximum flood control benefits as measured against a model of the 1986 flood event in which the town of Thornton, New Hope Island, Dead Horse and Tyler Island all flooded. Allowing the project area to flood when needed to achieve maximum flood control benefits, will provide area for flood waters to spread out creating a flood control facility much like the Yolo Bypass on the western side of the North Delta. At present on the eastern side of the North Delta flood waters are channelized which results in floodwaters backing up towards Sacramento, flooding I-5, the branch jail, Point Pleasant and other areas. The North East Delta has needed a dedicated floodway for many years.

In addition to creating a floodway, dredging the channels to move floodwaters through the project area will be needed. This will result in less frequent flooding of the project area and reduce the duration of flooding when the project area becomes flooded. Although levee setback may also result in moving more water through the project area, because of instability in new levee footing, this may not be effective in most of the project area.

After the project improves flooding in the North East Delta, there must be a commitment by all parties to not further intrude and remove area from the floodway. Upstream development alone has and is incrementally negatively impacting flood control in the project area. Allowing any removal of floodway area will be devastating to all other areas in the North East Delta and must be vigorously opposed.

Russ van Loben Sels

U.S. Army Corps of Engineers
California Department of Water Resources

North Delta Improvements Project

Public Meetings Announcement

The U.S. Army Corps of Engineers (Corps) and California Department of Water Resources (DWR) have scheduled two public meetings to receive comments on the proposed North Delta Improvements Project (NDIP). The CALFED Bay-Delta Program project would implement flood control improvements in the northern Sacramento-San Joaquin Delta, principally on and around Staten Island, Dead Horse Island, and McCormack Williamson Tract, in a manner that would benefit aquatic and terrestrial habitats and alleviate flood-related problems in the North Delta area.

Your active participation is welcome and important to ensure that the NDIP meets the needs of area residents, land owners, visitors and the environment. If special assistance is required, please contact Gwen Knittweis as far in advance of the meetings as possible to enable DWR to secure the needed services. If a request cannot be honored, the requestor will be notified.

Pursuant to the National Environmental Policy Act and the California Environmental Quality Act, the Corps and DWR, respectively, are initiating the NDIP Feasibility Study for a portion of the Sacramento-San Joaquin Delta, and plan to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the proposed NDIP. Development of the Feasibility Report will be closely coordinated with development of the draft EIS/EIR, which will document existing conditions, project actions, and project effects.

Public Meeting Schedule:

6 to 8 p.m., Wednesday
February 19, 2003
Jean Harvie Community Center
14273 River Road
Walnut Grove, Calif.

1:30 to 4 p.m., Thursday
February 20, 2003
Bonderson Building
Hearing Room A
901P Street
Sacramento, Calif.

For more information, please visit http://ndelta.water.ca.gov, or contact:

Ms. Becky Wren
Environmental Manager
U.S. Army Corps of Engineers
Phone: 916-557-5162
rebecca.wren@usace.army.mil

Ms. Gwen Knittweis
North Delta Project Manager
California Department of Water Resources
Phone: 916-651-7015
gwenk@water.ca.gov

North Delta Improvements Project
California Department of Water Resources
PO Box 942836
Sacramento, CA 94236-0001

First Class
US Postage Paid
Sacramento, CA
Permit No. 2840

US Army Corps
of Engineers
Sacramento District

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

KATZ & ASSOC
1228 N ST #5
SACRAMENTO CA 95814-

DECLARATION OF PUBLICATION
(C.C.P. 2015.5)

COUNTY OF SACRAMENTO

STATE OF CALIFORNIA

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the printer and principal clerk of the publisher of The Sacramento Bee, printed and published in the City of Sacramento, County of Sacramento, State of California, daily, for which said newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Sacramento, State of California, under the date of September 26, 1994, Action No. 379071; that the notice of which the annexed is a printed copy, has been published in each issue thereof and not in any supplement thereof on the following dates, to wit:

February 16, 2003

I certify (or declare) under penalty of perjury that the foregoing is true and correct and that this declaration was executed at Sacramento, California, on **February 16, 2003.**

[signature]

(Signature)

NO 511 PUBLIC NOTICE

The U.S. Army Corps of Engineers (Corps) and California Department of Water Resources (DWR) have scheduled two public meetings to receive comments on the proposed North Delta Improvements Project (NDIP). The CalFed Bay-Delta Program project would implement flood control improvements in the northern Sacramento-San Joaquin Delta, principally on and around Staten Island, Dead Horse Island, and McCormack Williamson Tract, in a manner that would benefit aquatic and terrestrial habitats and alleviate flood-related problems in the North Delta area.

Meetings are scheduled for 6:00-8:00 PM, Feb. 19, at the Jean Harvie Community Center, 14273 River Road, Walnut Grove, Calif., and 1:30-4:00 PM, Feb. 20 at the Bonderson Hearing Room, 901 P St., Sacramento, Calif. All parties interested in this study are encouraged to attend. If special assistance is required, please contact Gwen Knittweis (see contact information below) as far in advance of the workshops as possible to enable DWR to secure the needed services. If a request cannot be honored, the requestor will be notified.

Pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), the Corps and DWR, respectively, are initiating the NDIP Feasibility Study for a portion of the Sacramento-San Joaquin Delta, and plan to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the proposed NDIP. Development of the Feasibility Report will be closely coordinated with development of the draft EIS/EIR, which will document existing conditions, project actions, and project effects. Responsible and trustee agencies under CEQA may include: California Department of Fish and Game; The Reclamation Board of the State of California; State Lands Commission; California Regional Water Quality Control Boards; State Water Resources Control Board; California Department of Transportation; California Department of Conservation; and California Department of Boating and Waterways.

FOR FURTHER INFORMATION CONTACT:
Ms. Becky Wren, Environmental Manager
U.S. Army Corps of Engineers, CESPK-PD-R
1325 J Street, Sacramento, CA 95814-2922
Telephone: (916) 557-5162
Email address:
rebecca.wren@usace.army.mil
or: Ms. Gwen Knittweis
North Delta Project Manager
California Department of
Water Resources
PO Box 942836, Sacramento, CA 94236-0001
Telephone: (916) 651-7015
Email address: gwenk@water.ca.gov.
Also http://ndelta.water.ca.gov
contains further project information.

Run 1Ti, February 16, 2003

PROOF of PUBLICATION

NOTICE

STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN } ss.

THE UNDERSIGNED SAYS:

I am a citizen of the United States and a resident of San Joaquin County; I am over the age of eighteen years, and not a party to or interested in the above-entitled matter. I am the principal clerk of the printer of THE RECORD, a newspaper of general circulation, printed and published daily in the City of Stockton, County of San Joaquin and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of San Joaquin, State of California, under the date of February 25, 1952, File Number 52857, San Joaquin County Records; that the notice, of which the annexed is a printed copy (set in type not smaller than nonpareil), has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates,

to-wit: FEBRUARY 16

all in the year 2003,

I declare under penalty of perjury that the foregoing is true and correct.

Executed on FEBRUARY 18, 2003

at Stockton, California

Stella Hernandez — Signature

PUBLIC NOTICE

The U.S. Army Corps of Engineers (Corps) and California Department of Water Resources (DWR) have scheduled two public meetings to receive comments on the proposed North Delta Improvements Project (NDIP). The CalFed Bay-Delta Program project would implement flood control improvements in the northern Sacramento-San Joaquin Delta, principally on and around Staten Island, Dead Horse Island, and McCormack Williamson Tract, in a manner that would benefit aquatic and terrestrial habitats and alleviate flood-related problems in the North Delta area.

Meetings are scheduled for 6:00-8:00 PM, Feb. 19, at the Jean Harvie Community Center, 14273 River Road, Walnut Grove, Calif., and 1:30-4:00 PM, Feb. 20 at the Bonderson Hearing Room, 901 P St., Sacramento, Calif. All parties interested in this study are encouraged to attend. If special assistance is required, please contact Gwen Knittweis (see contact information below) as far in advance of the workshops as possible to enable DWR to secure the needed services. If a request cannot be honored, the requestor will be notified.

Pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), the Corps and DWR, respectively, are initiating the NDIP Feasibility Study for a portion of the Sacramento-San Joaquin Delta, and plan to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the proposed NDIP. Development of the Feasibility Report will be closely coordinated with development of the draft EIS/EIR, which will document existing conditions, project actions, and project effects. Responsible and trustee agencies under CEQA may include: California Department of Fish and Game; The Reclamation Board of the State of California; State Lands Commission; California Regional Water Quality Control Boards; State Water Resources Control Board; California Department of Transportation; California Department of Conservation; and California Department of Boating and Waterways.

FOR FURTHER INFORMATION CONTACT: Ms. Becky Wren, Environmental Manager, U.S. Army Corps of Engineers, CESPK-PD-R, 1325 J Street, Sacramento, CA 95814-2922, telephone: (916) 557-5162, Email address: rebecca.wren@usace.army.mil, or: Ms. Gwen Knittweis, North Delta Project Manager, California Department of Water Resources, PO Box 942836, Sacramento, CA 94236-0001, telephone: (916) 651-7015, Email address: gwenk@water.ca.gov. Also http://ndelta.water.ca.gov contains further project information.

#152747 2/16/03

US Army Corps of Engineers
Sacramento District

U.S. Army Corps of Engineers
California Department of Water Resources

North Delta Improvements Project

Public Meeting Comment Card

Name: ____

Organization: ______________________________________

Address: ____

Phone: ____________________ Fax: ____________________ Email: ____________________

Question/Comment: __________________________________

____

____

____

____

____

____

Stamp

North Delta Improvements Project
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

US Army Corps
of Engineers
Sacramento District

PUBLIC WORKSHOP GUIDE

North Delta Improvements Project, California

CALFED North Delta Flood/Ecosystem Improvements Scoping

Welcome to this public workshop for the North Delta Improvements Project. The purpose of the public workshop is to receive ideas, concerns and issues from area residents and other interested parties on flooding and ecosystem problems and opportunities in the North Delta area. **Your active participation is welcome and important to ensure that the Study meets your needs.**

Today's public workshop is scheduled from 1:30 to 4 p.m. The workshop will begin with an open house and information session. Participants are invited to visit information tables to learn about the study and talk with study team members. The open house will be followed by a brief project overview presentation and comments/questions session. Afterwards, participants are welcome to return to the information tables for more discussion and to provide comments to study team members.

We would like to receive a broad range of public input. Listed below is a space for you to take notes and some questions to consider in providing comments on the project. You can use this sheet for notetaking, or turn it in to project staff for inclusion in the public record of comments. As well, you may provide comments by:

- ✓ Fill out a "Comment Card" and return to the project team by U.S. Mail or leave it in one of several drop-boxes at today's workshop.
- ✓ Write your comments (or have a study team member) on the easels provided during the information sessions at the public workshop.
- ✓ Provide comments verbally during the comments/questions section at the public workshop.

Thank you for your interest and participation!

Range of Actions:

What do you think about the potential flood control and ecosystem concepts being considered? Have a broad enough range of actions been considered? Are there feasible ideas that the project team has not yet considered?

____

____

____

____

US Army Corps of Engineers
Sacramento District

More Information Visit:
http://ndelta.water.ca.gov

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

Conceptual Alternatives:
Do you have any issues or concerns associated with the conceptual alternatives presented at the workshop? Do you have any suggestions for modifying or improving the conceptual alternatives?

____

____

____

____

Environmental Effects:
Are there specific environmental effects that you would like to see addressed? Are there any environmental issues that are particularly important to the local communities?

____

____

____

____

Mitigation Measures:
Mitigation measures to address the potential environmental impacts of project implementation will be defined in the EIR/EIS. Are there any specific mitigation measures you would like to see included?

____

____

____

____

Assessment Methodology:
Do you have suggestions for criteria or methods to consider in assessing the effectiveness of project alternatives?

____

____

____

____

US Army Corps of Engineers
Sacramento District

North Delta Improvements Project

Bonderson Building, Sacramento, Calif.
1:30-4 p.m., Feb. 20, 2003

Public Meeting Sign-In Sheet

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
W Hoppe		684-2711	
GILBERT COSIO	MBK ENGRS	456-4400	
RICK SOEHREN	DWR	916-653-0758	
Michael Norris	DWR	651-7009	
Herb Hereth	DWR	485-0435	
Suzanne DeLeon	DFG		
Margit Aramburu	DPC	776-2290	
Lauren Hastings	CALFED ERP	916-653-4647	hastings@water.ca.gov

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
Henry Matsunaga	Hunson Engineering 444 N. 3rd St #400 Sac 95814	448-2821	matsunaga@JCH-ENGR.COM
Mark Spannagel	Assemblyman Doug LaMalfa State Capitol 4177 Sac 95814	319-2002	Mark.Spannagel@asm.ca.gov
Denneese Bonds Chanis	DWR		
Bernice A. Sullivan	Friant WU authority 1521 I St Sac 95814	441-1931	bsullivan@fwua.org
John Winther	Delta Wetlands 3697 Mt Diablo Blvd #100 Lafayette Ca 94549	925-283-4216	

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
Katrina Chow	US Army Corps	916-557-6724	katrina.e.chow@usace.army.mil
Larry W Easttearn	KCRA-TV	325-3255	leasttearn@hearst.com
Tina Lunt	Cosumnes River Task Force 9701 Dino Drive, Suite 170 Elk Grove CA 95624	916 714-1104 ext 112	tina.lunt@canacdnet.org
ROGER LEE	DWR / REC. BD. 3310 EL CAMINO AVE. SACRAMENTO, CA 95821	916 574-0353	rlee@water.ca.gov
Boone Lek	DWR / Rec Board 1416 9th St. Sac. 95814	916 654-4009	blek@water.ca.gov
Craig Crouch	Sac Co. DWR	(916) 874-5431	
Sergio Guillén	CA Bay-Delta Authority	(916) 657-4765	sguillen@water.ca.gov
RICH DORNHELM	MOFFATT & NICHOL ENG 2001 N. MAIN ST SUITE 360 WALNUT CREEK CA 94596	925 944 5411	rdornhelm@moffattnichol.com

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
John Hanson	RO 348 - 444 N. 3rd St. #400 Sacramento CA	448-2821	jhanson@jch-engr.com
Steve Sinnock	Kjeldsen, Sinnock & Neudeck P.O. Box 844 Stockton, CA 95201	(209) 946-0268	ssinnock@ksninc.com
JOE BALKAN	KCRA 3 TELEVISION CIRCLE SACRAMENTO, CA	325-3750	JBALKAN@HEARST.COM
Arie Lester	DWR 3251 S St Sac 95815	227-2488	alester@water.ca.gov
Robert Clark	CCVFCA & NDWA 910 K St. Ste 310 Sacramento 95814	916-446-0197	ccvfca@softcom.net
Ken Hitch	Corps of Engineers 1325 J. St Sacramento	916-557-6699	kenneth.e.hitch@usace.army.mil
Lanny H. Fisk	PaleoResource Consultants 5325 Elkhorn Blvd. #294 Sacto 95842	916-339-9594	Lanny@PaleoResource.com
Jeff Stuart	NOAA Fisheries		j.stuart@noaa.gov

PUBLIC WORKSHOP GUIDE

North Delta Improvements Project, California

CALFED North Delta Flood/Ecosystem Improvements Scoping

Welcome to this public workshop for the North Delta Improvements Project. The purpose of the public workshop is to receive ideas, concerns and issues from area residents and other interested parties on flooding and ecosystem problems and opportunities in the North Delta area. **Your active participation is welcome and important to ensure that the Study meets your needs.**

Today's public workshop is scheduled from 6 to 8 p.m. The workshop will begin with an open house and information session. Participants are invited to visit information tables to learn about the study and talk with study team members. The open house will be followed by a brief project overview presentation and comments/questions session. Afterwards, participants are welcome to return to the information tables for more discussion and to provide comments to study team members.

We would like to receive a broad range of public input. Listed below is a space for you to take notes and some questions to consider in providing comments on the project. You can use this sheet for notetaking, or turn it in to project staff for inclusion in the public record of comments. As well, you may provide comments by:

- ✓ Fill out a "Comment Card" and return to the project team by U.S. Mail or leave it in one of several drop-boxes at today's workshop.
- ✓ Write your comments (or have a study team member) on the easels provided during the information sessions at the public workshop.
- ✓ Provide comments verbally during the comments/questions section at the public workshop.

Thank you for your interest and participation!

Range of Actions:

What do you think about the potential flood control and ecosystem concepts being considered? Have a broad enough range of actions been considered? Are there feasible ideas that the project team has not yet considered?

US Army Corps of Engineers
Sacramento District

More Information Visit:

http://ndelta.water.ca.gov

Conceptual Alternatives:

Do you have any issues or concerns associated with the conceptual alternatives presented at the workshop? Do you have any suggestions for modifying or improving the conceptual alternatives?

Environmental Effects:

Are there specific environmental effects that you would like to see addressed? Are there any environmental issues that are particularly important to the local communities?

Mitigation Measures:

Mitigation measures to address the potential environmental impacts of project implementation will be defined in the EIR/EIS. Are there any specific mitigation measures you would like to see included?

Assessment Methodology:

Do you have suggestions for criteria or methods to consider in assessing the effectiveness of project alternatives?

North Delta Improvements Project

Jean Harvie Community Center, Walnut Grove, Calif.

6-8 p.m. Feb. 19, 2003

US Army Corps of Engineers
Sacramento District

Public Meeting Sign-In Sheet

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
BILL DARSIE	KSN ENGINEERS R.D. 2086	209 946 0268	wdarsie@ksninc.com
LINDA ALLEN	11680 KESTREL LAKE RD ELK GROVE CA 95758	916-684-2741	N/A
JOHN ALLEN	11680 KESTREL LAKE RD ELK GROVE CA 95758	916-684-2741	N/A
Aleck Dambacher	Rec Dist 348 311 main SKN 95204	916 4256406	duckpond@softcom.net
Steve Mello	RD563 NDWA - CVFCA	916 777-1801	Deltablkm@citlink.net
Galen Whitney	property owner	916-775-1821	
Ed. Schmit	DWR	916-651-7007	
JB MORAIS	14591 WALNUT GROVE RD. WG. 95690	916 776 4447	jbmorais@hotmail.com
Frank Silk	BLMD.	916 7766535	

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
Bill Kirkham	6600 Twin Cities Elk Grove CA	916 684-2595	billk@dgweb.com
Nancy Baldwin	11600 Kestrel Lake Rd Elk Grove CA 95758	684-2086	nbonthego@cwo.com
Thomas Herzog	12350 Herzog Rd Courtland Calif 95615	916 971 4060	
Topper Van Loben Sels	P.O. Box 7 W.G 95690		
Linda van Loben Sels	" "		
John Brodie	SJ County RCD 1222 Monaco Ct. #23 Stockton CA 95207	209-946-6456 x125	rurangl@hotmail.com
Christopher Lee	RD. 556 13760 Hwy 160 W.G. 95690	916-776-1731	
Brent Tadman	Box 883 Walnut Grove Ca 95690	916-776-4078	btadman@citlink.net
Mike Eaton	TNC	9166831699	meaton@tnc.org

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
WALDO HOLT	SAN JOAQUIN AUDUBON SOCIETY		
TIM WILSON	RD 2111	916 776 1701	TIM@KAYDIX.COM
Jeff Hart	Hart Restoration	(916) 775-4021	jeffhart@citlink.net
Bill Fleenor	UC Davis	(530) 752-5669	wefleenor@ucdavis.edu
Chris Hammersmark	UC Davis	(530) 752-5669	chammersmark@ucdavis.edu
Dave Bettencourt	Rec Dist 563	916 777 5982	
John L. Lewallen	Pobovgs WC	916 779-6233	
Don Deckert	New Hope Landing	209-794-2627	
Howard Dunbar	New Hope Landing		

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
katrina chow	US Army Corps 1325 J street, Sacto	916-557-6724	katrina.c.chow@usace.army.mil
John P Baranek	Herzog Co 12300 Herzog Rd Courtland Ca 95615	916 775-1264	herzogco@citlink.net
Kip Korth	Willow Berm Marina 140 Brannan Isl Rd Isleton Ca 95641	916 777 6313	Kkorth29@hotmail.com
Gil Labrie	Brand Rd 38	916-776-2271	dccengineering @citlink.net?

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
Lo Hopper		684-2711	
Rick Cooper	USDI - BLM Cosumnes River Preserve	683-1701	
Ron Ganfried	US Army Corps of Engineers	916/557-5159	
Grant Kreinberg	SAFCA 1007 7th St, STE 7 Sacramento 95814	916-874-7606	

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
Bill Darsie	RD 2086	209 946 0268	wdarsie@ksninc.com
Mike Ballas		(916) 628-3901	mmballas@gns2000.com

NAME	AGENCY & ADDRESS	PHONE	E-MAIL
Jack Williams	Jack Williams Ranches Inc.	209-466-8591	JACKWILLIMS RANches.com
Isaac Wilson			IsaacNWilson@Yahoo.com

Appendix B

Description of Alternatives Evaluation Process Report

DRAFT

Description of Alternatives Evaluation Process

North Delta Flood Control and Ecosystem Restoration Project

Delta Suisun Marsh Office
Division of Flood Management
June, 2006

DEPARTMENT OF WATER RESOURCES

TABLE OF CONTENTS

List of Tables

List of Figures

Document Purpose

This appendix documents the technical analysis, stakeholders' input, and hydraulic modeling that lead to the Group 1 and Group 2 flood control and ecosystem restoration alternatives described in the Administrative DRAFT EIR for the North Delta Flood Control and Ecosystem Restoration Project. The goal of this project is to achieve well-integrated ecosystem restoration and flood control within a complex system and provide additional enhancements such as recreation and conveyance benefits to the extent possible. Although refinement is necessary within the proposed alternatives, the preliminary analysis detailed in this section has indicated that these general concepts hold the greatest promise for achieving multiple project benefits. The document also provides a description of and rationale for making decisions regarding all the alternatives including those which have been set aside during the planning process.

Numerous factors were considered to arrive at the alternatives currently being taken forward for detailed impact analysis in the project EIR. This includes the development of a three-tiered screening criteria for alternatives development and impact analysis which is described in this document. The first level screening criteria were roughly applied to developing the alternatives to be considered for detailed impact analysis. The second and third level screening criteria will be applied in impact analysis for the EIR and will guide selection of a preferred alternative at the end of the environmental documentation process.

Stakeholder and science panel input has been and continues to be greatly encouraged and highly valued throughout the alternatives development process and impact analysis. This document details some of the key review and input points that have led to the present level of alternatives development. The document is organized mainly chronologically. Appendix A provides a chronological listing of key meetings and events in the project alternatives development process.

Early Flood Control Scenarios

North Delta area improvements have been the focus of planning efforts for many years. In 1987, DWR launched a planning and environmental documentation process for the North Delta Program that led to a release of a draft EIR/EIS in 1990. Many of the elements and objectives of the 1990 effort were similar. However, one important difference is that the Draft 1990 EIR/EIS included water supply and conveyance benefits from modification of the Delta Cross Channel. Under the CALFED Bay-Delta Program, North Delta Flood Control and Ecosystem Restoration Improvements are being implemented separately from Delta Cross Channel Re-operation studies and Through-Delta Facility Studies. (See CALFED Bay-Delta Program Programmatic Record of Decision, Volume 1, Page 50 for background on implementation of the North Delta conveyance plan). Therefore, cross channel modifications are not part of the planning process discussed herein and the potential for conveyance benefits, which were derived largely from such modifications in the 1990 Draft EIR/EIS, is not as significant, and is limited to those associated with dredging.

The main goals stated in the 1990 Draft EIR/EIS include: alleviate flooding in the North Delta, reduce reverse flows in the lower San Joaquin River, improve water quality, reduce fishery impacts, and improve State Water Project flexibility and water supply reliability. Ecological restoration actions were limited to setting back levees and enhancing wildlife habitat associated with the levees. The preferred alternative at the time of release of the 1990 Draft EIR/EIS for the North Delta Program, illustrated in figure 1, had a cost of $290 million and included:

- Dredge the main stem of the South Fork Mokelumne River.
- Enlarge the main stem and North Fork Mokelumne River with levee setbacks and channel dredging.
- Enlarge the Delta Cross Channel gate structure.
- Acquire the necessary state and federal permits, and
- Test mitigation collector wells and fish screens.

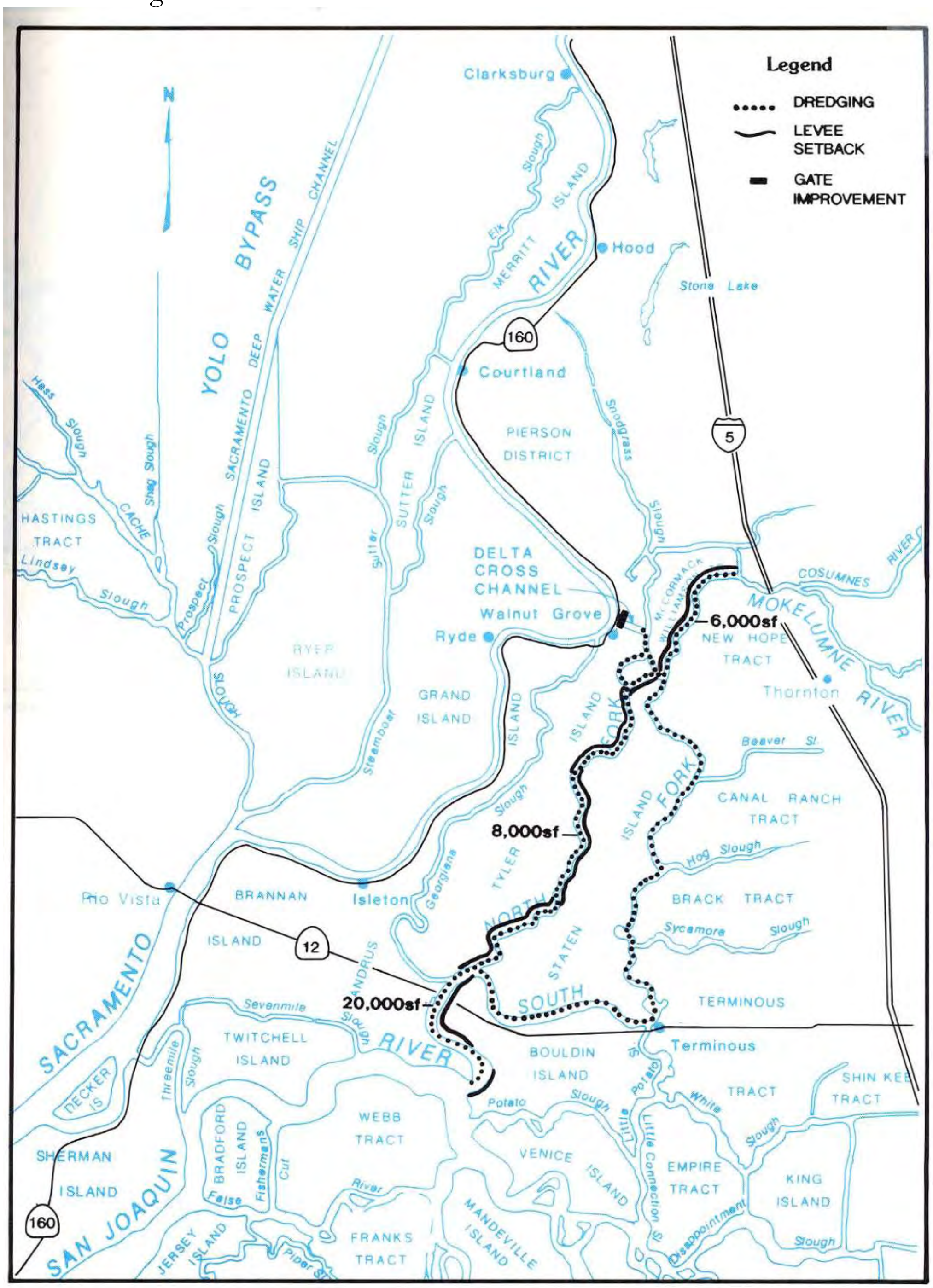


Figure 1: Preferred Alternative from 1990 North Delta EIR/EIS

Also under consideration in the Draft were numerous alternatives combining the components above in different ways as well as the additional idea of a floodway on Staten Island or McCormack-Williamson Tract.

In 1995, DWR suspended North Delta planning efforts in deference to the CALFED Bay-Delta Program and the goals of the 1990 North Delta EIR/EIS have been absorbed into the CALFED Program mainly in the North Delta Flood Control and Ecosystem Restoration improvements and the Delta Cross Channel Re-operation/Through-Delta Facility studies.

While the CALFED Bay-Delta Program was completing the Programmatic Bay-Delta EIR/EIS, CALFED staff convened the North Delta Improvements Group (NDIG) to initiate North Delta Improvements planning. NDIG is a key stakeholder forum that includes Agency representatives, local landowners, reclamation district staff, and other interested parties. The group focused early planning efforts on preparation of the "DRAFT White Paper on North Delta Improvements," (White Paper) dated July 2000, to capture the complex history of the area, the then-current related planning efforts, and preliminary planning research. (The White Paper is available on the North Delta website at http://baydeltaoffice.water.ca.gov/ndelta/northdelta/index.cfm under "documents"). The 1990 EIR/EIS was consulted extensively for background material and the 1990 alternatives were a logical starting point for developing early conceptual alternative scenarios. The White Paper presented the scenarios illustrated in Figures 2 through 7. These scenarios included:

- Levee raising and channel dredging,
- South Mokelumne River bypass,
- North Mokelumne River bypass,
- Tyler Island bypass,
- Staten Island bypass, and
- Staten Island floodway and South Mokelumne River setback levees.

Hydraulic modeling had not been performed for the White Paper scenarios at the time the White Paper was released. At this time, DWR was working with stakeholders to develop an appropriate modeling tool which led to development of a North Delta HEC-RAS Hydraulic Model as discussed in the next section. North Delta modeling for the 1990 EIR/EIS had been performed using the NETWORK model. However, this analysis method was widely criticized by stakeholders because of the technical limitations of the NETWORK model and because it was not consistent with modeling methods performed by the Sacramento- San Joaquin Comprehensive study, a key regional flood control planning effort.

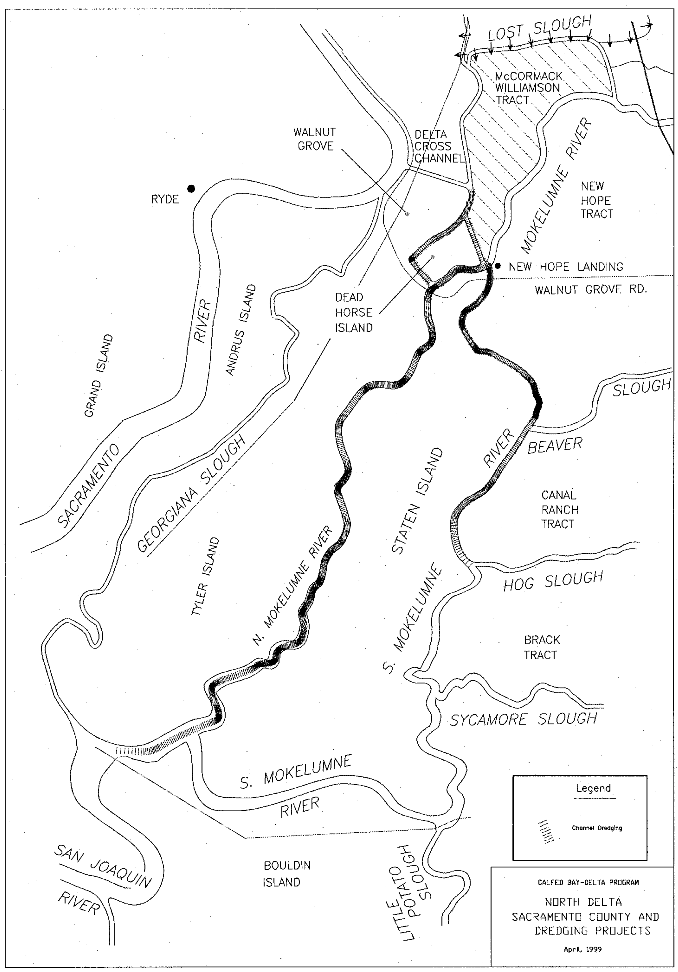


Figure 2: Levee raising and channel dredging

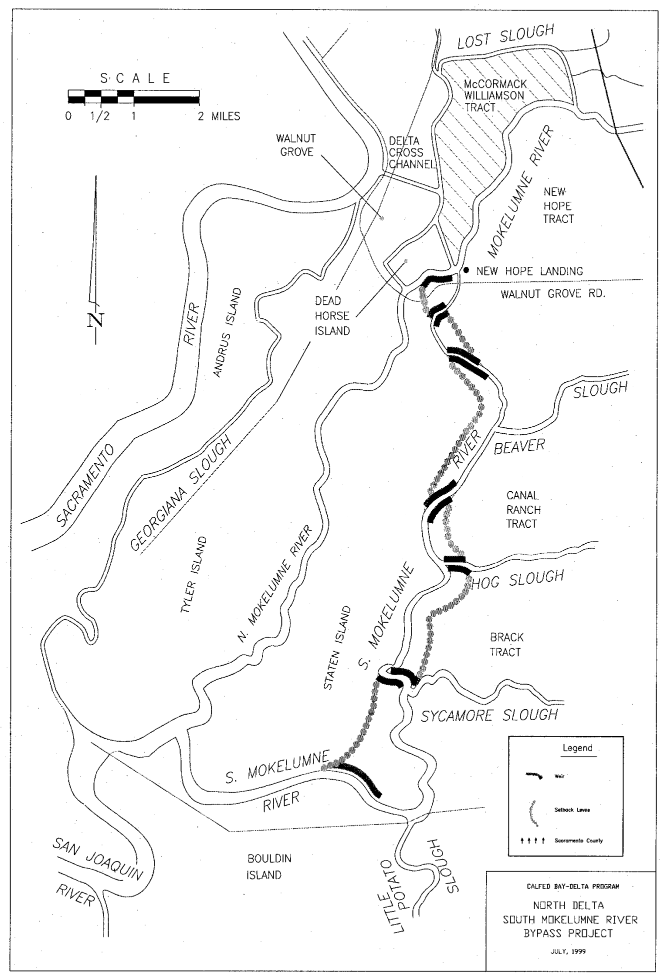


Figure 3: South Mokelumne River bypass

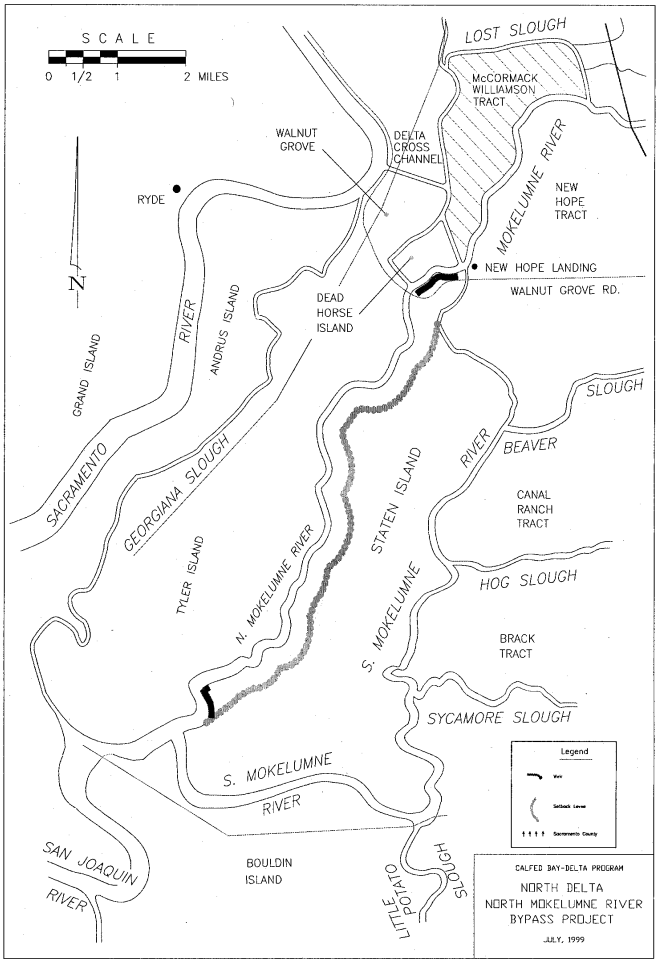


Figure 4: North Mokelumne River bypass

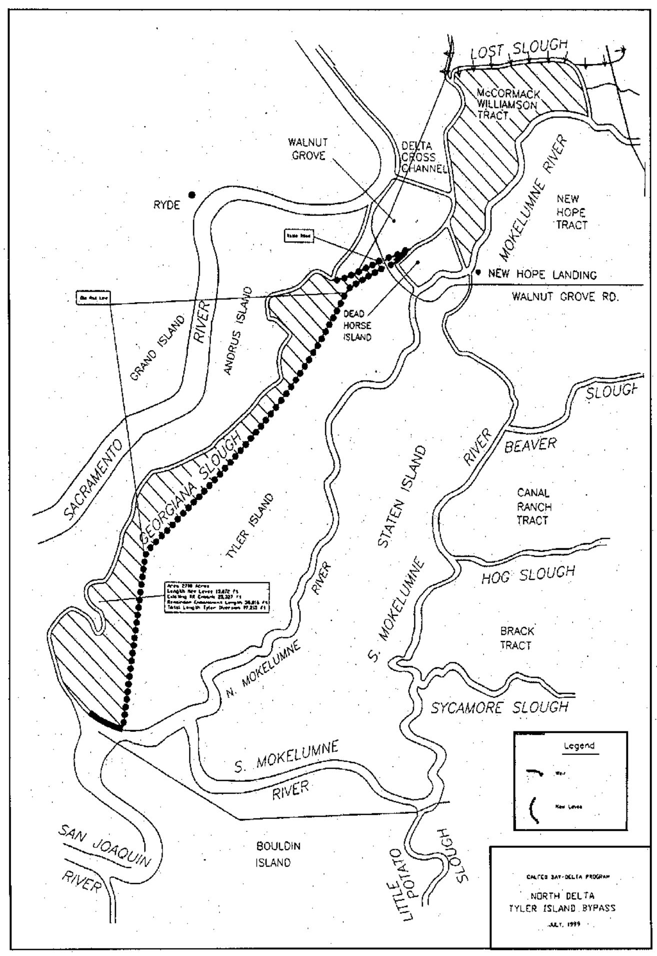


Figure 5: Tyler Island bypass

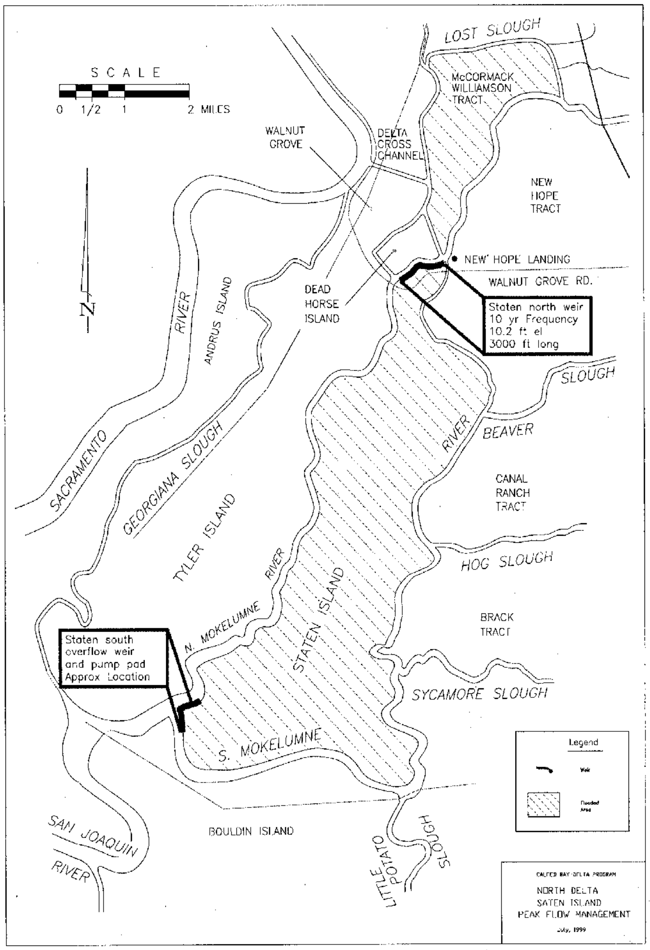


Figure 6: Staten Island bypass

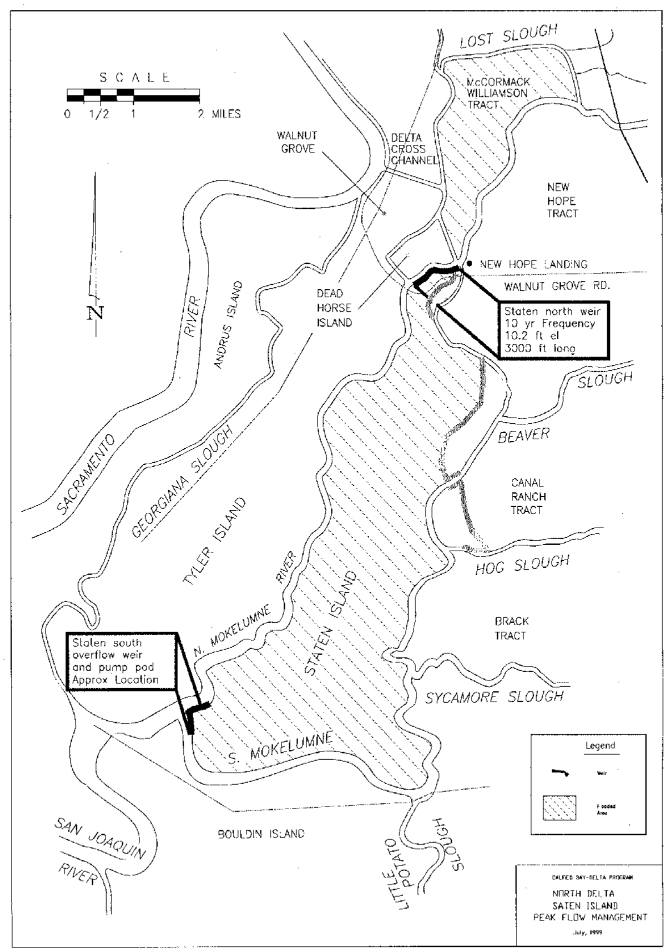


Figure 7: Staten Island floodway and South Mokelumne River setback levees

Early Ecological Restoration Project Development

This section describes events early in the North Delta planning process that were instrumental in formulating the ecosystem-restoration elements of the Project.

Coordination with CALFED ERP

Department of Water Resources and Jones and Stokes staff met with the CALFED Ecosystem Restoration Program (ERP) Steering Committee throughout 2001-2002 to obtain guidance on ecosystem restoration concepts for the project. The Steering Committee advised North Delta staff that specific guidance regarding ecosystem alternatives would not be available until after the CALFED program developed the Delta Regional Ecosystem Restoration Implementation Program (DRERIP); the DRERIP was not scheduled to be available in the near-term at that point and is currently not available as of May 2006. Because the DRERIP or similar documents was not available to provide specific project guidance, DWR and CALFED ERP staff agreed to continue to coordinate to assure North Delta project ecosystem restoration compatibility with CALFED ERP goals. In coordination with CALFED ERP, the following objectives for the project were initially developed:

1. Restore ecological processes, including hydrologic, geomorphic and biologic processes, to the extent practicable in the North Delta Improvements Project area.
    a. Promote natural flooding processes, tidal action and appropriate salinity regime.
    b. Improve river floodplain connectivity
    c. Allow channel migration where practicable.
    d. Promote sediment deposition, especially to increase elevations in areas of subsidence due to agricultural activities.
    e. Promote Delta foodweb productivity and water exchange with adjacent channels.

2. Restore self-sustaining habitats including freshwater tidal marsh, seasonal floodplain, and riparian.

3. Support special status species in the area.

4. Limit exotic species establishment to the extent practicable.

5. Limit methylmercury introduction into the food-chain to the extent practicable.

McCormack-Williamson Tract Purchase and Restoration Plans

In 1999, The Nature Conservancy (TNC) obtained $5.6 million in CALFED Ecosystem Restoration Program funds to purchase the approximately 1600-acre McCormack-Williamson Tract for ecosystem restoration and flood control. Also in 1999, UC Davis researchers and DWR obtained CALFED Ecosystem Restoration Program funds in complementary proposals. UCD researchers received $556,200 to conduct historic research and baseline studies for restoration planning and a monitoring program and DWR received $355,000 for restoration planning and design of engineering alternatives for the Tract. The UC Davis research included analysis of historic hydrogeomorphic conditions, modern hydrologic and sedimentologic regime, baseline studies of aquatic resources and riparian resources, and development of data management and monitoring systems.

The primary ecological/biological objective of the combined proposals was to restore self-sustaining freshwater tidal marsh and riparian habitat within the Tract. Restoration of these habitats was intended to:

1) support aquatic and riparian species of concern,
2) promote Delta foodwebs by reintroducing more natural, unimpaired flow conditions,
3) provide support for adaptive management of seasonally and perennially flooded habitats in order to promote native invertebrates and fish and to limit the impact of invasive species, such as the Chinese Mitten Crab, and
4) provide new web-based expert systems to support biological monitoring in restored tidal marsh systems.

Ancillary benefits of the project were:

1) enhance flood management in the project area,
2) new methodologies for assessing historic and current hydrologic conditions and sedimentologic flux rates in the Delta, and
3) new expert systems for biological monitoring in the Bay-Delta region.

The UC Davis paleogeomorphic research showed that McCormack-Williamson Tract was historically dominated by fluvial processes. Baseline aquatic resources show predominance of exotic fish species around McCormack-Williamson Tract, especially in the Delta Meadows area. Data from the research are available on the UC Davis website http://watershed.ucdavis.edu/crg/. UC Davis researchers are preparing a final report, which will be used to guide restoration planning.

TNC also received $680,000 in CALFED Ecosystem Restoration Program funds for start-up stewardship activities including wildlife-friendly levee resloping, planning, and outreach work. In 2001, TNC constructed approximately 5,000 linear feet of wildlife-friendly levee along the Northeast McCormack-Williamson Tract levee, a section of levee particularly subject to erosion from wave fetch from Southwest winds during flood events. Besides providing habitat, wildlife-friendly levee resloping (adding a gradual levee slope to the land-side of the levee and planting on it) protects the inboard side of the levee from erosion magnified by wind fetch during flooding events. The Nature Conservancy has received $2.5 million from CALFED ERP to create another 20,000 linear feet of wildlife-friendly levee. The North Delta Project plans to provide habitat by constructing wildlife-friendly levees around much of the remaining interior of McCormack-Williamson Tract.

TNC, DWR, and UC Davis researchers developed the restoration scenarios illustrated in Figure 8 for McCormack-Williamson Tract as part of planning activities funded by CALFED grant funds. These restoration scenarios allowed tidal flow into McCormack-Williamson Tract, and had considered possible flood control benefits. Scenario 6 has a setback levee widening the Mokelumne River. In Scenario 7 the Mokelumne River levee is degraded. Scenarios 2 and 4 have breaches allowing tidal action in M-W Tract. Scenarios 3 and 8 have a cross-levee limiting tidal action to the North and South parts of the Tract, respectively.

UC Davis researchers developed a hydraulic model for the North Delta to aid in determining the functionality of ecosystem restoration scenarios on McCormack-Williamson Tract. A one-dimensional MIKE 11 hydraulic model was developed to quantify the hydraulics for various ecosystem restoration scenarios. Originally, the model was bounded within Benson's Ferry and New Hope Landing as the upstream and downstream boundaries, respectively. The "Post Scoping Alternatives Development" section of this document discusses the later expansion of the North Delta Mike 11 model domain and calibration of the model for a wide range of events for use in project alternatives refinement and impact analysis.

The model was used to evaluate trends in habitat type with the different restoration scenarios. Areal extent of habitat type was dependent upon breach location and size. Many of the restoration options had more subtidal habitat than desired though much of the subtidal habitat was less than 2 feet deep. For all scenarios, there was a minimal effect of flood flow stages at Benson's Ferry and New Hope Landing. Further development of restoration scenarios occurred in part because scenarios shown in Figure 8 would not be aggressive enough to achieve appreciable flood control benefits.

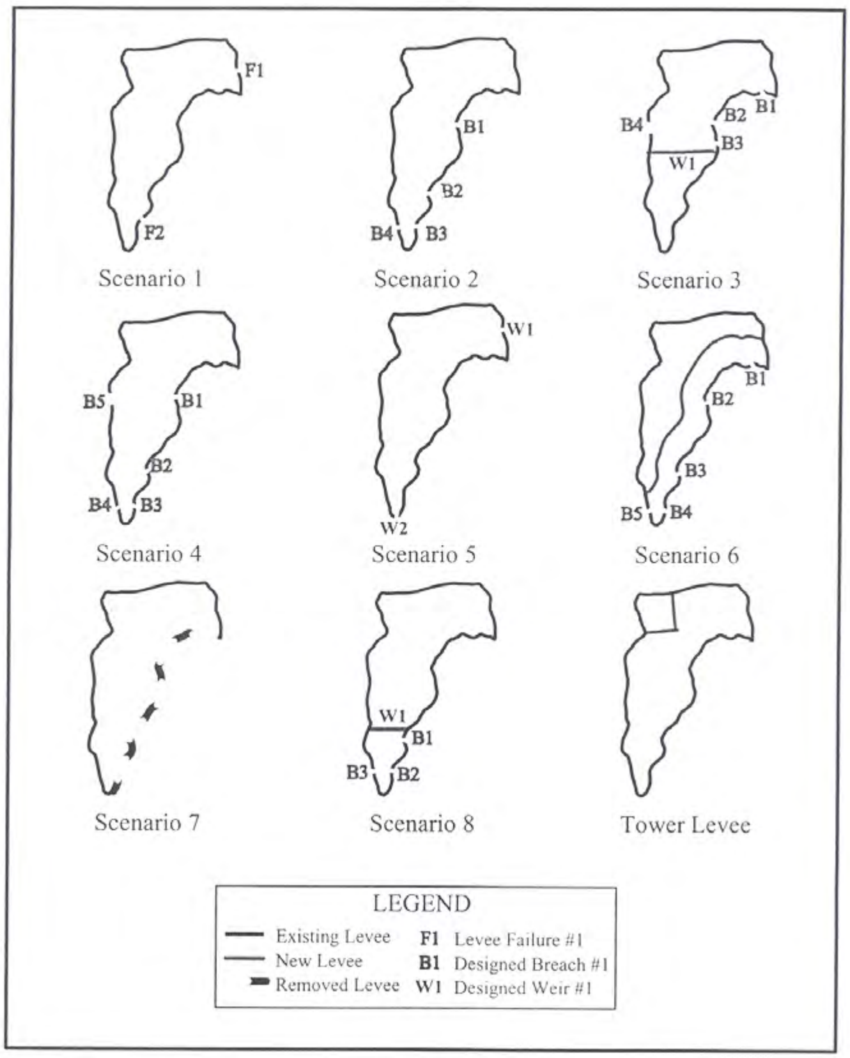


Figure 8: Schematics of various McCormack-Williamson Tract restoration scenarios evaluated with MIKE11

Staten Island Purchase and Ecological Values

Staten Island was purchased by The Nature Conservancy (TNC) in late 2002 with roughly $17.5 million in Prop 204 funds and roughly $17.5 million in Prop 13 funds under the Flood Protection Corridor Program. Consistent with the fund sources for purchase of Staten, North Delta planning committed to carefully balance use of Staten for ecosystem restoration as well as flood control and preservation of agriculture. The objective of restoration includes protection of the sandhill crane habitat, a State listed threatened species, on Staten Island. Staten Island land managers have flooded their fields in the winter to attract sandhill cranes for the last twenty years or so. The Staten Island purchase agreement limited flooding of Staten Island to no more than 1:10 year flooding, a frequency assumed to not substantially harm sandhill cranes. This limitation came from a February 2000 report by cranes researchers Carroll Littlefield and Gary Ivey, commissioned by The Nature Conservancy. Consultation with DFG regulators regarding crane impacts will be part of the Environmental Impact Report process and may result in design changes (with perhaps a different flood frequency than 1:10 year) and/or mitigation for impacts to cranes.

The Nature Conservancy is continuing to manage Staten Island for sandhill cranes, and in 2002 Ducks Unlimited received $1.5 million in CALFED Ecosystem Restoration Program funding to improve control of drainage systems on the island and monitor and evaluate different wildlife-friendly farming practices and crane use. The Nature Conservancy funded sandhill crane monitoring for the winter 2002-2003 by Gary Ivey and Caroline Herziger, resulting in an August 2003 report. The report states that more than 8000 cranes were observed in the period September through March. Other findings include the possibility that cranes would benefit from additional wetlands and crop rotation.

Alternatives Development for Public Scoping

Several significant events occurred during and after preparation of the White Paper that would influence subsequent North Delta ecosystem and flood control planning:

- CALFED administered a contract with USBR who solicited for bids to prepare environmental documentation for North Delta improvements. Jones and Stokes Associates was the successful candidate and was brought on board to prepare environmental documentation for North Delta planning in Fall 2001.

- The Comprehensive Study planning effort, a large regional flood control planning effort covering the Sacramento and San-Joaquin River systems, was implemented in response to recommendations in the Flood Emergency Action Team (FEAT) Report following the catastrophic flood events of 1997. The HEC-RAS modeling platform was used for the Comprehensive study. The North Delta project area was not included in the bounds of the Comprehensive Study; however, North Delta planning staff coordinated with Comprehensive Study staff for consistency in modeling and planning assumptions.

- CALFED released the CALFED Bay-Delta Final Programmatic EIR/EIS in summer 2000 followed by the Programmatic Record of Decision which included a plan of action, implementation strategy, and mitigation strategies for the Preferred Program Alternative.

- DWR staff in coordination with Jones and Stokes, Agencies, and North Delta area stakeholders convened the Hydraulic Modeling Coordination Team (HMCT) to identify and guide development of a suitable hydraulic modeling tool. DWR, Sacramento County Department of Public Works, and the Sacramento Area Flood Control Agency (SAFCA) cost-shared the development of a regional hydraulic model of the North Delta area. Model development work was performed by MBK Engineers, a private engineering consultant.

In summer of 2002, DWR, in coordination with the Agencies, stakeholders (mainly through the North Delta Improvements Group or NDIG), and Jones and Stokes began developing conceptual alternatives for the environmental documentation process. As a starting point, the White Paper scenarios were reassessed. Throughout completion of the CALFED Bay-Delta Final Programmatic EIR/EIS planning process, there was a strong emphasis on the part of CALFED Agencies and stakeholders to focus implementation actions on lands not in private ownership. In light of the fact that McCormack-Williamson Tract and Staten Island were already or would near-term be in non-private ownership, White paper alternatives such as the South Mokelumne River Bypass and Tyler Island Bypass, that relied heavily on lands in private ownership, were put aside. This lead to development of conceptual alternative components in preparation for public scoping.

DWR also convened, in coordination with Jones and Stokes and regulatory Agencies, the North Delta Agency Team (NDAT), a group of Agency representatives with regulatory interest in the project, to provide input to the planning process. Conceptual components were presented in the NDAT and NDIG meetings throughout the fall in preparation for public scoping (Appendix A includes a timeline of key conceptual review points throughout the alternatives development process). The components presented in the meetings are shown in Figures 9 through 14, and included the following Alternatives:

- Staten Whole Island Bypass
- Staten Island Parallel Levee and Bypass
- Road Relocation and South Fork Mokelumne River Setback Levees
- North Fork Mokelumne River Parallel Levee and Detention
- Dead Horse Island Setback Levee and Restoration Project
- Dead Horse Island Floodway Component

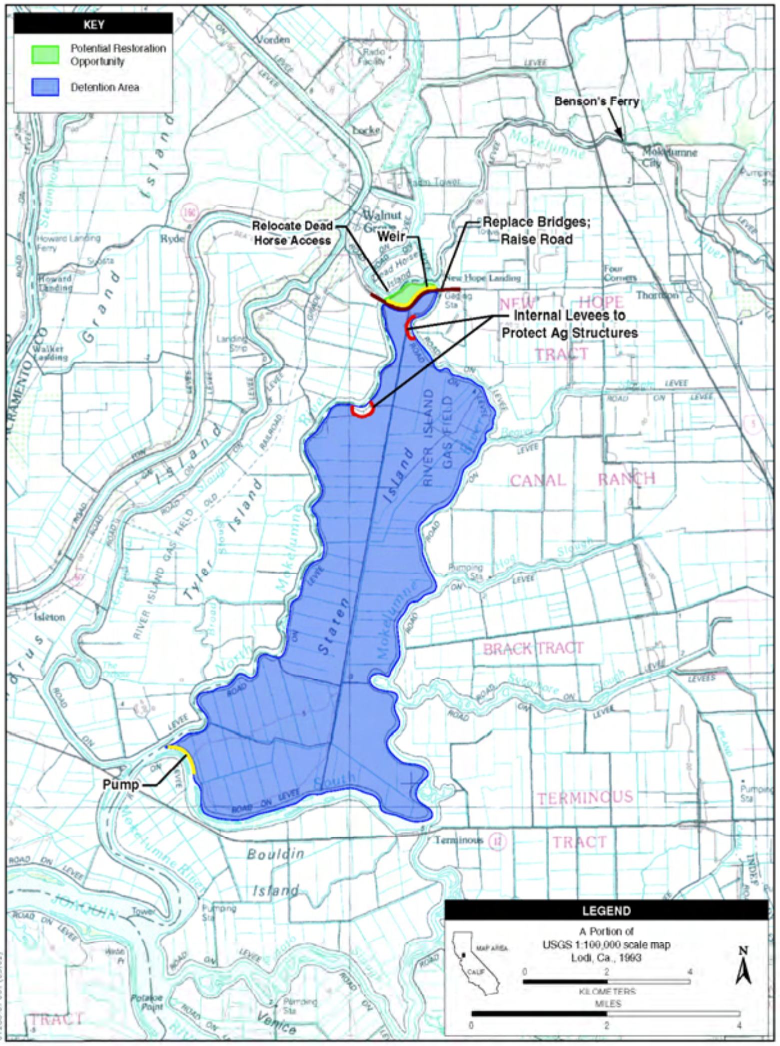


Figure 9: Staten whole island bypass

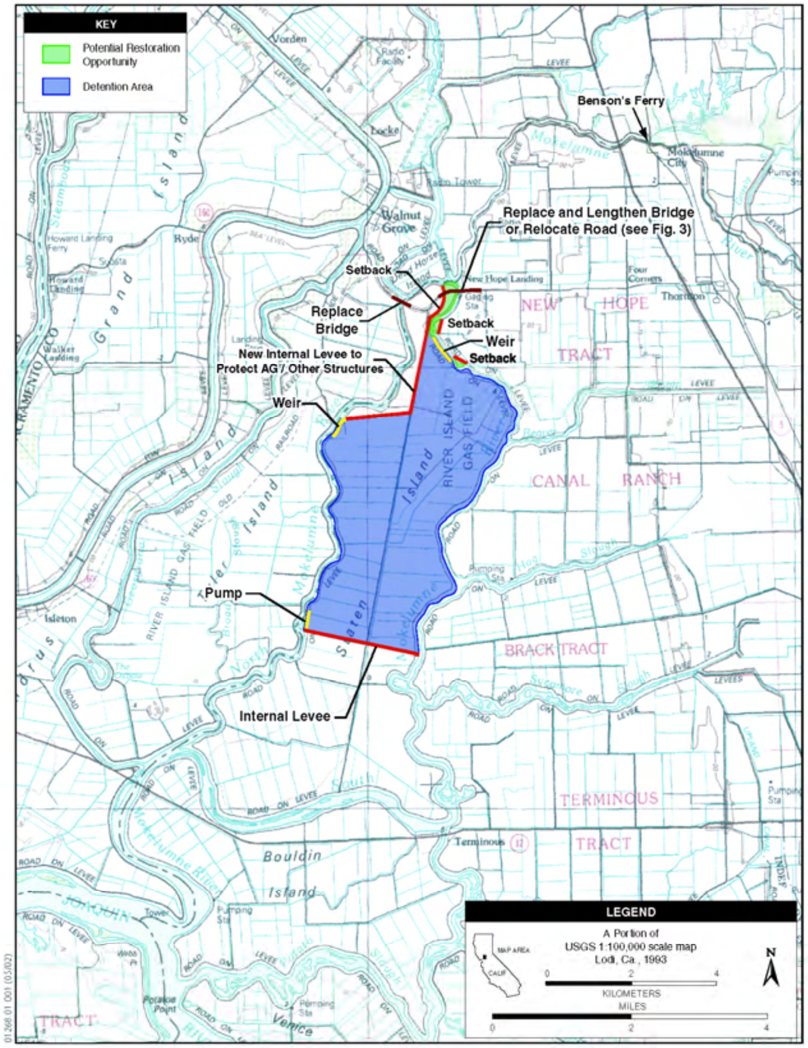


Figure 10: Staten partial-island bypass

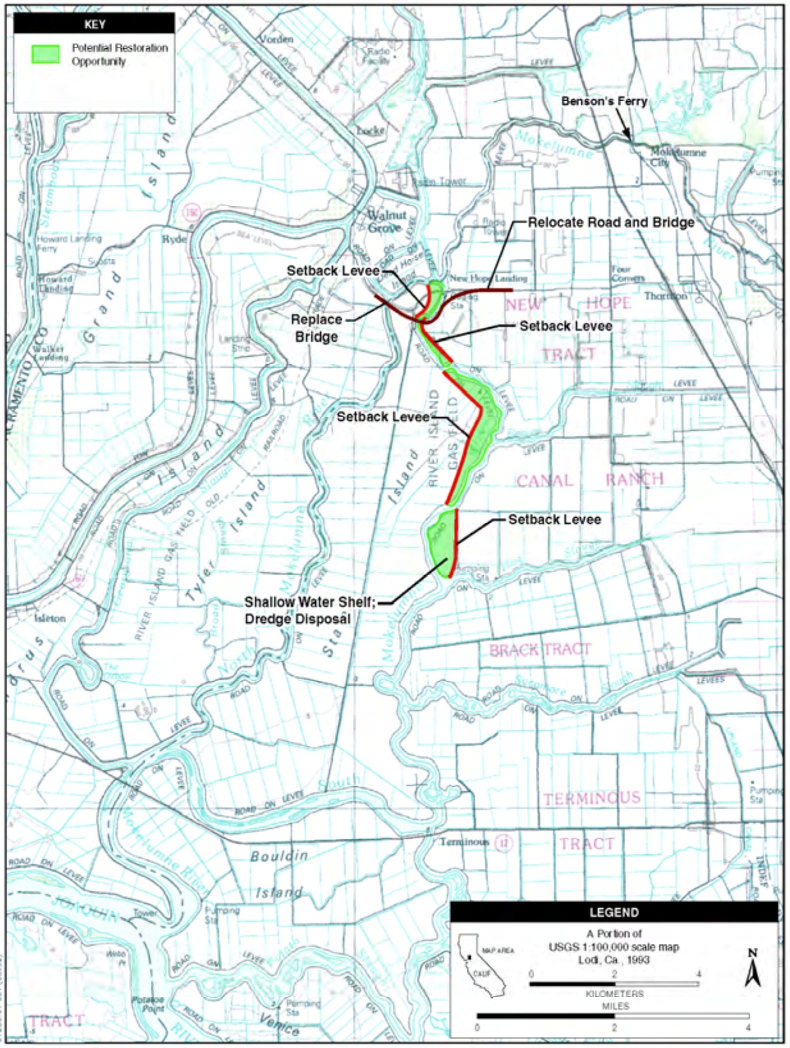


Figure 11: Road relocation and South Fork Mokelumne River setback levees

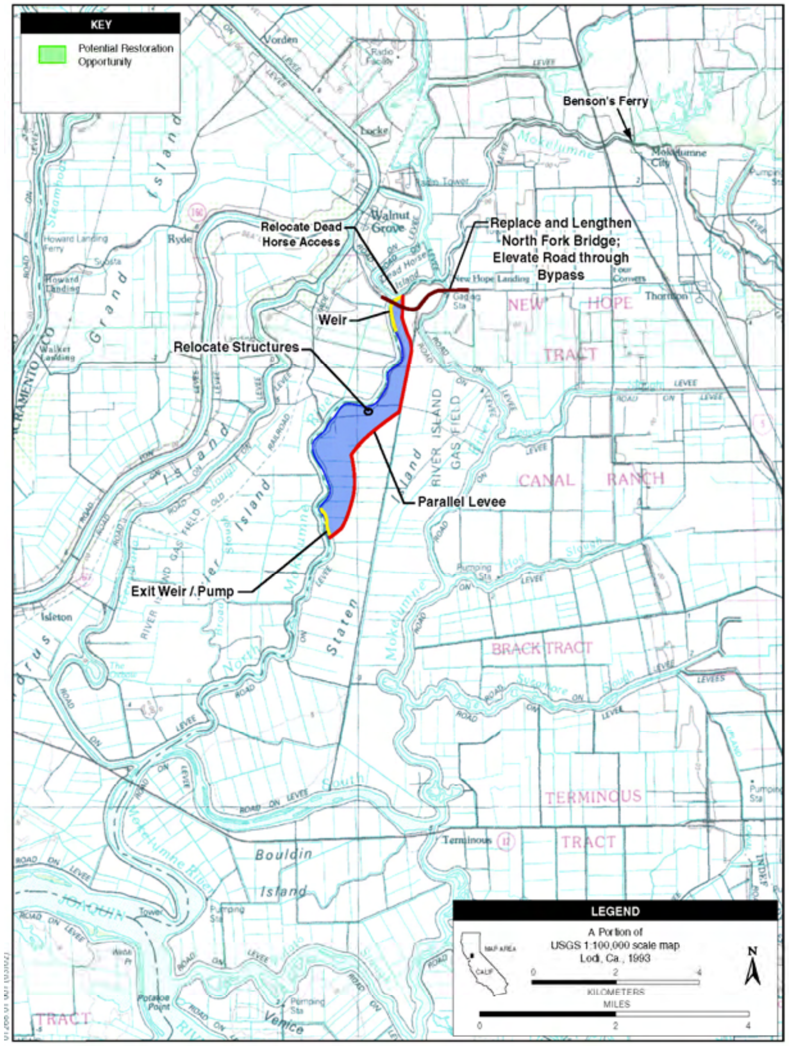


Figure 12: North Fork Mokelumne River parallel levee and detention

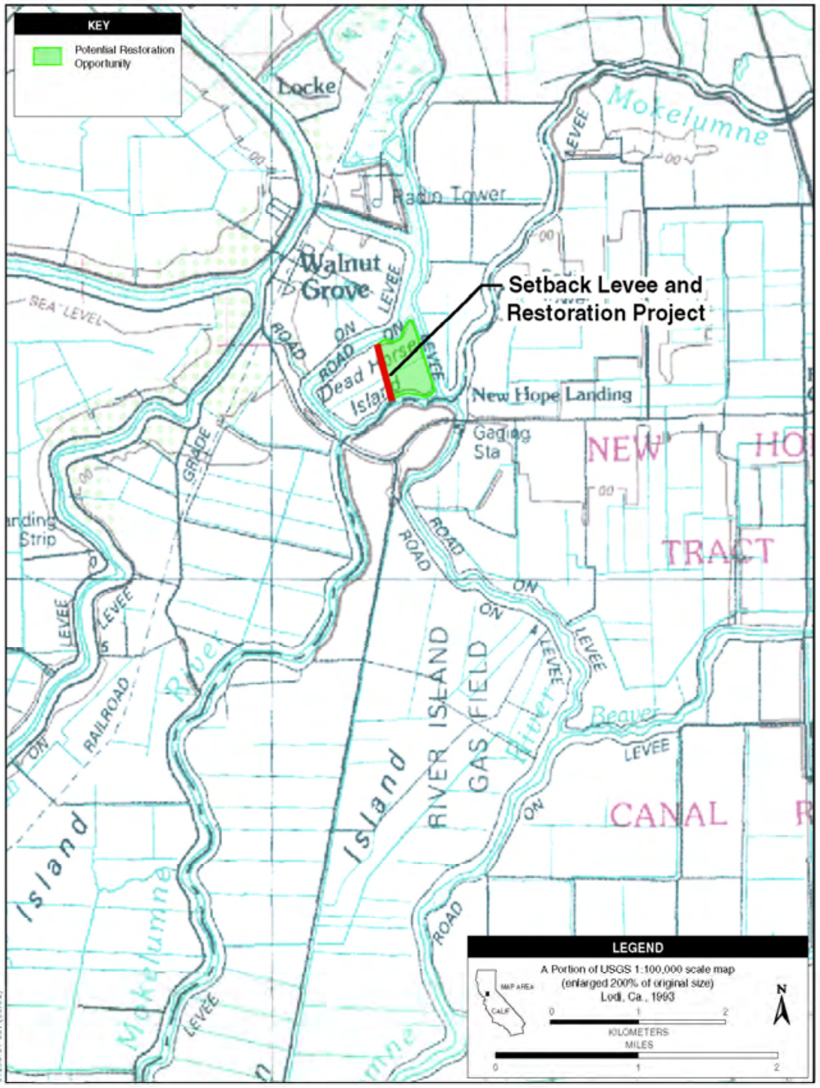


Figure 13: Dead Horse Island setback levee and restoration project

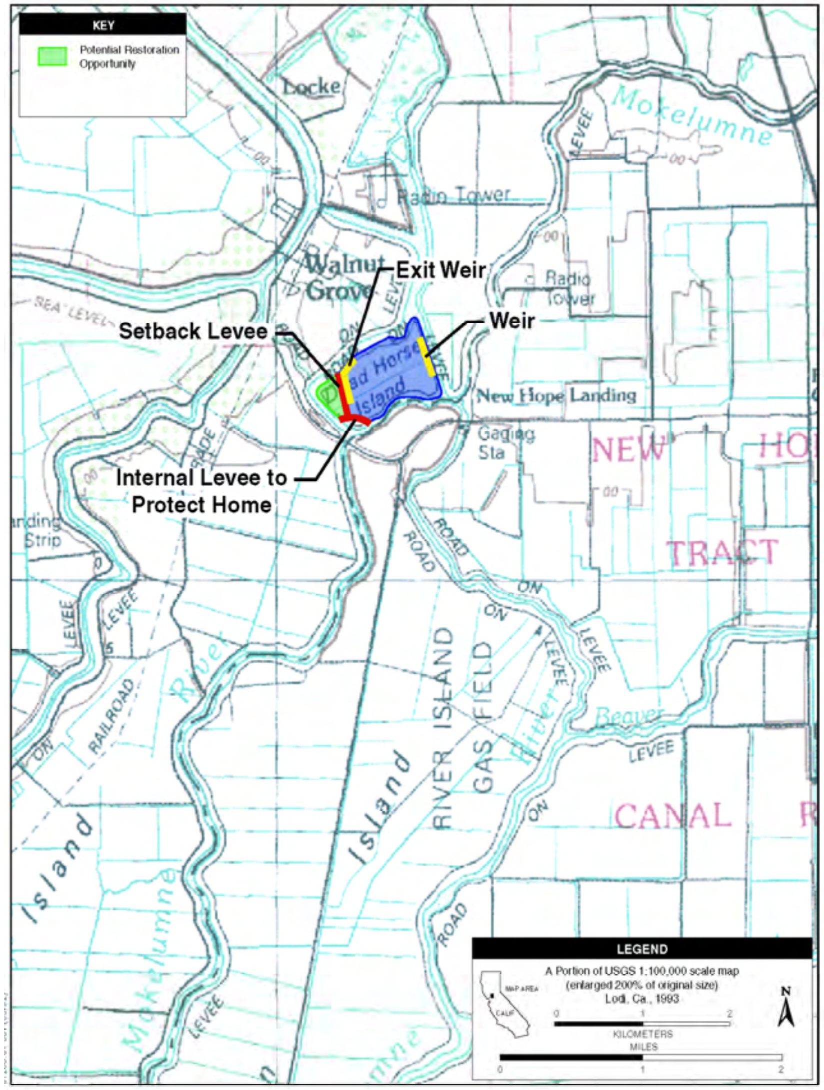


Figure 14: Dead Horse Island floodway component

Hydraulic Modeling for Public Scoping Alternatives

In fall of 2002, initial development of the North Delta HEC-RAS model was completed. An overview of the completed HEC-RAS model including calibration and verification of the model was presented to a joint NDIG/NDAT on November 5, 2002. The model was calibrated for one large storm event (for the 1997 stream flow and stage data) and verified with the 1995 event. The model results were then submitted to a panel of technical experts for peer review; Peer review was completed in spring 2003 and showed a favorable evaluation of the model with comments and suggestions for enhancement. The HEC-RAS peer review report is available by request from DWR staff.

The North Delta HEC-RAS model was used as a planning tool during preliminary alternatives development to determine water surface elevations at various index locations impacted from proposed flood control measures. The model study area includes the streams and floodplains of Beach and Stone Lakes south of Morrison Creek, the Cosumnes River downstream of Michigan Bar, Deer Creek downstream of Sloughhouse, and the Mokelumne River downstream of Woodbridge. The downstream model boundary of the study area was the San Joaquin River. Refer to Figure 15 for a map of the North Delta HEC-RAS study area.

Project components and alternatives modeling, presented in Tables 1 through 3, were performed. Then a peer review of the model was done by the technical experts, and later the model was refined according to the peer review comments. Some of the HEC-RAS modeling presented in the "Post Scoping Flood Control Alternatives Development" section was performed using a version of the North Delta HEC-RAS that has some of the peer review comments incorporated. Results from similar alternative scenarios modeled with the later version of the North Delta HEC-RAS indicated benefits with slightly smaller magnitudes throughout the system for all alternatives when compared with the preliminary modeling presented in this section. Future Mike 11 modeling for impact assessment further verified qualitative conclusions presented herein. Future Mike 11 modeling is further discussed in the "Post Scoping Alternatives Development" section.

Hydrologic input data selected to run the model was gathered from the January 1997 flood event. The simulation period for all modeling was from 1200 hours, December 29, 1996 to 1200 hours, January 9, 1997. Two base conditions were simulated with the model; the 1997 flood event including historic 1997 levee failures and the 1997 flood event without levee failures. Historic levee failures occur on the upper and lower Cosumnes River as well as McCormack-Williamson Tract and Dead Horse Island. Levee breaches are triggered in the model at either a specific simulation time or when the water surface elevation reaches 1.0 foot below the top of the levee. Most of the modeling presented in this document includes the levee failure scenario described. A few of the earlier modeling runs (components 9 through 11 and 13) are compared with the 1997 flood event without the levee failure scenario. Due to the nature of components 9 through 11 and 13, it was appropriate to simulate the components without the historic McCormack-Williamson Tract levee failures. The Mike 11 hydraulic modeling presented in the "Post Scoping Alternatives Development" that was performed for impact analysis of proposed flood control alternatives includes levee failure criteria throughout the entire model domain, so that levee failures throughout the system can occur if triggered by the overtopping of any of the levees.

Modeling results are referenced to the 22 geographic locations, termed index points, within the North Delta HEC-RAS study area and are illustrated in Figure 16. Index points 1-17 are located along stream channels within the modeled area, whereas index points 18-22 are located on land surface. Tables presenting modeling results include the base condition peak stage results during the simulation period, and change in peak stage for each component/alternative, with respect to the base condition results, with the exception of results for index points 18-20. Index points 18-20 represent peak stage or change in peak stage, depending on the modeling scenario. Table footnotes provide clarity on the meaning of these values, as it varies depending on the model run. All peak stage values are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29), in units of feet, and change in peak stage for all results is in units of feet.

Components 1-13, which are illustrated in Figures 17-29, were modeled to assess the relative magnitude of potential flood stage reductions that could be achieved with the components. While flood control target stage goals were later developed for this project at Benson's Ferry and New Hope (see discussion in "Post Scoping Alternatives Development" and in Appendix B), in early model runs it was understood that it would be desirable for flood control components to achieve stage reductions on the order of at least 1' upstream and downstream of McCormack-Williamson Tract (Benson's Ferry and New Hope Landing as gage points), with an objective of maximizing these reductions to the extent possible. These modeling results were presented to the NDIG in January, 2003 and are summarized in Tables 1 and 2.

Early modeling results lead to some qualitative general conclusions:

- McCormack-Williamson conveyance and downstream actions, such as detention or dredging, work best as a whole for flood control effectiveness and to avoid redirected impacts.
- Only the most aggressive conveyance of floodwaters through McCormack-Williamson Tract will achieve sizeable stage reductions upstream.
- Dredging component caused downstream impacts that would need to be addressed and was only effective in combination with McCormack-Williamson conveyance components.

Flood Control Effectiveness

Modeling of components 1-13 showed that McCormack-Williamson conveyance and downstream actions, such as detention or dredging, work best as a whole for flood control effectiveness and to avoid redirected impacts. HEC-RAS model results for components 1-4 (Figures 17-20) show sizeable reductions in the lower parts of the system (on the order of 1- 2.7 feet at New Hope and 1.5- 2 feet at Miller Ferry Bridge) with insignificant reductions in the upper system such as at Benson's Ferry, indicating that components on Staten only are not effective at reducing upstream stages without enhanced flow through McCormack-Williamson to convey upstream floodwaters. McCormack-Williamson Tract modifications (components 9-13) show downstream stage increases indicating that McCormack-Williamson conveyance without downstream components could cause downstream stage impacts that will need to be addressed.

McCormack-Williamson Conveyance

Modeling results of components 9-13 showed that aggressive conveyance measures on McCormack-Williamson are necessary to achieve significant stage reductions upstream. (As discussed above, in early model runs it was understood that it would be desirable for flood control components to achieve stage reductions on the order of at least 1' upstream and downstream of McCormack-Williamson Tract with an objective of maximizing these reductions to the extent possible.) Smaller breaches as well as setback levees along the Mokelumne River were modeled with the hope that these components would provide significant upstream stage reduction and potentially provide ecosystem restoration benefits; however, these components did not provide significant upstream stage reduction. The concept of a setback levee parallel to the Mokelumne River along M-W Tract was also modeled with the North Delta HEC-RAS (component 12). The HEC-RAS modeling shows that stage benefits in larger flood events are negligible (less than .1' at Benson's Ferry). Also, two points of concern within the project area, New Hope Landing and Millers Ferry shows stage increases of .2' and .1', respectively with a setback levee along M-W Tract.

Component 13 was modeled with the intent of achieving significant stage reductions in the upper portion of the North Delta system. The purpose of performing three similar modeling runs (13a, 13b, and 13c) was to evaluate the sensitivity of the east levee breach length. Components 13a, 13b, and 13c have an east levee breach length of 300 feet, 1000 feet, and 4000 feet, respectively. The elevation for all breaches was set at the existing ground surface elevation (2.5' NGVD29). The southwest levee was breached approximately 3400' feet and to an elevation of -2' NGVD29 for all variations of component 13.

The modeling results for component 13 clearly indicate that longer breaches on McCormack-Williamson Tract are necessary to achieve significant upstream stage reductions. It is notable that downstream stages at New Hope Landing and Miller Ferry are significantly raised in these scenarios because of the increased ability to convey upstream flood flows; these stage increases must be addressed with downstream components as the system must work as a whole.

Dredging

Dredging component modeling results, shown as component 8 in Table 1 and alternative 5 in Table 3 when coupled with McCormack-Williamson Tract conveyance, illustrate that dredging would cause downstream impacts that would need to be addressed and was only effective at lowering Benson's Ferry stages in combination with McCormack-Williamson Tract conveyance components. Therefore, the dredging component alone does not address flood issues in the northern portion of the project area. The dredge modeling performed to date is sufficient to support these general qualitative conclusions; However, future modeling of dredging will need to refine dredge boundaries. For example, stakeholder input and technical analysis revealed that much of the proposed North Fork dredging area was either already significantly scoured or otherwise unsuitable for dredging and that dredging locations on the main stem Mokelumne and Snodgrass Slough would be more effective.

Flood Control Modeling Results Presented at Public Scoping

In recognition that components needed to be looked at in combination, the components with potential for significant stage reduction (on the order of at least 1') were modeled in combination to see what range of stage benefits were possible system-wide. The groupings of components, or conceptual alternatives, were presented in February, 2003 as part of the public scoping sessions. The HEC-RAS modeling results from conceptual alternatives, or combined components, illustrating potential stage reduction benefits from such alternatives were shown as part of the technical poster presentations that accompanied public scoping meetings. This included aggressive action on M-W for conveyance including breaching the east and southwest levees as well as downstream detention basin configurations, setbacks, dredging, and bridge replacement. For a downstream detention basin configuration on Staten Island, the half island detention component was modeled and indicated that half of Staten Island could provide adequate volume to provide stage benefits. Because of the need to balance ecosystem, agricultural, and flood control uses, it is desirable to minimize the acreage inundated while achieving flood benefits; therefore future scenarios on Staten Island focused on partial-island scenarios. As well, a setback levee along the entire southeast levee of McCormack-Williamson adjacent to the North Fork was modeled in combination with Staten detention to see if it would be more effective as part of a whole system conveyance. The combinations of components that formed conceptual alternatives (alternatives 1 through 7) are shown in the figures 30-37.

All conceptual alternatives were compared with the 1997 flood event base conditions with levee failures per historic January 1997 locations and breach size. It should be noted that base condition assumes no levee failure. The 1997 base condition with levee failures was used for component comparison for most index points. Response from stakeholders and individuals familiar with the area was that the base condition result at index point 5 (New Hope Landing) seemed uncharacteristic of that location during high water events prompted discussions and review of the model. Original base condition results and component modeling did not include relief breaks, which means the model assumed no major return flows back into the river once the water ponded on M-W Tract. Water only returned to the system by overtopping of the M-W Tract southwest levee. Relief breaks are now incorporated into the model with the same locations and dimensions as the January 1997 relief breaks that occurred (triggered when the elevation on M-W Tract reaches elevation 15'NGVD29), and are the reason for the change in base condition results. A few of the components were modeled with the base condition results that included relief breaks and compared against the results in Table 1. The changes in the results did not warrant modeling all components with the new set of base conditions.

Table 3 presents modeling results for the 1997 flood for each of the conceptual alternatives. It is important to recognize that these early modeling runs were performed to characterize a range of potential stage improvements for public scoping and to reveal issues to be further assessed in detailed planning and hydraulic modeling. For example, during public scoping, alternative #5 with dredging (Figure 34) revealed that the dredging scenarios would need to address downstream stage increases. As well, setback scenarios showed promise but revealed downstream stage increases that would need to be addressed. These issues and the wide range of comments from Agencies and stakeholders have guided development of screening criteria and refinement of alternatives.

Other general conclusions that resulted from pre-scoping conceptual alternatives analysis and hydraulic modeling analysis include:

- There is a minimal flow conveyance benefit from eliminating the bridges in the channels.
- Bridge replacement will be required for Staten setbacks.
- Staten Island cannot function as a flood bypass because of deep bowl-like topography

To expand on the final general conclusion stated above, the following rationale supports that the physical characteristics of Staten Island restrict it from functioning as a flood bypass. Soil elevations range from roughly -5' to -20' (shown in Figure 37). Base condition results for 1997 (shown in Table 3) illustrate that average stages at the southern end of Staten (illustrated at index points 9 for South Fork at Little Potato and 15 for Lower Mokelumne at North & South Fork Confluence) are just over 7'

NGVD29 in a flood event. However, at the southern end of Staten, land surface elevations average -20 feet. For a weir or one-way flow structure to pass flows through Staten Island at elevation 7', the Island would need to have a storage on the order of 180,000 acre-feet based on stage-volume estimates. It is unlikely that a weir at the top of Staten could be placed at an elevation low enough to capture this volume without taking on flows year round (unless the weir were operable, which is undesirable because of maintenance and liability concerns.

Even if it were possible to capture a volume this great on Staten Island, most of it would not be "bypassed" through the Island, but would need to be pumped out after a flood event: Mean high tidal elevations on the Mokelumne in the vicinity of the southern end of Staten range from roughly 3.7' to 3.8' with the low end of the tidal cycle at -.5' in months January through March when the island is most likely to be needed for flood control (San Joaquin at Venice Island – USFWS Mean High Tide Report, 1980). Therefore, Staten could conceivably drain to -.5 by tidal action, but this would still leave roughly 110,000 acre-feet on the Island that would need to be pumped out.

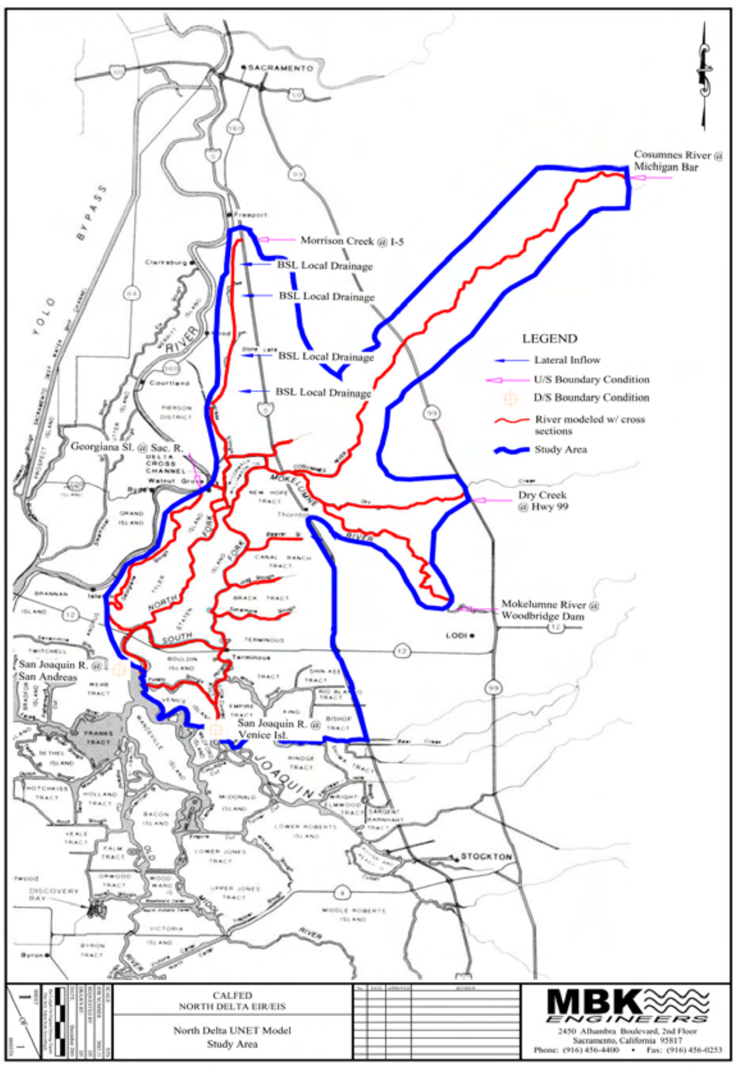


Figure 15: North Delta HEC-RAS study area

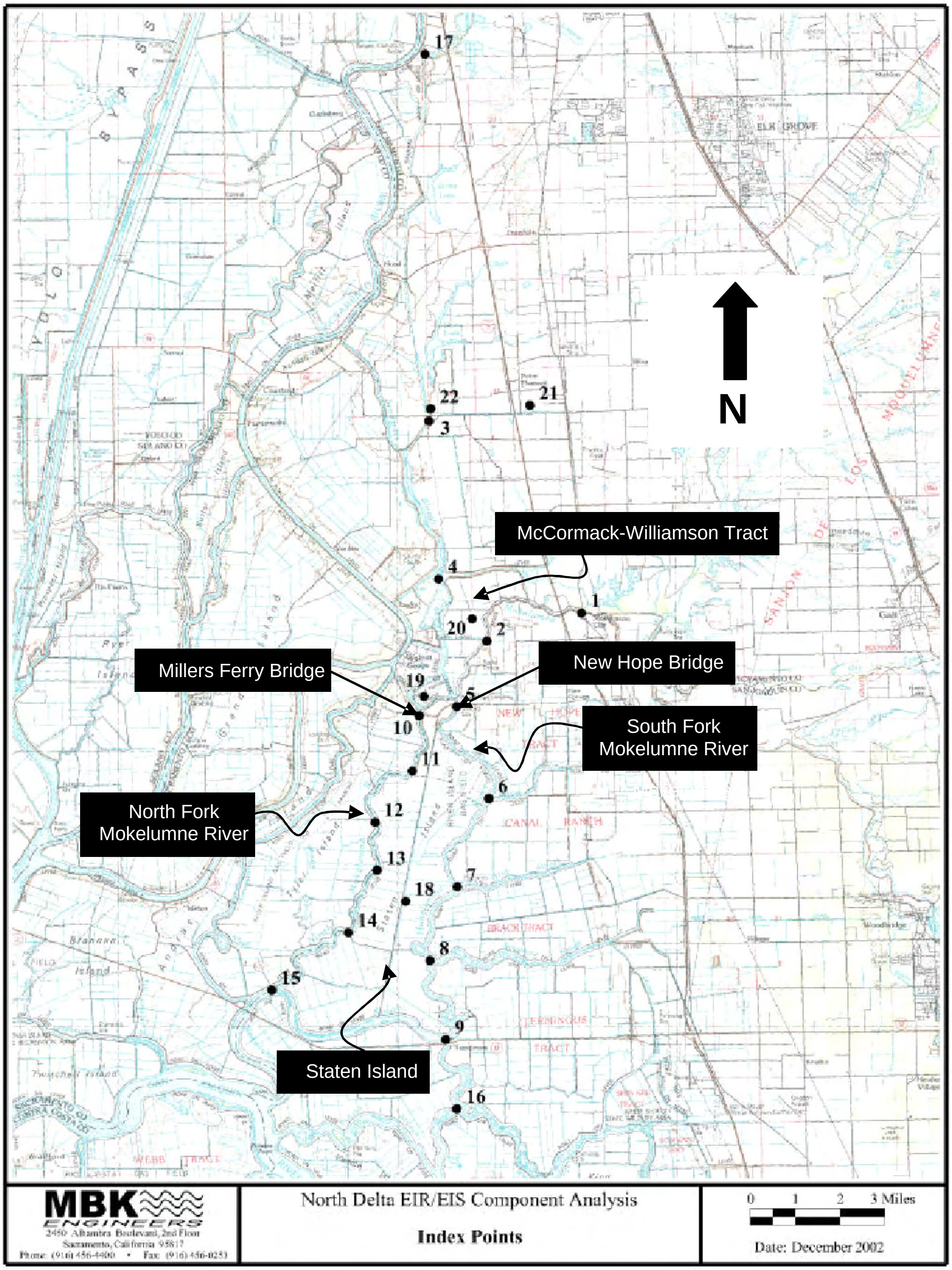


Figure 16: Location of index points associated with the North Delta HEC-RAS model

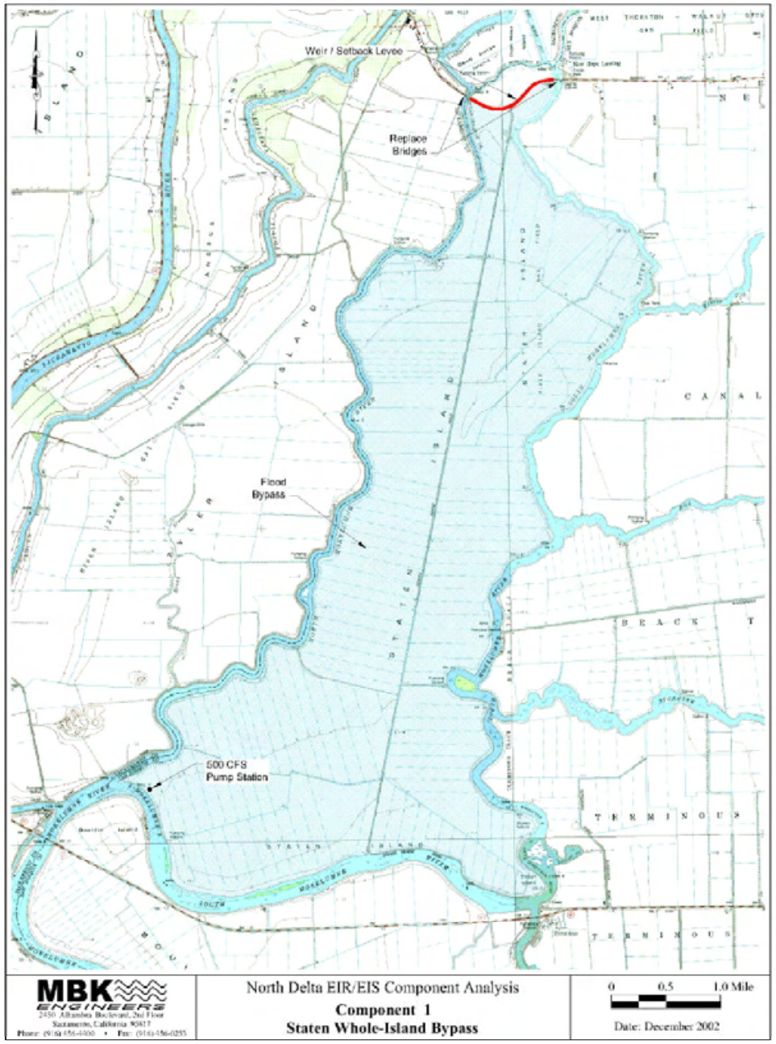


Figure 17: Component 1 - Staten whole island bypass

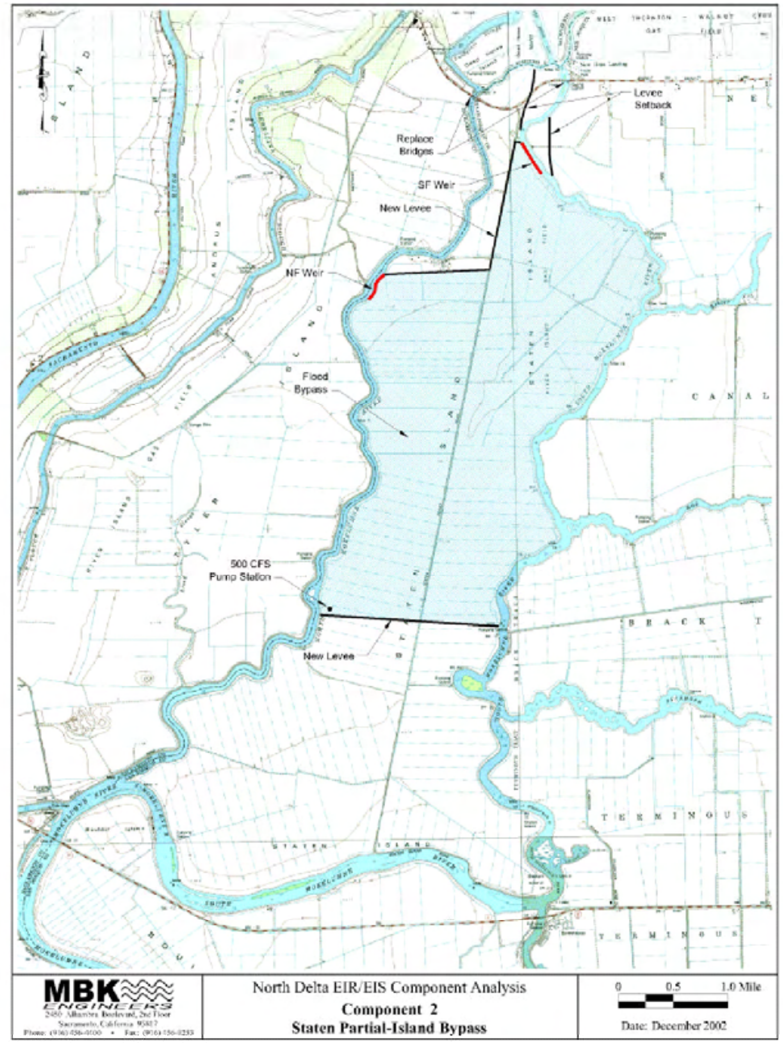


Figure 18: Component 2 - Staten partial-island bypass

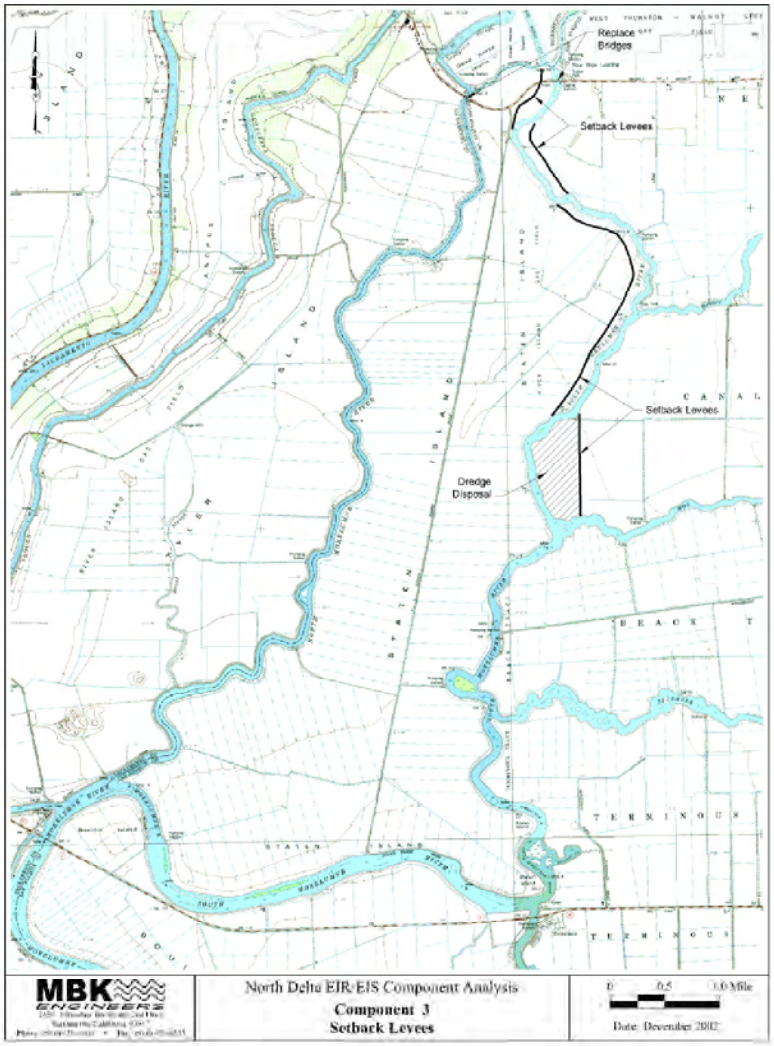


Figure 19: Component 3 - South Mokelumne setback levees

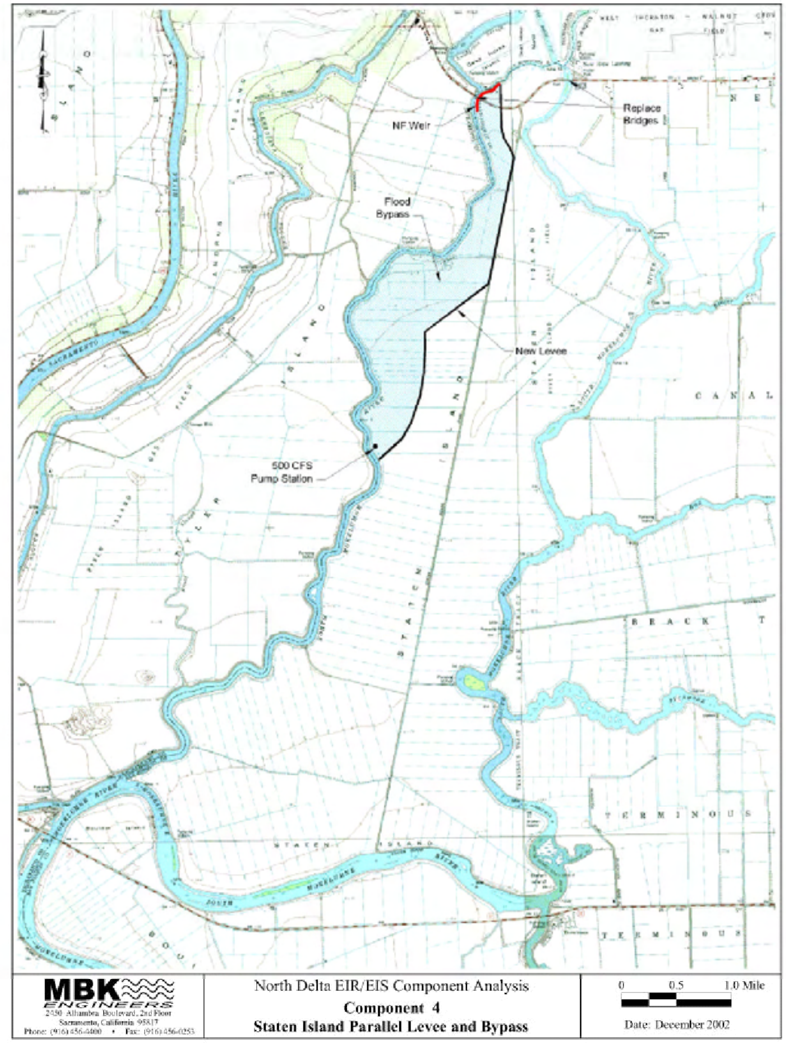


Figure 20: Component 4 - Staten parallel levee and bypass

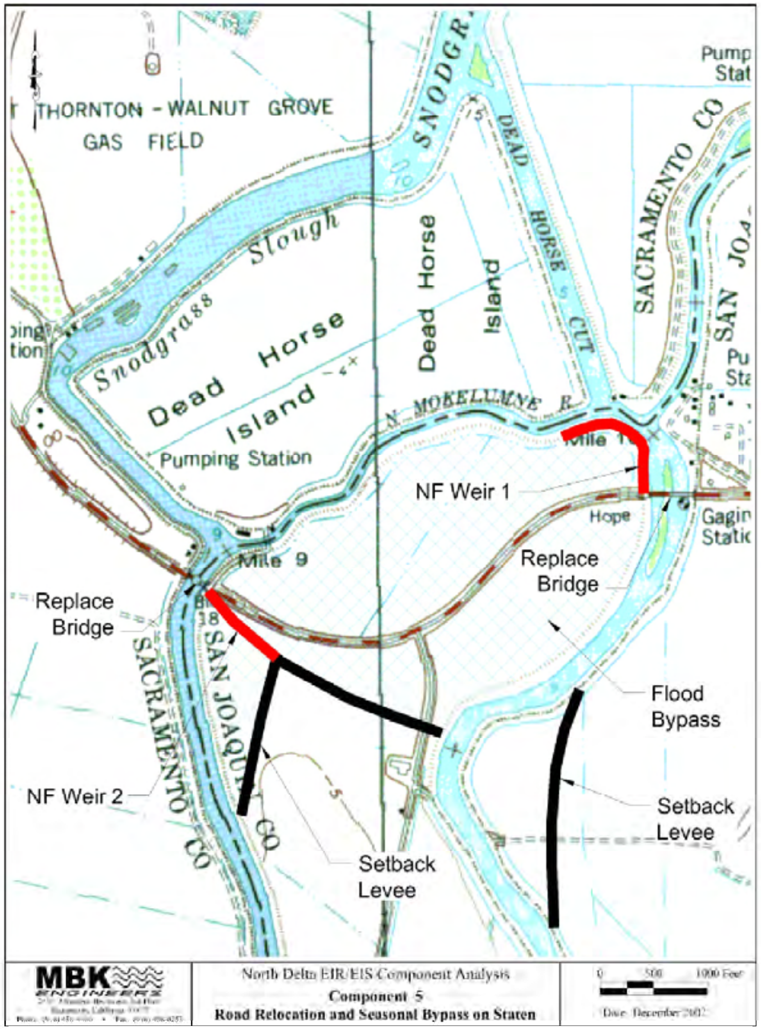


Figure 21: Component 5 - Road relocation and seasonal bypass on Staten

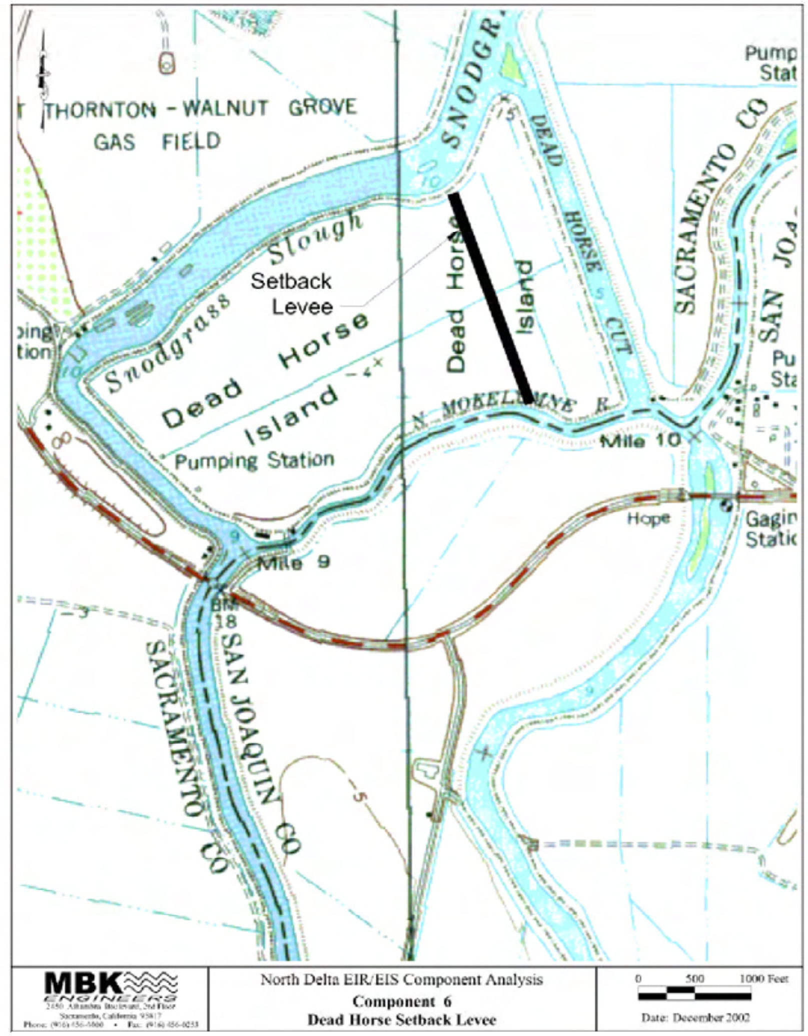


Figure 22: Component 6 - Dead Horse Island setback levee

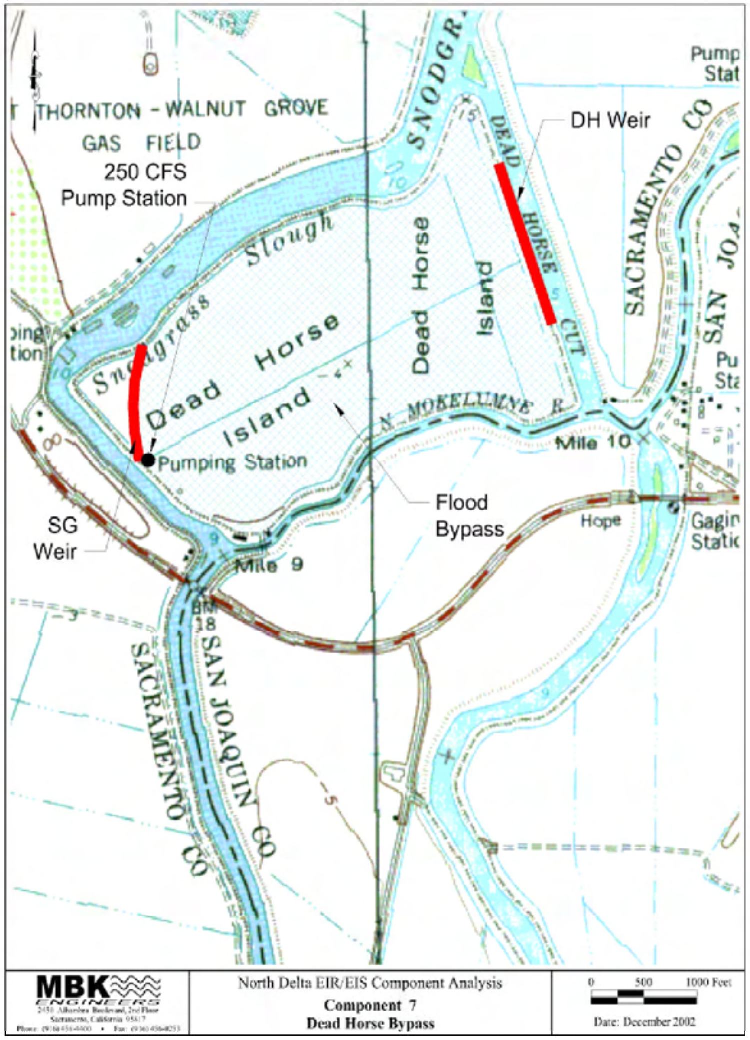


Figure 23: Component 7 - Dead Horse bypass

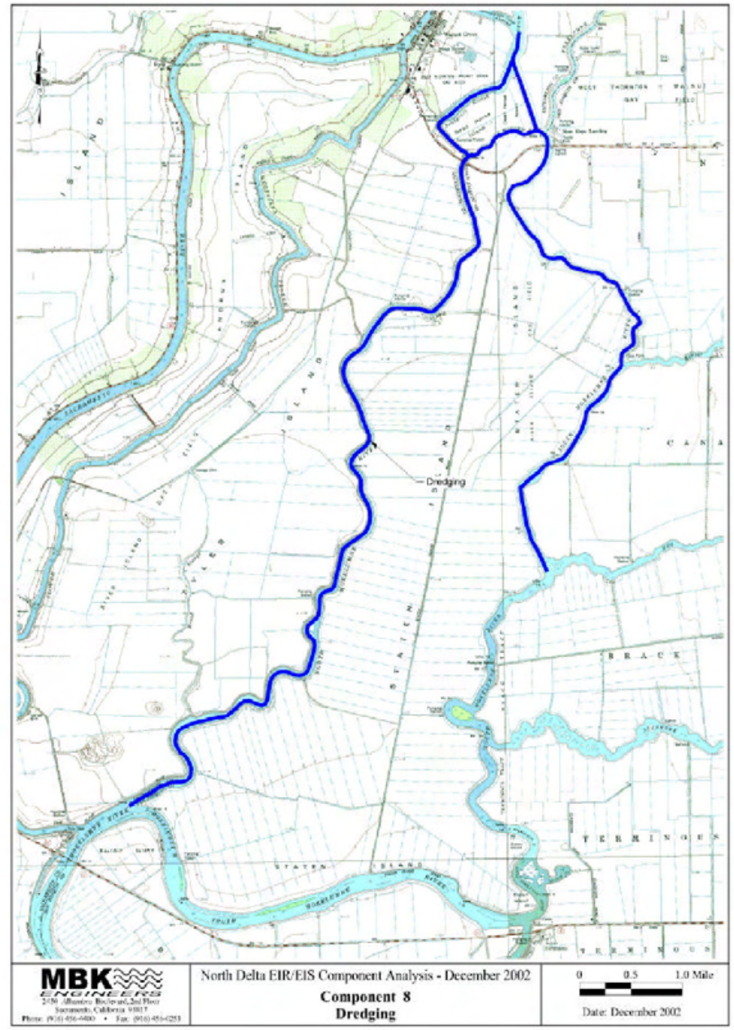


Figure 24: Component 8 - Dredging

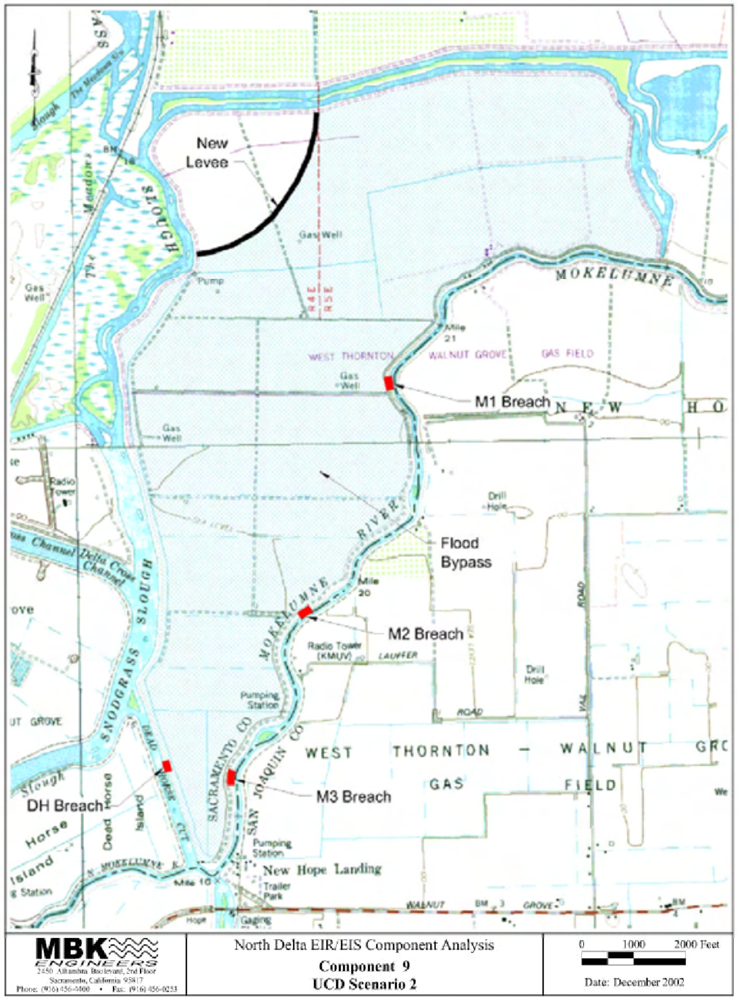


Figure 25: Component 9 - Levee breaches along the Mokelumne River parallel to M-W Tract

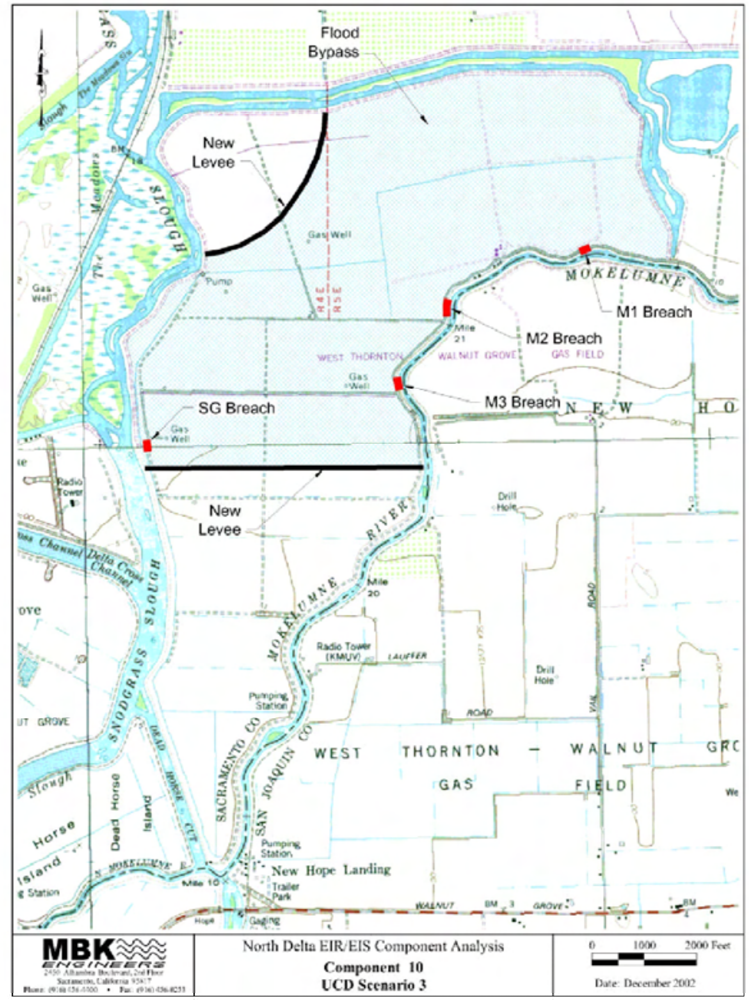


Figure 26: Component 10 - Flood bypass with cross levee on M-W Tract

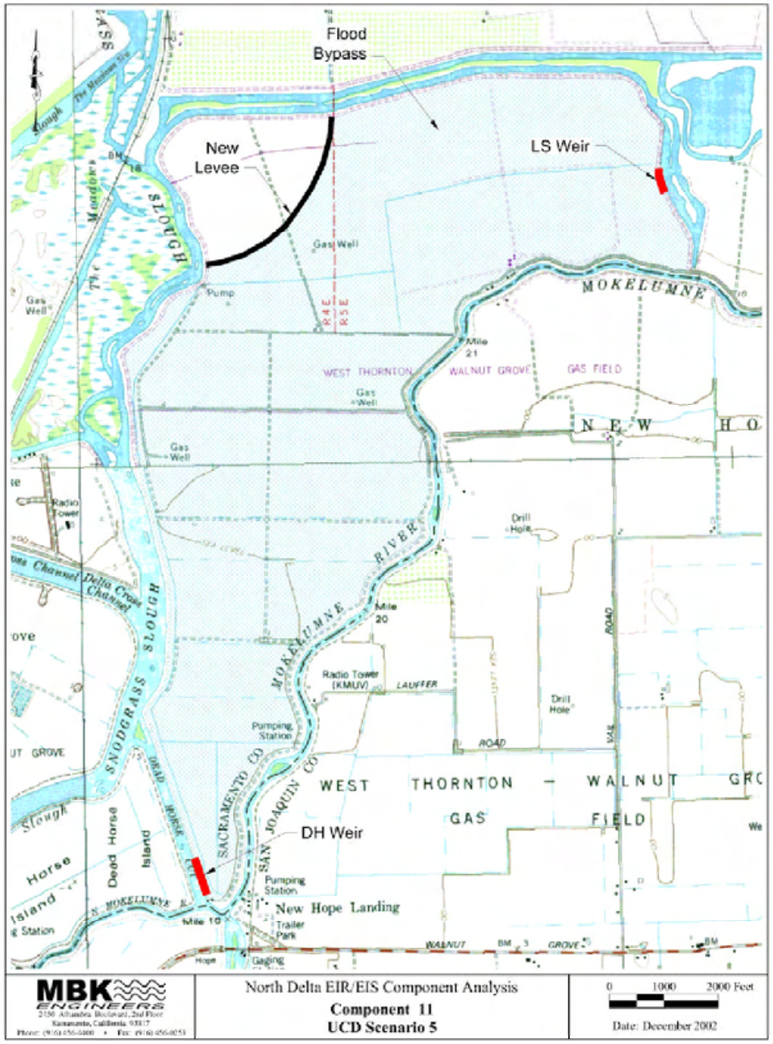


Figure 27: Component 11 - Flood bypass on M-W Tract

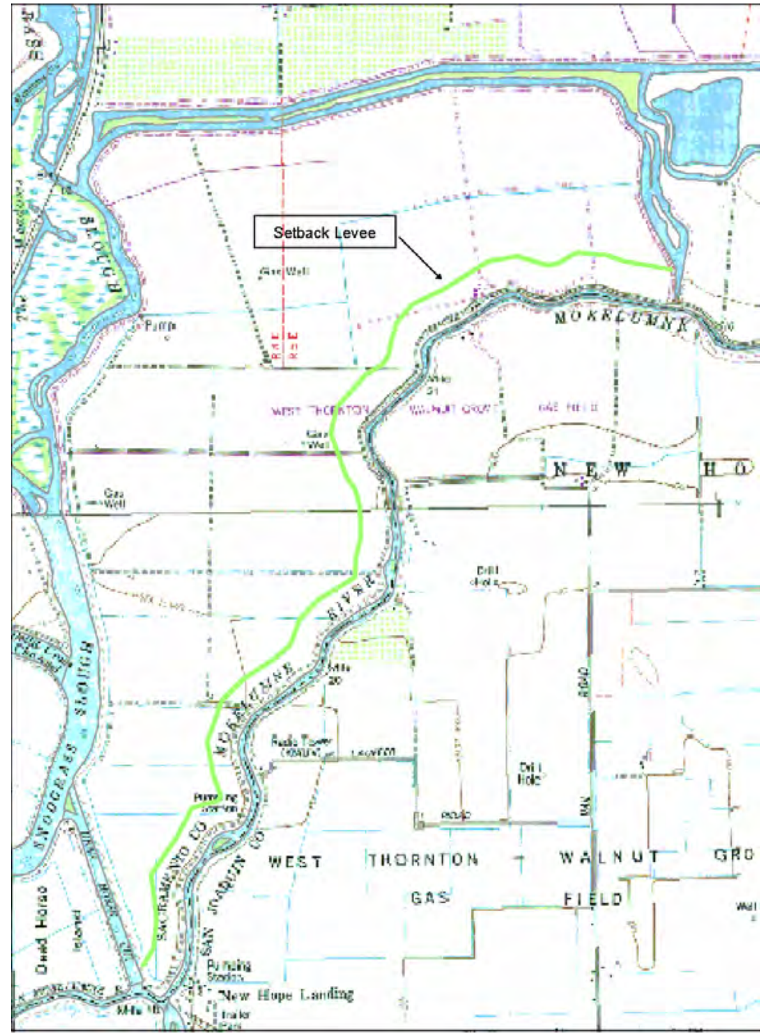


Figure 28: Component 12 – M-W Tract setback levee

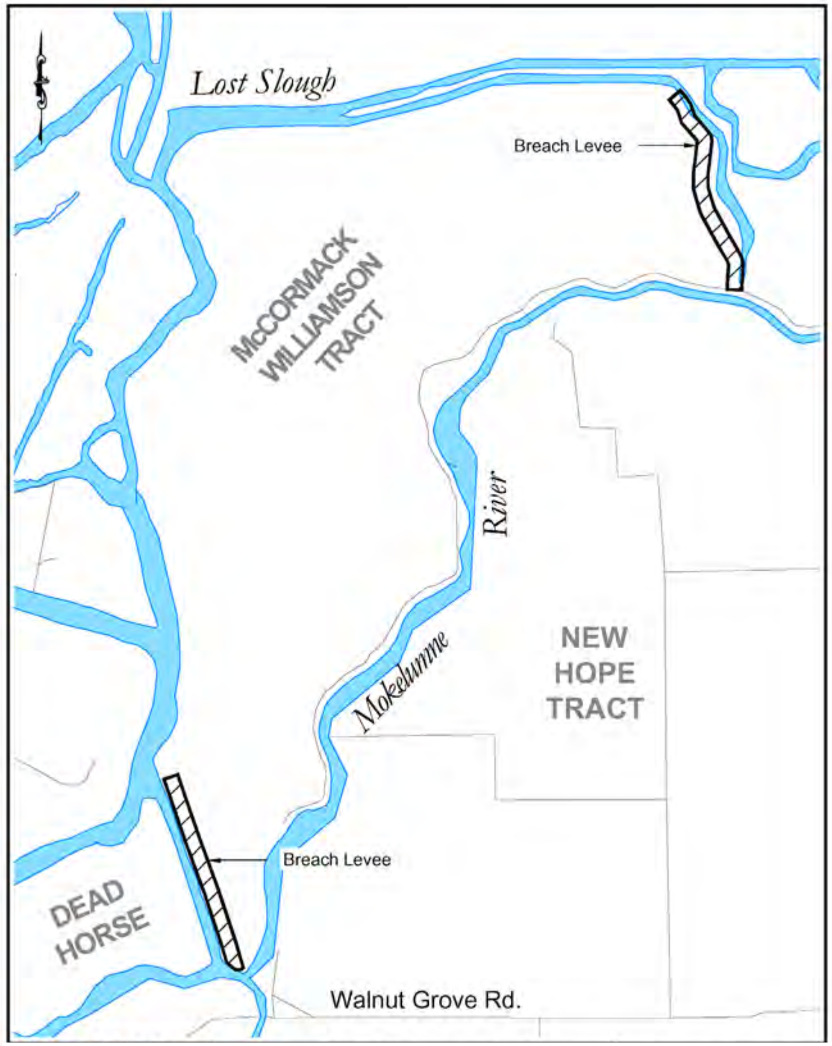


Figure 29: Component 13 - M-W Tract levee breaches

Table 1: Comparison of components with respect to the base condition (1997 flood event with historical levee failures)

Index Point	Location	Base Condition Results (NGVD29, units=feet)	Peak Stage Difference (feet)								
			Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 6	Comp 7	Comp 8	Comp 12
1	Mokelumne River (Benson's Ferry)	18.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2	Mokelumne River	16.1	-1.0	-0.9	-1.1	-0.4	-0.3	-0.1	-0.3	-0.8	-2.0
3	Snodgrass Slough	13.3	-1.2	-1.2	-1.4	-0.7	-0.2	0.0	-0.3	-1.0	0.0
4	Snodgrass Slough at Lost Slough	13.4	-1.3	-1.3	-1.8	-0.7	-0.2	0.0	-0.3	-1.0	0.1
5	South Fork Mokelumne (New Hope)	12.6	-2.7	-2.2	-2.5	-1.0	-0.6	-0.1	-0.4	-1.5	0.2
6	South Fork Mokelumne at Beaver Slough	9.3	-1.5	-1.1	-0.3	-0.7	-0.3	-0.1	-0.4	-0.5	0.1
7	South Fork Mokelumne at Hog Slough	7.4	-0.6	-0.5	1.3	-0.3	-0.1	0.0	-0.2	0.2	0.0
8	South Fork Mokelumne at Sycamore Sl.	6.9	-0.3	-0.2	0.4	-0.2	0.0	0.0	-0.1	0.1	0.0
9	South Fork Mokelumne at Little Potato	6.7	-0.1	-0.1	0.1	-0.1	0.0	0.0	-0.1	0.0	0.0
10	North Fork Mokelumne (Miller Ferry)	11.5	-1.5	-2.0	-2.0	-1.4	0.2	0.0	-0.2	-1.3	0.1
11	North Fork Mokelumne	10.2	-1.2	-1.9	-1.5	-1.1	0.1	0.0	-0.2	-0.8	0.1
12	North Fork Mokelumne	9.1	-0.9	-1.4	-1.1	-0.8	0.1	0.0	-0.2	-0.4	0.1
13	North Fork Mokelumne	8.5	-0.7	-1.1	-0.8	-0.6	0.1	0.0	-0.2	-0.3	0.1
14	North Fork Mokelumne	7.8	-0.5	-0.8	-0.5	-0.5	0.0	0.0	-0.2	-0.2	0.0
15	Lower Mokelumne at N&S Fork Confluence	6.9	-0.2	-0.2	0.0	-0.2	0.0	0.0	-0.1	0.0	0.0
16	Little Potato Sl @ White Sl	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	Morrison Creek @ Beach Lake	11.6	-0.5	-0.5	-0.6	-0.2	-0.1	0.0	-0.1	-0.5	0.0
18	Staten Island	No Flooding	15.3	23.6	No Flooding	23.0	16.1	No Flooding	No Flooding	No Flooding	No Flooding
19	Dead Horse Island (SA 46)	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding	18.5	0.0	No Flooding
20	McCormack Williamson (SA 44)	15.95	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1
21	Point Pleasant (SA 7.1)	13.61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	Stone Lake u/s Lambert Road (SA 3.1)	11.46	-0.7	-0.7	-0.8	-0.4	-0.2	0.0	-0.2	-0.7	0.0

- Base condition results for index points 1-17 and 20-22 represent the water surface elevation at the corresponding geographic location and the component results for each index point represents the change in peak stage.
- A positive value associated with change in peak stage represents an increase in the peak stage from the base condition, whereas a negative value associated with change in peak stage represents a decrease in the peak stage from the base condition.
- Index points 18 and 19 base condition results indicate that water did not inundate Staten or Dead Horse during the simulation of the base condition with a value of "No Flooding".
- Component results with numeric values assigned to index point 18 represent the peak stage within the island. This is to be compared with a ground surface elevation of -25', -26', -13', -4', and -3' NGVD29 for components 1, 2, 4, 5, and 10 respectively.
- The component result with numeric value assigned to index point 19 represents the water surface elevation within the island. This is to be compared with a ground surface elevation of -5.5' NGVD29 for component 8.

Table 2: Comparison of components with respect to the base condition (1997 flood event without historical levee failures)

Index Point	Location	Base Condition Results (NGVD29, units=feet)	Peak Stage Difference (feet)					
			Comp 9	Comp 10	Comp 11	Comp 13a	Comp 13b	Comp 13c
1	Mokelumne River (Benson's Ferry)	19.4	-0.1	-0.2	-0.4	-1.1	-1.7	-2.1
2	Mokelumne River	14.4	-1.2	-0.9	-0.1	0.3	0.4	0.4
3	Snodgrass Slough	13.0	0.1	0.5	0.1	0.7	0.9	1.2
4	Snodgrass Slough at Lost Slough	13.0	0.1	0.6	0.1	0.8	1.0	1.4
5	South Fork Mokelumne (New Hope)	11.3	0.0	0.2	0.4	1.6	2.2	2.5
6	South Fork Mokelumne at Beaver Slough	8.6	0.0	0.1	0.2	1.0	1.4	1.6
7	South Fork Mokelumne at Hog Slough	7.2	0.0	0.1	0.1	0.5	0.7	0.9
8	South Fork Mokelumne at Sycamore Sl.	6.8	0.0	0.0	0.0	0.3	0.5	0.6
9	South Fork Mokelumne at Little Potato	6.7	0.0	0.0	0.0	0.2	0.3	0.4
10	North Fork Mokelumne (Miller Ferry)	10.5	0.2	0.3	0.4	1.5	1.9	2.3
11	North Fork Mokelumne	9.4	0.1	0.2	0.3	1.2	1.6	1.9
12	North Fork Mokelumne	8.6	0.1	0.2	0.2	1.0	1.3	1.5
13	North Fork Mokelumne	8.1	0.1	0.2	0.2	0.8	1.1	1.3
14	North Fork Mokelumne	7.5	0.1	0.1	0.1	0.6	0.8	1.0
15	Lower Mokelumne at N&S Fork Confluence	6.7	0.0	0.0	0.0	0.3	0.4	0.5
16	Little Potato Sl @ White Sl	6.5	0.0	0.0	0.0	0.0	0.0	0.0
17	Morrison Creek @ Beach Lake	11.8	-0.1	0.2	-0.2	0.0	0.0	0.1
18	Staten Island	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding
19	Dead Horse Island (SA 46)	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding	No Flooding
20	McCormack Williamson (SA 44)	No Flooding	15.5	16.7	16.9	20.6	20.4	20.8
21	Point Pleasant (SA 7.1)	14.4	-0.4	-0.7	-0.8	-0.9	-0.9	-1.0
22	Stone Lake u/s Lambert Road (SA 3.1)	11.7	0.0	0.3	-0.2	0.4	0.5	0.8

- Base condition results for index points 1-17 and 21-22 represent the water surface elevation at the corresponding geographic location and the component results for each index point represents the change in peak stage.
- A positive value associated with change in peak stage represents an increase in the peak stage from the base condition, whereas a negative value associated with change in peak stage represents a decrease in the peak stage from the base condition.
- "No Flooding" indicates that water did not inundate the islands and tract during the simulation of the base condition. All component results reflect the same condition for Staten and Dead Horse Islands.
- Index point 20 component results show inundation of M-W Tract. The numeric value represents the peak stage referenced to NGVD29, in units of feet.

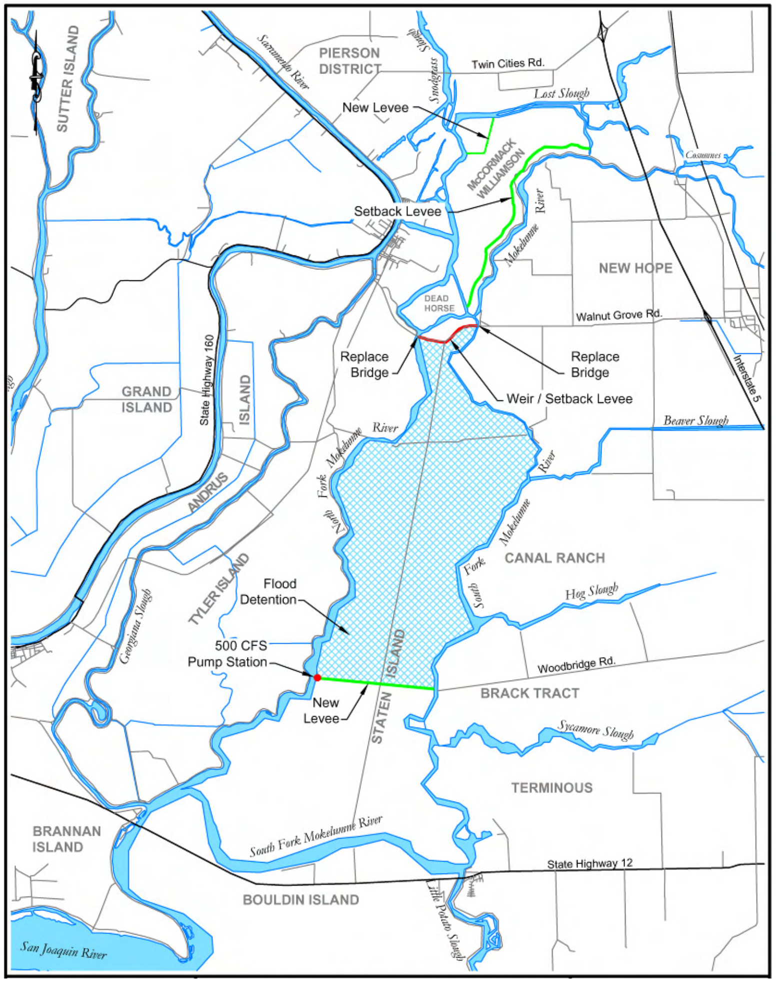


Figure 30: Public scoping alternative 1

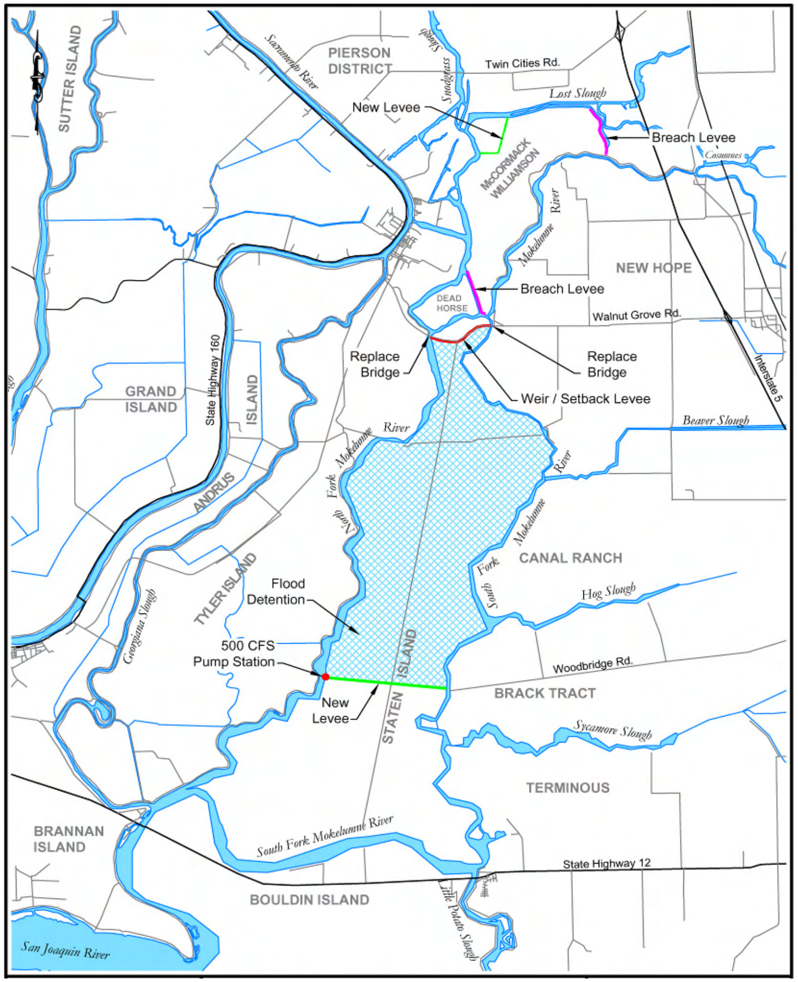


Figure 31: Public scoping alternative 2

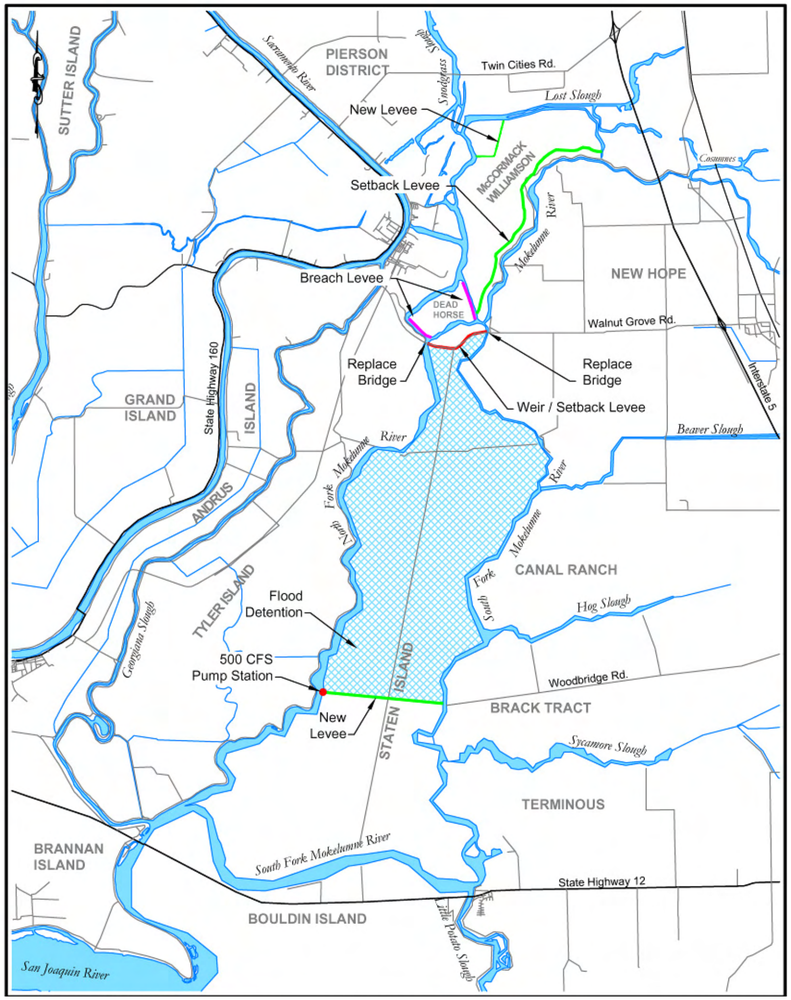


Figure 32: Public scoping alternative 3

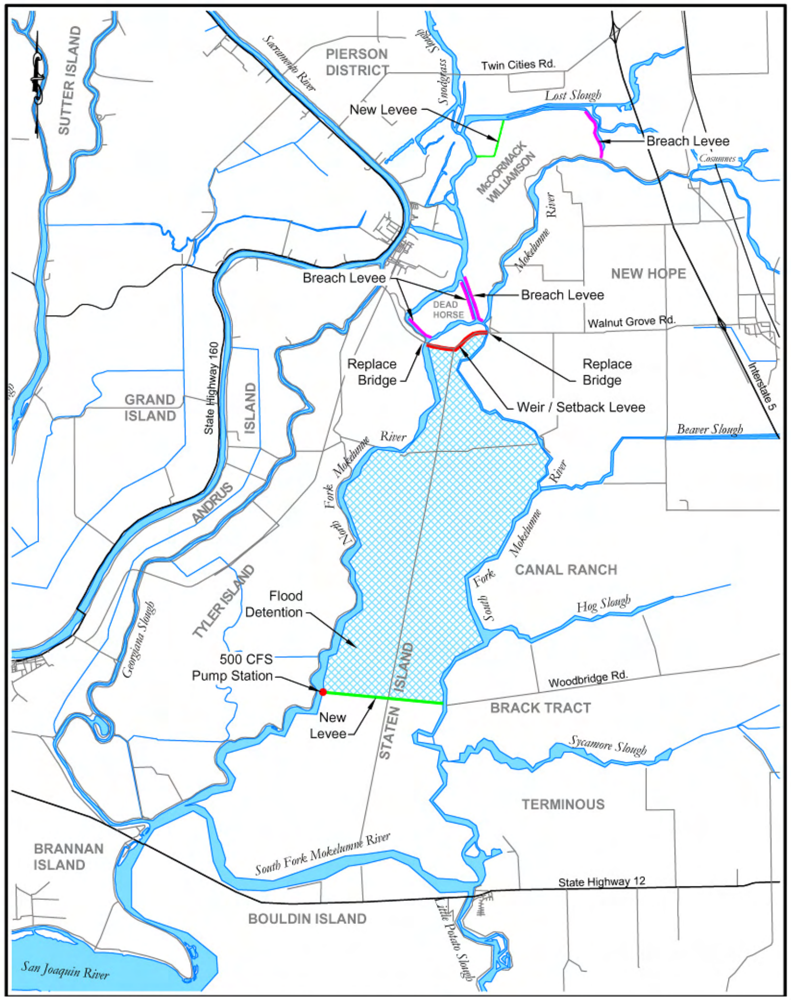


Figure 33: Public scoping alternative 4

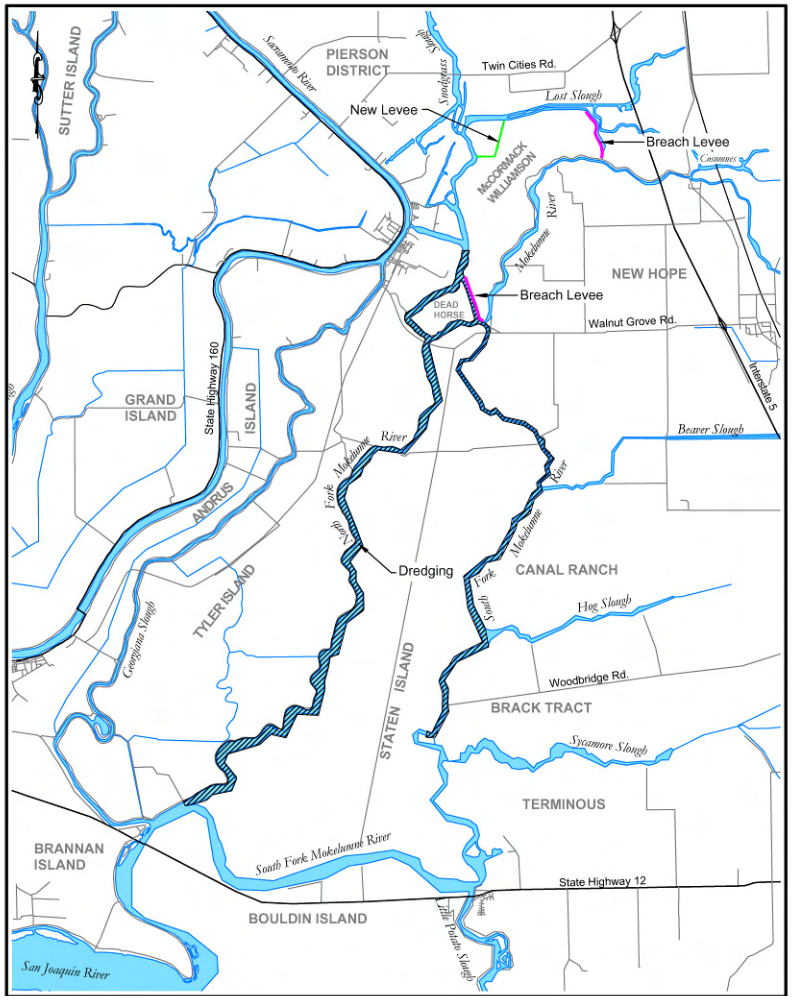


Figure 34: Public scoping alternative 5

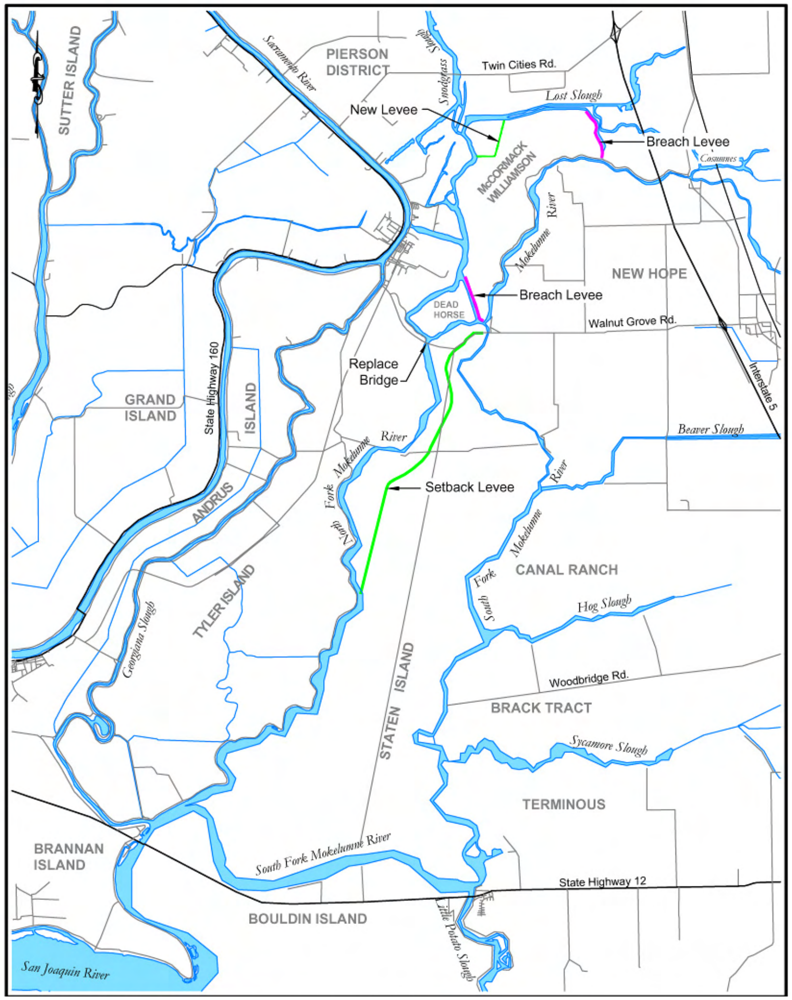


Figure 35: Public scoping alternative 6

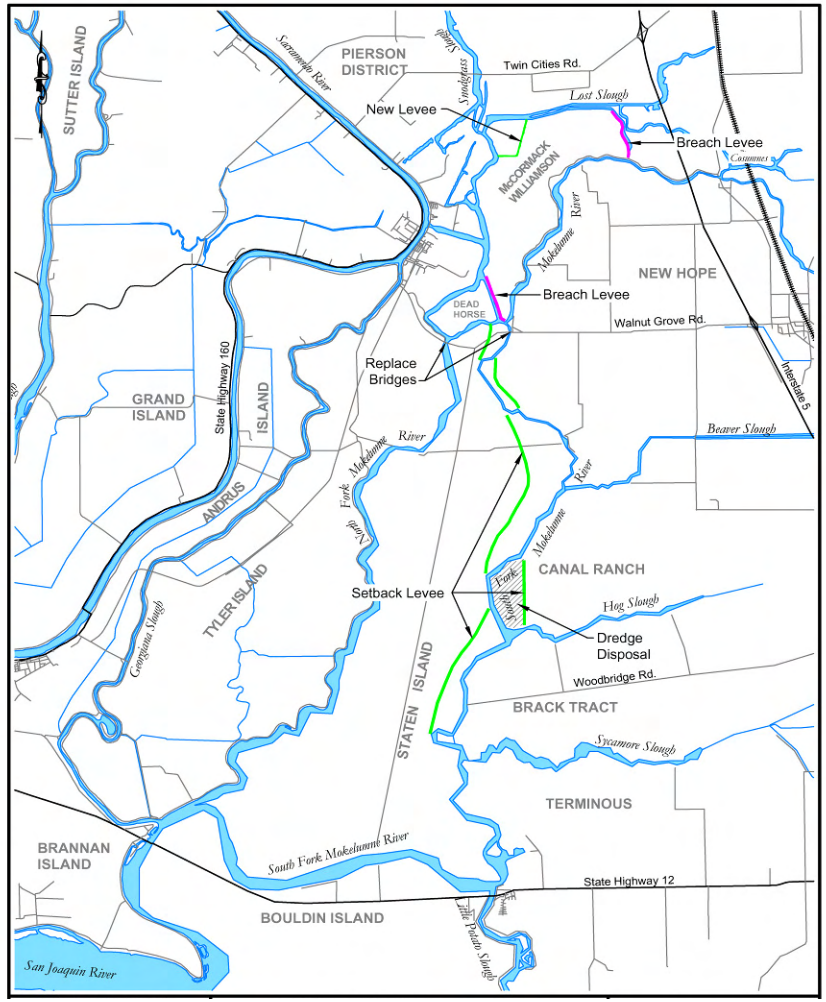


Figure 36: Public scoping alternative 7

Table 3: Modeling results of public scoping alternatives using the 1997 flood event base condition with historical levee failures

			Peak Stage Difference (feet)						
Index Point	**Location**	**Base Condition Results (NGVD29, units=feet)**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**	**Alt 7**
1	Mokelumne River (Benson's Ferry)	18.6	-0.4	-1.2	-0.4	-1.3	-1.1	-1.2	-1.4
2	Mokelumne River	15.8	-1.6	-3.1	-1.6	-3.1	-2.0	-2.6	-3.3
3	Stone Lake d/s Lambert Road	13.9	-1.6	-1.1	-1.8	-1.1	-0.7	-0.8	-1.3
4	Snodgrass Slough at Lost Slough	14.1	-1.8	-1.3	-1.9	-1.3	-0.8	-0.9	-1.5
5	South Fork Mokelumne (New Hope)	13.5	-2.7	-2.9	-2.7	-2.9	-1.0	-2.1	-3.0
6	South Fork Mokelumne at Beaver Slough	10.0	-1.7	-1.8	-1.6	-1.7	-0.3	-1.1	-0.8
7	South Fork Mokelumne at Hog Slough	7.8	-0.8	-0.8	-0.8	-0.8	0.2	-0.3	1.1
8	South Fork Mokelumne at Sycamore Sl.	7.2	-0.5	-0.5	-0.5	-0.5	0.3	0.0	1.1
9	South Fork Mokelumne at Little Potato	7.0	-0.4	-0.4	-0.4	-0.4	0.2	0.1	0.4
10	North Fork Mokelumne (Millers Ferry)	12.5	-2.3	-1.7	-2.3	-1.6	-0.8	-0.9	-1.9
11	North Fork Mokelumne	11.0	-1.8	-1.3	-1.8	-1.3	-0.3	0.2	-1.4
12	North Fork Mokelumne	9.8	-1.4	-1.1	-1.5	-1.1	0.1	1.2	-1.0
13	North Fork Mokelumne	9.1	-1.2	-0.9	-1.2	-0.9	0.1	1.2	-0.7
14	North Fork Mokelumne	8.3	-0.9	-0.7	-0.9	-0.7	0.1	0.9	-0.4
15	Lower Mokelumne at N&S Fork Confluence	7.1	-0.4	-0.4	-0.4	-0.3	0.2	0.3	0.2
16	Little Potato Sl at White Sl	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	Morrison Creek at Beach Lake	11.8	-0.8	-0.7	-0.8	-0.7	-0.6	-0.6	-0.9
18	Staten Island	No Flooding	20.9	21.7	21.0	21.8	No Flooding	No Flooding	No Flooding
19	Dead Horse Island (SA 46)	No Flooding	No Flooding	No Flooding	16.3	17.6	No Flooding	No Flooding	No Flooding
20	McCormack Williamson (SA 44)	15.4	No Flooding	-1.79	No Flooding	-2.0	-1.2	-1.5	-2.0
21	Point Pleasant (SA 7.1)	13.6	0.0	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2
22	Stone Lake u/s Lambert Road (SA 3.1)	12.0	-1.3	-1.2	-1.4	-1.3	-1.0	-1.1	-1.5

- Base condition results for index points 1-17 and 20-22 represent the water surface elevation at the corresponding geographic location and the alternative results for all each index point represents the change in peak stage.
- A positive value associated with change in peak stage represents an increase in the peak stage from the base condition, whereas a negative value associated with change in peak stage represents a decrease in the peak stage from the base condition.
- Index points 18 and 19 base condition results indicate that water did not inundate these islands during the simulation with a value of "No Flooding".
- Alternative results with numeric values assigned to index pt. 18 represent the peak stage within the island. This is to be compared with a GSE of -18' NGVD29.
- The alternative results with numeric value assigned to index point 19 represent the water surface elevation within the island. This is to be compared with a ground surface elevation of -5.5' NGVD29.

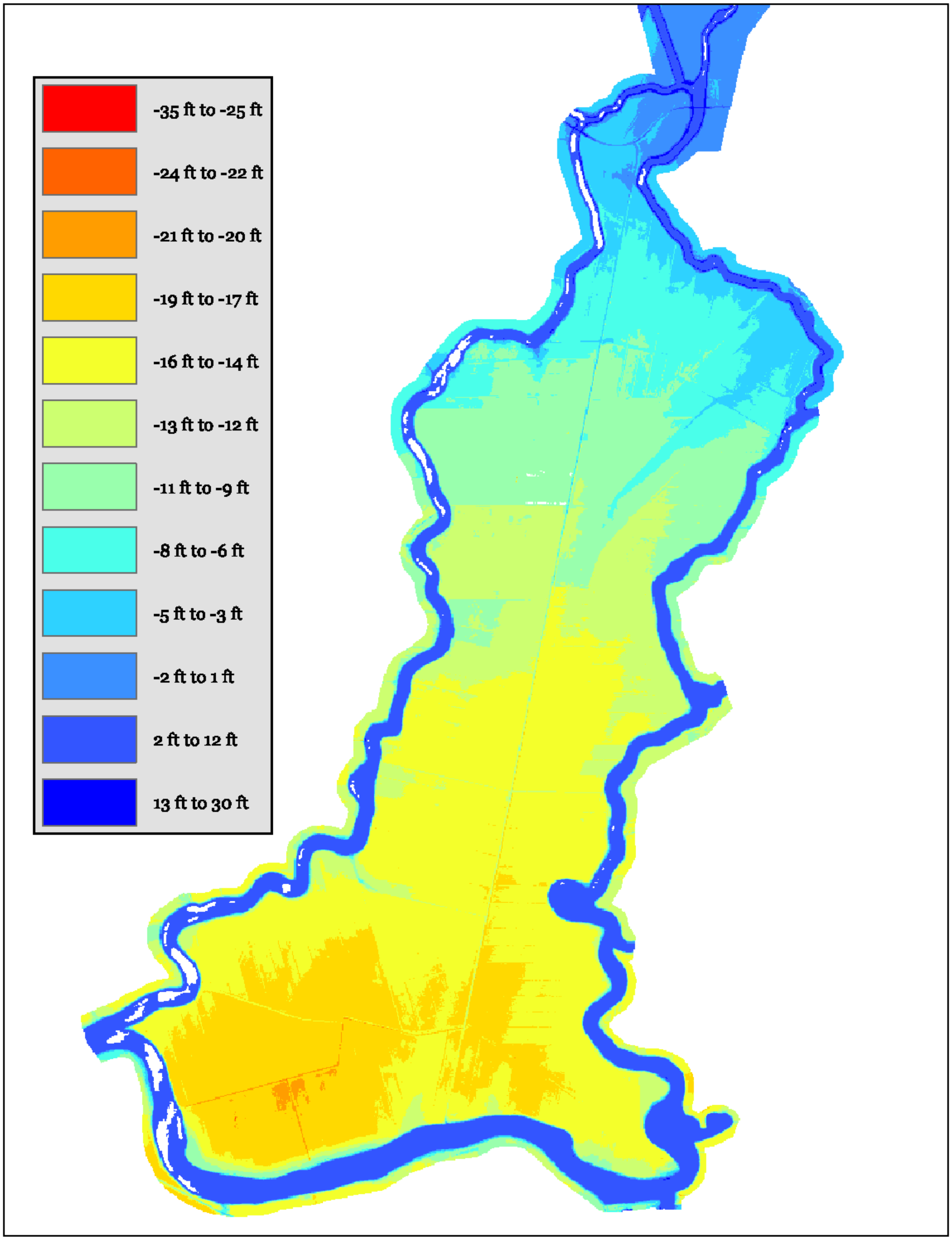


Figure 37: Staten Island digital elevation map

Ecosystem Restoration Ideas Presented at Public Scoping

Potential ecosystem restoration ideas presented at the public scoping meetings were:

- Floodplain habitat
- Intertidal wetlands
- Shallow-water habitat
- In-channel islands
- Riparian habitat
- Shaded riverine aquatic habitat

Some of these habitats could be created by setback levees along New Hope Tract, Staten Island, Canal Ranch, or Brack Tracts.

McCormack-Williamson Tract

A draft restoration scenario for McCormack-Williamson Tract was presented (see Figure 38). The restoration scenario was based on topographic (see Figure 39) and tidal data for the Tract. There would be floodplain habitat in the northern part of the Tract (with the highest elevations about 3-4' msl, intertidal habitat in the central portion of the Tract (elevation about sea level) and open water habitat in the southern portion of the Tract (elevation a couple feet below sea level). Chris Hammersmark (UC Davis graduate student working on CALFED ERP grant for McCormack-Williamson Tract) cited the following tidal data for the area. The Table was taken directly from Chris Hammersmark's thesis*, but the data were converted to feet.

Table 4: Tidal characteristic index values for the Mokelumne River at New Hope

Tide Level[1]	Tidal Datum (MLLW=0) feet[2]	NGVD 29 (MLLW=0.23) feet[4]
MHHW[3]	3.08	3.31
MHW	2.69	2.92
MTL	1.54	1.77
MLW	0.36	0.59
MLLW	0.00	0.23

Notes:

1) MHHW= mean higher high water, MHW= mean high water, MTL= mean tidal level, MLW= mean low water, MLLW= mean lower low water
2) Values calculated from 1979 water year data, and obtained from NOAA 1982
3) Not specified in Bench Mark sheet (NOAA 1982). Calculated by adding 0.39 feet, the difference between MHW and MHHW from other tidal summary values (NOAA 2002) to MHW.
4) Vertically translated based upon elevation data, MLLW=0.23 feet, from the Primary Bench Mark Stamping: Hope 1931 (PID: JS1243).

*Hammersmark, C.T., 2002. Hydrodynamic Modeling and GIS Analysis of the Habitat Potential and Flood Control Benefits of the Restoration of a Leveed Delta Island. M.S. Thesis in Hydrologic Sciences, UC Davis, p. 69.

The proposed intertidal habitat restoration was based on tidal data for the area. The tidal index values for the 1979 water year in the Mokelumne River (Chris Hammersmark, 2002) show a tidal range of about 3 feet. Tidal stage data taken from CDEC queries for years 1998, 1999 and 2001 show tidal elevations as low as -3 feet msl and as high as almost 5 feet msl for the Mokelumne River. At this stage additional modeling was needed to determine tidal elevations inside the McCormack-Williamson Tract, though it was likely the tidal range would be muted.

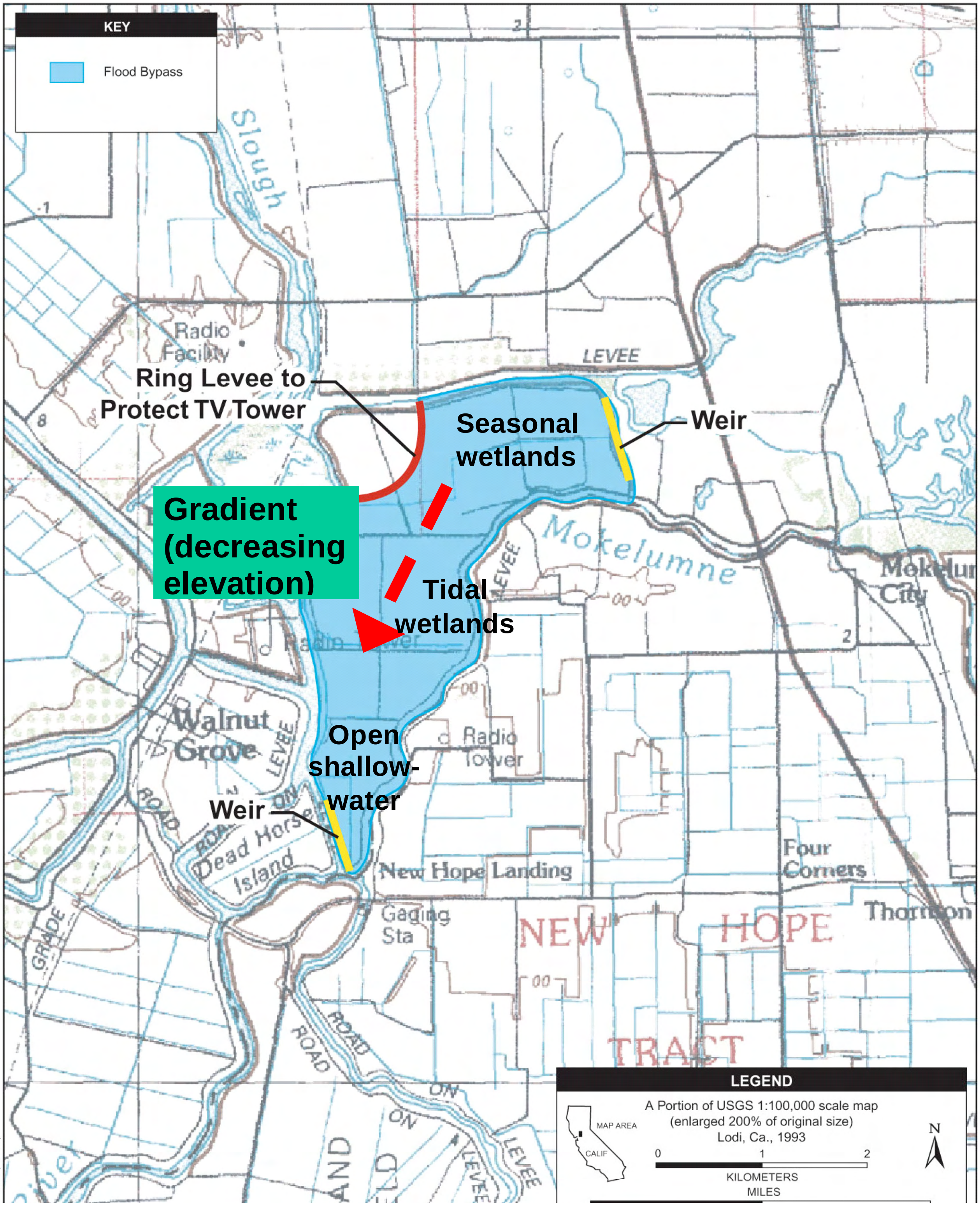


Figure 38: McCormack-Williamson Tract ecosystem restoration concept presented at public scoping

Jones & Stokes

McCormack-Williamson Tract Ideas

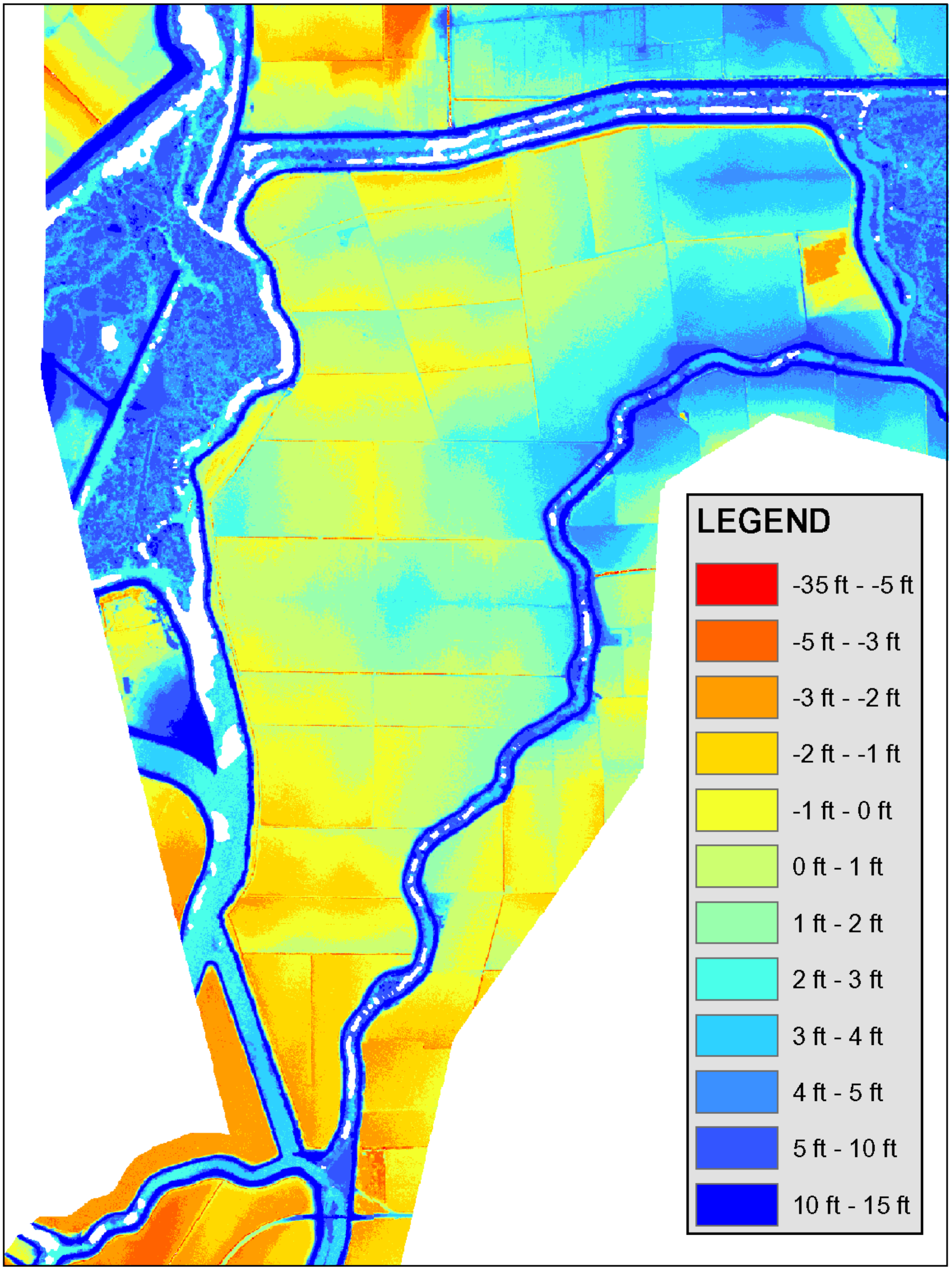


Figure 39: McCormack-Williamson Tract digital elevation map

Post Scoping Alternatives Development

The conceptual alternatives described in the previous section and shown in Figures 30 through 38 were presented at Public scoping sessions for the project in February 2003 and public comments were solicited. After the public scoping comments were assessed, DWR, in coordination with Agencies and stakeholders, performed analysis and modeling to further alternatives development. The first step in this process was to clarify project goals with input received during public scoping.; therefore, a comprehensive alternatives screening process including more specific flood control and ecosystem restoration goals, was developed. The screening process incorporated comments received in public scoping and was comprised of three screens or tiers. The first level screening criteria were roughly applied to develop the alternatives to be considered for detailed impact analysis. The second and third level screening criteria will be applied in impact analysis for the EIR and will guide selection of a preferred alternative at the end of the environmental documentation process. The draft screening process or "North Delta Flood Control and Ecosystem Restoration Proposed Alternatives Development Process" is included as Appendix B. The first screen reflects the essential ability of project alternatives to meet project goals.

Specific flood goals included in the first tier screen include:

- Provide flood control benefits to I-5 and the North Delta area by achieving a target stage of 16.5 feet at Benson's Ferry and 12 feet at New Hope Landing using the 97 event for stage and 86 event for volume.
- Convey flood flows to the San Joaquin River without immitigable stage impacts.
- Reduce risk of catastrophic levee failures during the 97 event for stage and 86 event for volume.
- Control flood waters coming through McCormack-Williamson Tract in a way that avoids the historical condition where a large surge or pulse of water from McCormack-Williamson Tract adversely affected adjacent island levees (e.g. Tyler and Dead Horse Islands) and downstream flows and knocked boats loose from local marina moorings in flood events.

Specific ecosystem restoration goals included in the first screen include:

- Restore ecological processes, including hydrologic, geomorphic and biologic processes in the North Delta Ecosystem Restoration and Flood Control Improvements Project area. Restoration of ecological processes could be achieved by:
    a. Promoting natural flooding processes, tidal action and appropriate salinity regimes.
    b. Improving river floodplain connectivity.
    c. Allowing channel migration, where practicable.
    d. Promoting sediment deposition, especially to increase elevations in areas of subsidence.
    e. Promoting food web productivity and water exchange with adjacent channels.
- Restore self-sustaining habitats, including freshwater tidal marsh, seasonal floodplain, and riparian, in the North Delta Ecosystem Restoration and Flood Control Improvements Project area.
- Support special status species in the North Delta Ecosystem Restoration and Flood Control Improvements Project area.
- Limit exotic species establishment in the North Delta Ecosystem Restoration and Flood Control Improvements Project area, to the extent practicable.

Public scoping session comments were considered to develop the alternatives screening process and to identify any new potential components for consideration. Other suggestions brought up in public scoping sessions and public scoping letters with most relevance to the alternatives development and screening process include:

- maintain agriculture and address farmland impacts
- eliminate flooding of areas not historically flooded
- focus habitat enhancement and flood control on publicly owned lands
- address water quality impacts
- greater emphasis on ecological restoration
- consider upstream detention
- Science-based solution
- consider "single" and "double" surge hydrologic events
- incorporate recreation
- maintenance must be part of the solution
- address navigation impacts
- consider impacts to Staten bird communities
- address growth-inducing impacts
- consider wetlands impacts

(A full and comprehensive listing of public comments is available in the Public Scoping Report on the North Delta website at http://baydeltaoffice.water.ca.gov/ndelta/northdelta/index.cfm under "documents").

Post Scoping Flood Control Alternatives Development

Per early HEC-RAS modeling run results, it was concluded that the only way to achieve appreciable stage reductions at Benson's Ferry and provide some flood control benefits to I-5 would be by providing an aggressive conveyance of flood flow through McCormack-Williamson Tract (M-W Tract). Hydraulic modeling showed that it was necessary to open up M-W Tract by degrading the east and southwest levees for best upstream stage reduction and that larger breach lengths yielded greater stage reductions. The effect of larger breaches in yielding greater upstream stage reductions can be realized by comparing modeling results of components 13a, 13b and 13c (presented in Table 2). Components 13a, 13b, and 13c have an east levee breach length of 300 feet, 1000 feet, and 4000 feet, respectively. Results show that the stage drop at Benson's Ferry increases with increasing breach length, with a 1' greater stage drop for the 4000 feet breach versus the 300 feet breach length. However, it was also determined after the public scoping meetings that an existing lease agreement with KCRA on M-W Tract requires that the road access maintain the same level of flood protection as current conditions. Since the lowest elevation on the access road is 8.5' NGVD29, the minimum east levee elevation must be no less than 8.5'. Another alternative would be to provide alternate access via a bridge or ferry, which would be cost prohibitive. As well, modeling results discussed below determined that constraining the weir height on McCormack-Williamson Tract to 8.5' and not considering weir elevations below this height does not significantly compromise flood stage reduction performance, if the weir width is maintained.

The component modeling results and the elevation constraint on the M-W Tract east levee lead to modeling of components 14 and 15, which are shown in Figure 40. Components 14 and 15 include degrading 3000' of the M-W Tract east levee, and 3400' of the southwest levee to the existing ground surface elevation (-2' NGVD29). Incised channels branching from the Mokelumne River and Middle Slough were modeled in an attempt to achieve a greater stage reduction and it was at one point viewed as an ecosystem restoration component of the project. The new levee and berm were incorporated to provide protection to private landowners just West on I-5 that would potentially be affected by the modifications. The variation between component 14 and 15 is that the east levee is degraded to the existing ground surface elevation (2.5' NGVD29) for component 14 modeling, whereas component 15 models the east levee at an elevation of 8.5' NGVD29. The results in Table 5 show that the variation in levee elevation does not significantly impact peak stage.

Model runs of conceptual alternatives with setback levees on either the North or South Forks of the Mokelumne, such as public scoping alternatives 6 and 7 shown in Figures 35 and 36, showed decrease in upstream flood stages, but had significant stage increases in the downstream part of the system that were unacceptable. Potential means to address downstream stage increases include significant levee raising which is costly, and dredging, which requires continued maintenance and uncertainty of ability to permit initial and/or maintenance dredging. As well, continuing the setbacks throughout the system was considered to be infeasible because of cost and technical issues associated with constructing setbacks on extensively peaty soils.

Staff developed the concept of a detention basin lower in the system as another means to address downstream stage impacts and to divert the peak volume of high stage events. Setback levees would provide better conveyance of flood water to the detention basin. Model runs showed that the further up the system the basin was placed, the more effective it was, because it was above the influence of the tides. As well, this would minimize the length of setbacks levees required, which are costly. Refer to Figures 41-43 for illustrations of early Staten Island detention basin concepts.

Because the topography of Staten Island becomes more and more subsided as one moves southward, an additional benefit of locating the detention basins as far north as possible, is that the pumping head required to pump out the basins would be less and there is more potential for some gravity draining. Also, an analysis of the soil types on Staten Island (see Figure 44) shows that there is a greater percentage of mineral soils, therefore better building materials, as one moves further north on the Island as well as the ability to potentially locate basin levees along the paths of historical channels which maximizes potential for mineral soils. On the southern end of the island, peat depths on the order of 20' make detention basin levees and setback levees cost prohibitive.

Preliminary North Delta HEC-RAS model runs were performed to size detention basins on the upper West and East sides of Staten, limiting the basin area to 1000 acres (Refer to Figures 45 and 46 for locations, and Table 7 for detailed results of these model runs). Runs A.1_2 and E (East and west Staten detention basins, respectively) show that a detention basin of 1000 acres is not large enough to prevent stage impacts downstream. In contrast, model runs C_1 and Run #4 were set up with no limitation on the volume of water entering the North Staten detention area (Figure 47), and a much larger volume of water entered the basin. These model runs show that iterative modeling must be performed to achieve a balance between volume of flow detained to provide flood control for the area and determining an appropriate height for the inlet structure for the detention basins so that Staten Island is not flooded for events smaller than the statistical 1:10 year event (which is stated in the Staten Island Purchase Agreement). These relationships were further examined with the Mike11 model and are discussed in the next section.

As well, the model results were compared to determine how sensitive high flow stages are to the McCormack-Williamson Tract southwest levee height. Model runs C_1 and Run #4 are similar in components, with the exception of the McCormack-Williamson Tract southwest levee elevation. Ecosystem restoration development after public scoping (as discussed in the next section) called for a wider range of habitats for analysis. The Project ecosystem improvements being considered were broadened to include floodplain restoration as well as tidal marsh restoration. Floodplain restoration necessitates a higher southwest levee elevation to prevent tidal action on the Tract. It has been determined that a levee height of 5.5' NGVD29 would be appropriate for floodplain restoration. Comparison of model runs C_1 and Run #4 indicates that degrading the McCormack-Williamson Tract to 5.5' NGVD29 instead of -2.5' NGVD29 will not compromise flood control benefits.

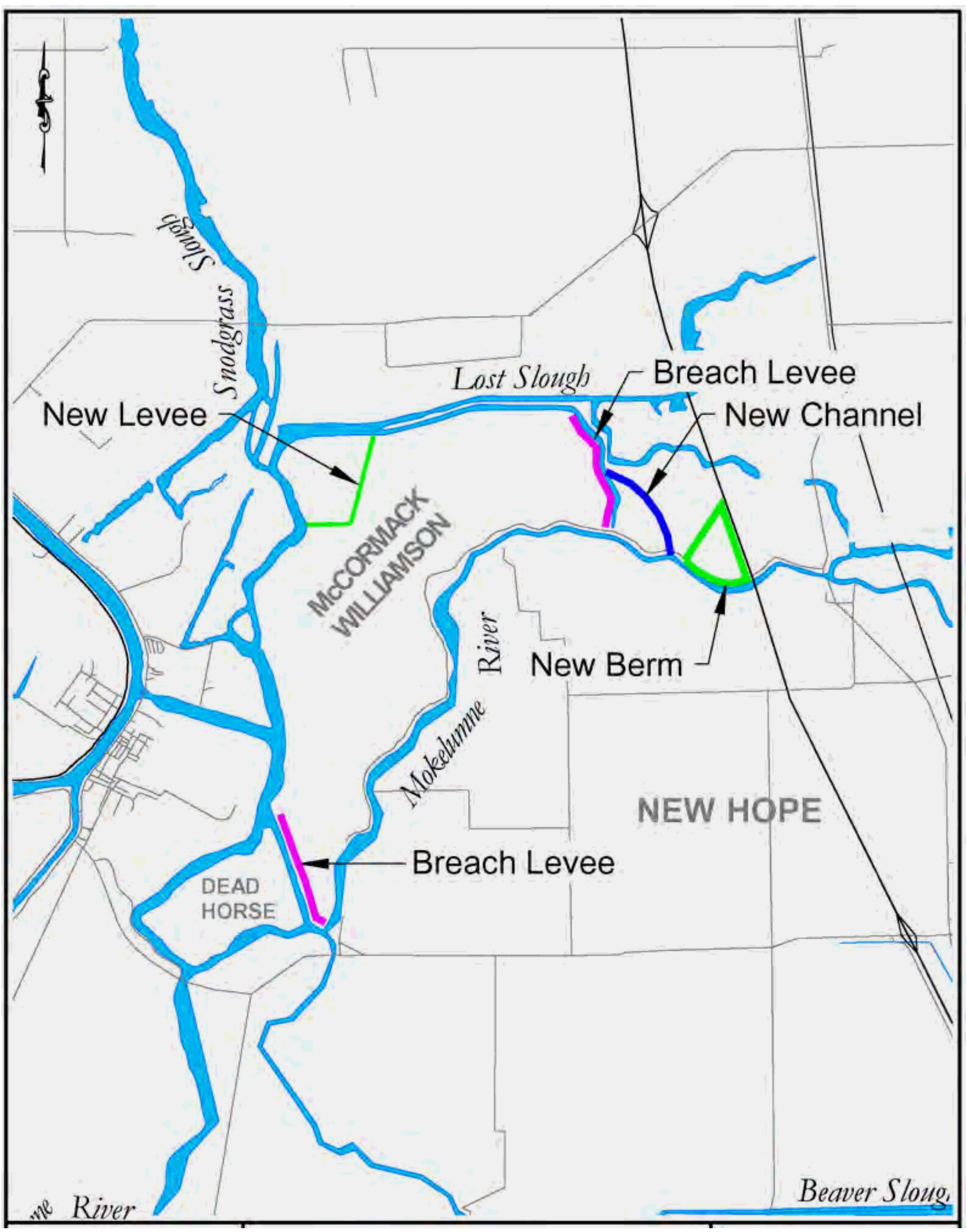


Figure 40: Components 14 and 15

Table 5: Effect of McCormack-Williamson Tract flood control components on stage for 1997 flood event.

Index Point	Location	Base Condition Results (NGVD29, units=feet)	Peak Stage Difference (feet) Comp 14	Peak Stage Difference (feet) Comp 15
1	Mokelumne River (Benson's Ferry)	18.6	-1.1	-1.0
2	Mokelumne River	15.8	-1.1	-1.1
3	Stone Lake d/s Lambert Road	13.9	0.2	0.2
4	Snodgrass Slough at Lost Slough	14.1	0.2	0.2
5	South Fork Mokelumne (New Hope)	13.5	0.1	0.1
6	South Fork Mokelumne at Beaver Slough	10.0	0.1	0.1
7	South Fork Mokelumne at Hog Slough	7.8	0.1	0.1
8	South Fork Mokelumne at Sycamore Sl.	7.2	0.1	0.1
9	South Fork Mokelumne at Little Potato	7.0	0.1	0.1
10	North Fork Mokelumne (Millers Ferry)	12.5	0.1	0.1
11	North Fork Mokelumne	11.0	0.2	0.2
12	North Fork Mokelumne	9.8	0.2	0.2
13	North Fork Mokelumne	9.1	0.2	0.2
14	North Fork Mokelumne	8.3	0.1	0.1
15	Lower Mokelumne at N&S Fork Confluence	7.1	0.1	0.1
16	Little Potato Sl at White Sl	6.5	0.5	0.0
17	Morrison Creek at Beach Lake	11.8	0.2	0.3
18	Staten Island	No Flooding	No Flooding	No Flooding
19	Dead Horse Island (SA 46)	No Flooding	No Flooding	No Flooding
20	McCormack Williamson (SA 44)	15.4	0.0	-0.1
21	Point Pleasant (SA 7.1)	13.6	-0.2	-0.2
22	Stone Lake u/s Lambert Road (SA 3.1)	12.0	0.4	0.5

- Positive number indicates an increase in stage due to the component.
- Negative number indicates a decrease in stage due to the component.
- Index points 18 and 19 base condition and alternative results indicate that water did not inundate these islands during the simulation with a value of "No Flooding".
- Index point 20 alternative results show inundation of M-W Tract. The numeric value represents the change in peak stage, in units of feet.

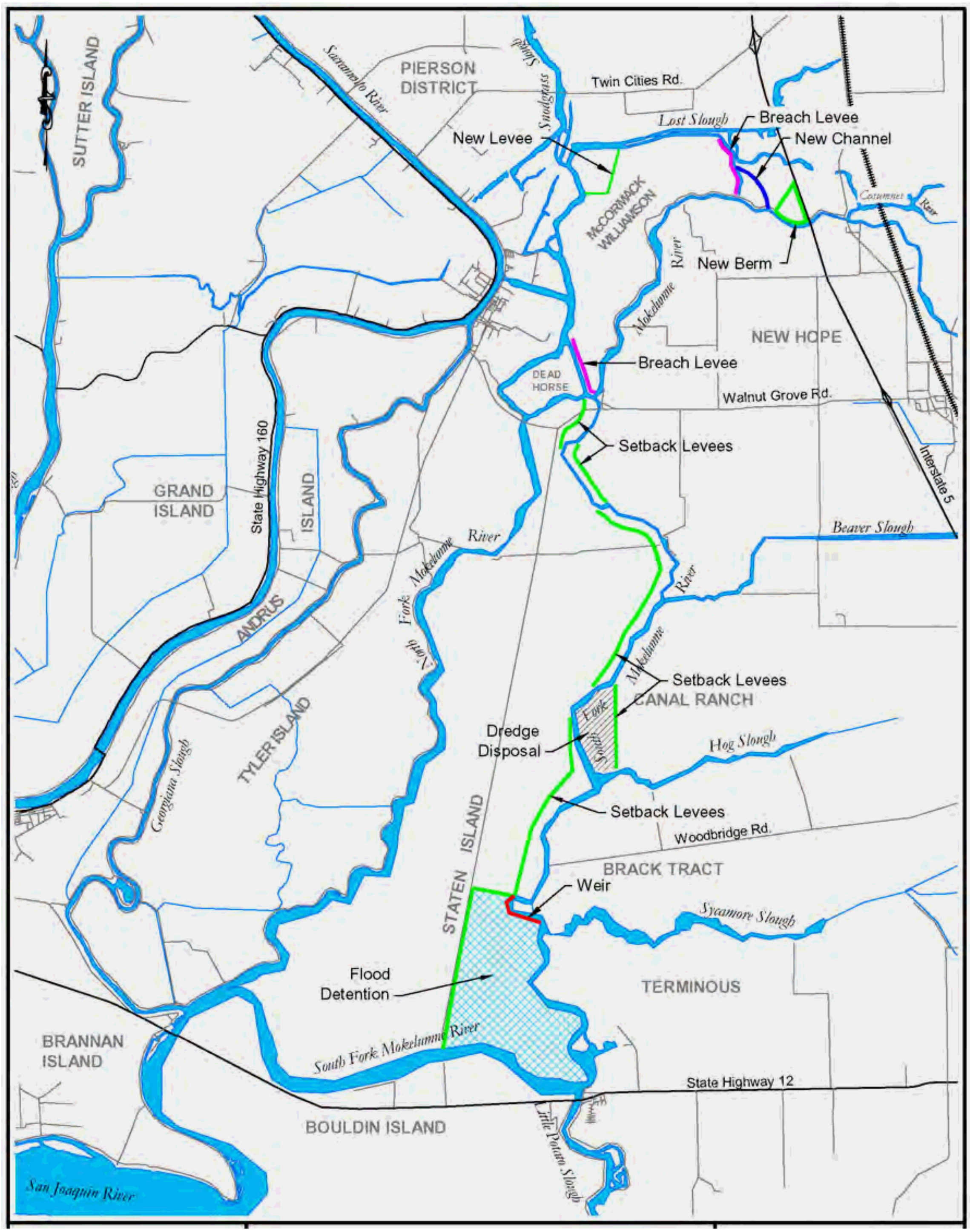


Figure 41: Public scoping alternative 7a

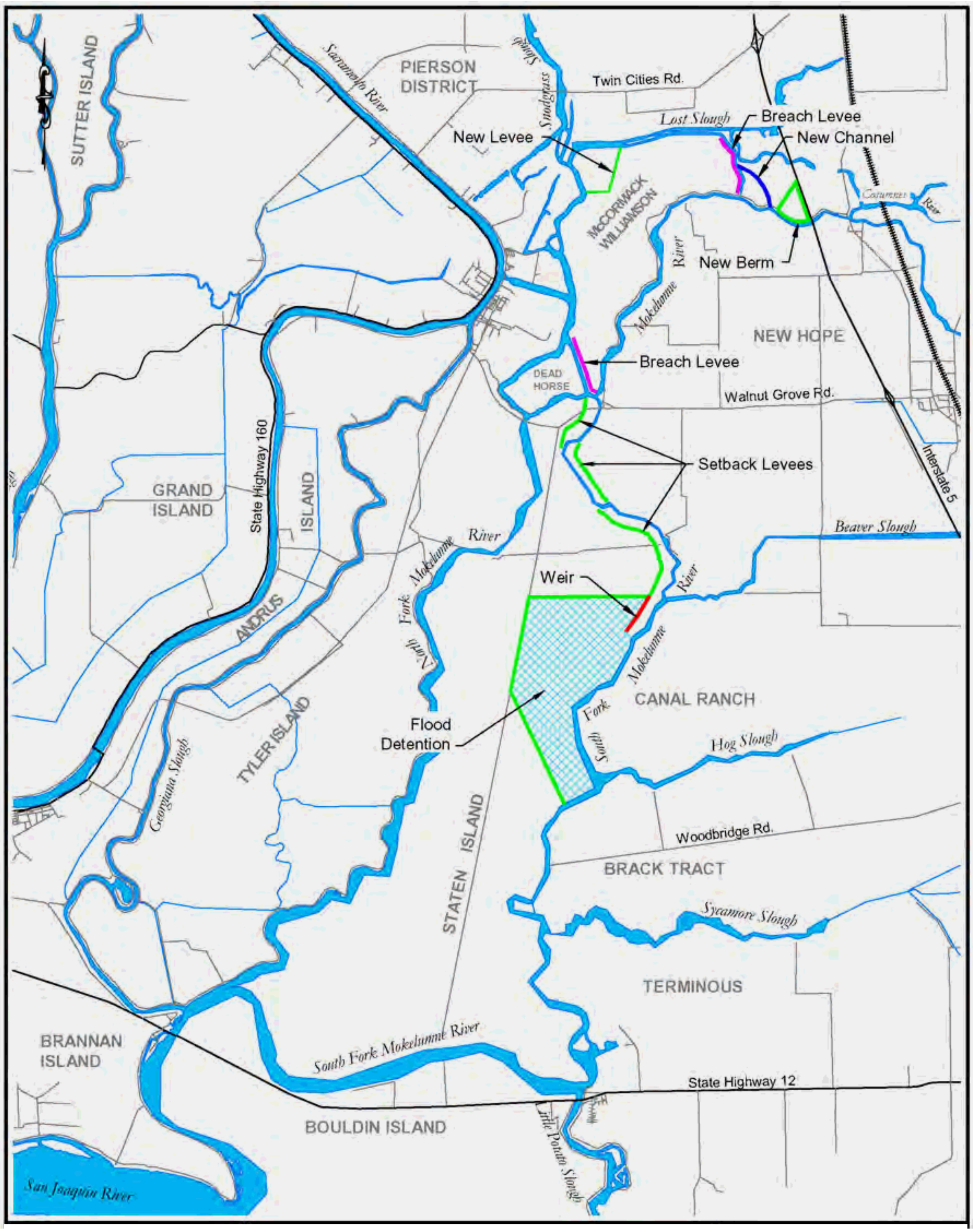


Figure 42: Public scoping alternative 7b

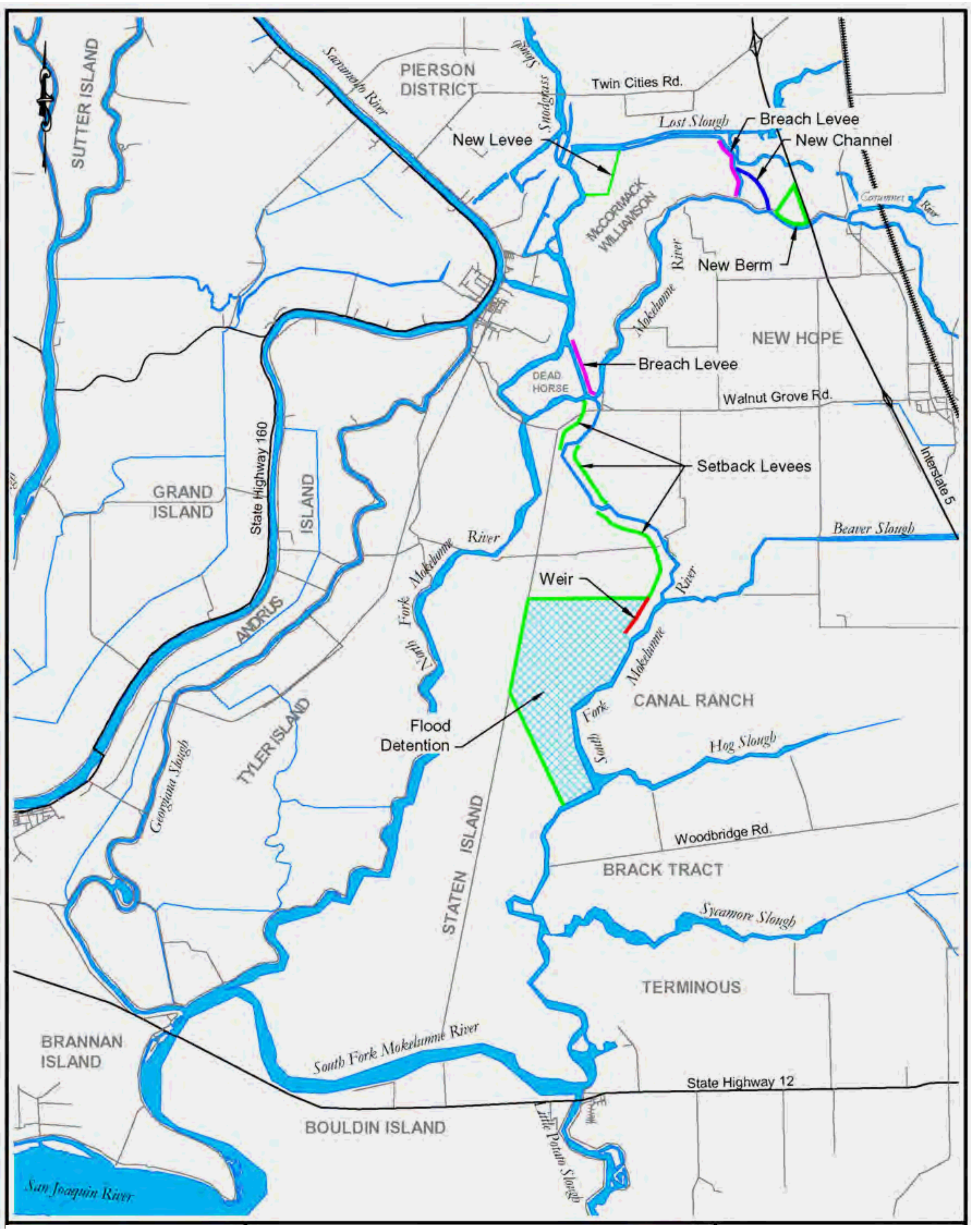


Figure 43: Public scoping alternative 7c

Table 6: Staten Island detention basin alternatives for 1997 flood event.

Index Point	Location	Base Condition Results (NGVD29, units=feet)	*Peak Stage Difference (feet)* Alt 7a	Alt 7b	Alt 7c
1	Mokelumne River (Benson's Ferry)	18.6	-1.4	-1.3	-1.3
2	Mokelumne River	15.8	-2.2	-2.1	-2.2
3	Stone Lake d/s Lambert Road	13.9	-0.4	-0.2	-0.3
4	Snodgrass Slough at Lost Slough	14.1	-0.4	-0.3	-0.3
5	South Fork Mokelumne (New Hope)	13.5	-1.2	-1.1	-1.2
6	South Fork Mokelumne at Beaver Slough	10.0	-1.0	-0.3	-0.6
7	South Fork Mokelumne at Hog Slough	7.8	-0.1	0.0	-0.4
8	South Fork Mokelumne at Sycamore Sl.	7.2	0.0	0.0	-0.2
9	South Fork Mokelumne at Little Potato	7.0	0.0	0.0	-0.1
10	North Fork Mokelumne (Millers Ferry)	12.5	-0.7	-0.5	-0.6
11	North Fork Mokelumne	11.0	-0.4	-0.3	-0.4
12	North Fork Mokelumne	9.8	-0.3	-0.2	-0.3
13	North Fork Mokelumne	9.1	-0.3	-0.2	-0.3
14	North Fork Mokelumne	8.3	-0.2	-0.2	-0.2
15	Lower Mokelumne at N&S Fork Confluence	7.1	-0.1	-0.1	-0.2
16	Little Potato Sl at White Sl	6.5	0.0	0.0	0.0
17	Morrison Creek at Beach Lake	11.8	-0.4	-0.2	-0.1
18	Staten Island	No Flooding	*	**	***
19	Dead Horse Island (SA 46)	No Flooding	No Flooding	No Flooding	No Flooding
20	McCormack Williamson (SA 44)	15.4	-0.7	-0.6	-0.6
21	Point Pleasant (SA 7.1)	13.6	-0.2	-0.2	-0.2
22	Stone Lake u/s Lambert Road (SA 3.1)	12.0	-0.6	-0.3	-0.3

- Positive number indicates an increase in stage due to the component.
- Negative number indicates a decrease in stage due to the component.
- "N/A" indicates that a levee failure on Dead Horse Island did not occur during simulations of these alternatives. Therefore, a value for peak stage or change in peak stage is not applicable for index point 19 for alternatives 7a, 7b, or 7c.
- Index points 18 and 19 base condition results indicate that water did not inundate these islands during the simulation with a value of "No Flooding".
- *=20,000 acre-feet of water diverted to the detention basin.
- **=21,000 acre-feet of water diverted to the detention basin.
- ***=22,000 acre-feet of water diverted to the detention basin.
- Index point 20 base condition and alternative results show inundation of M-W Tract. The numeric value in the base condition column represents the peak stage (NGVD29, units=feet) and the alternative results values represent change in peak stage, in units of feet.

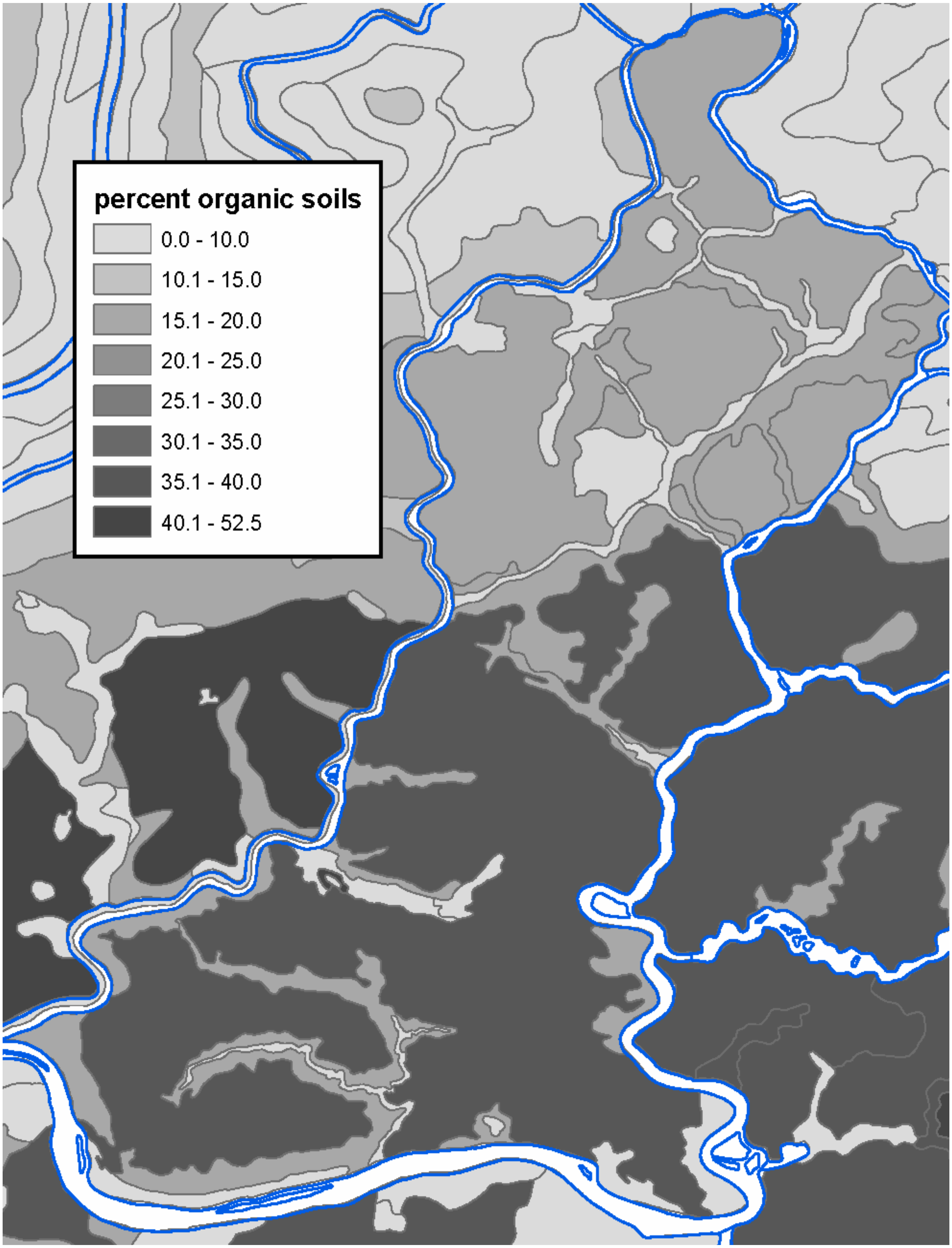


Figure 44: Percent organic soils on Staten Island

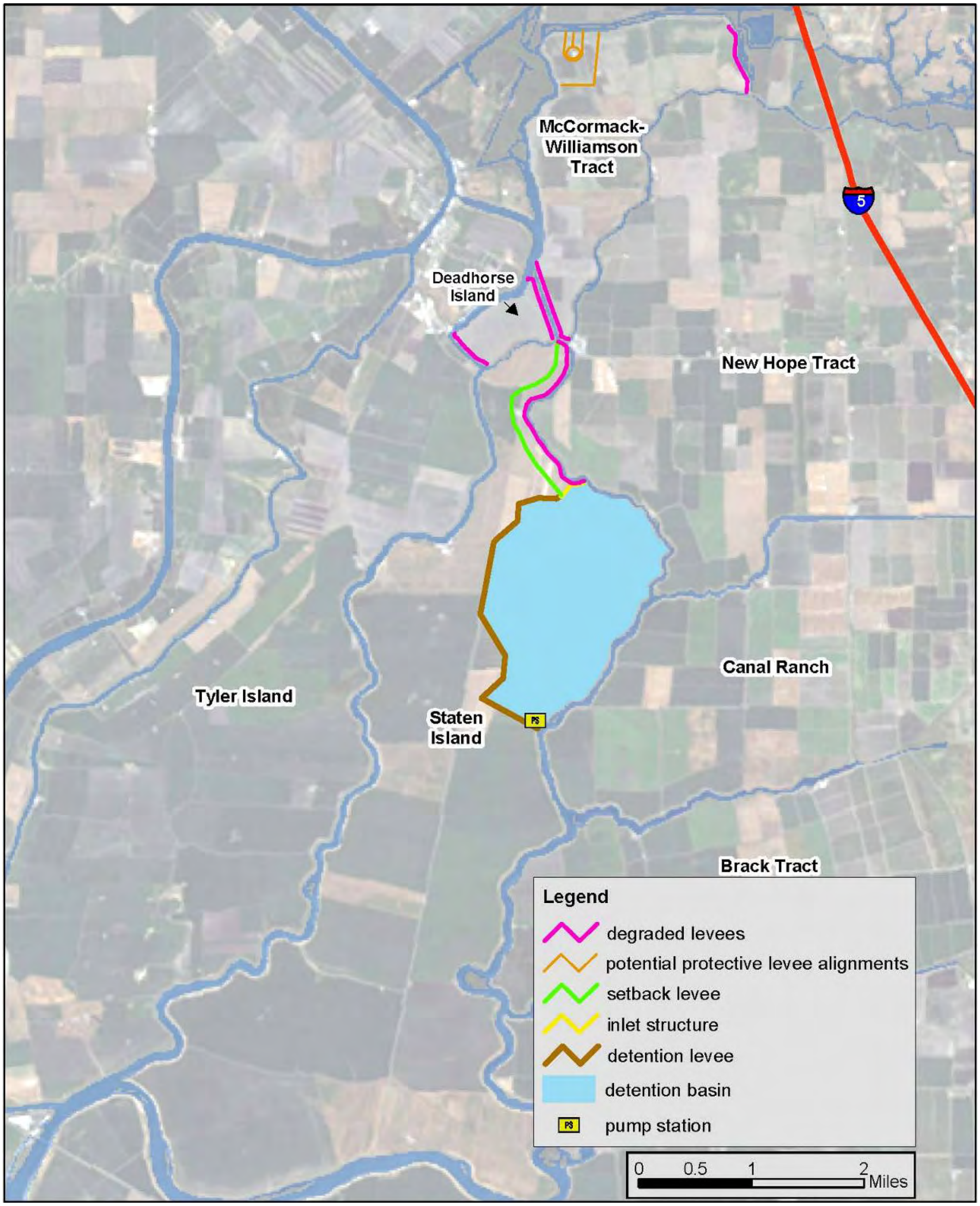


Figure 45: East Staten detention basin alternative (A.1_2)

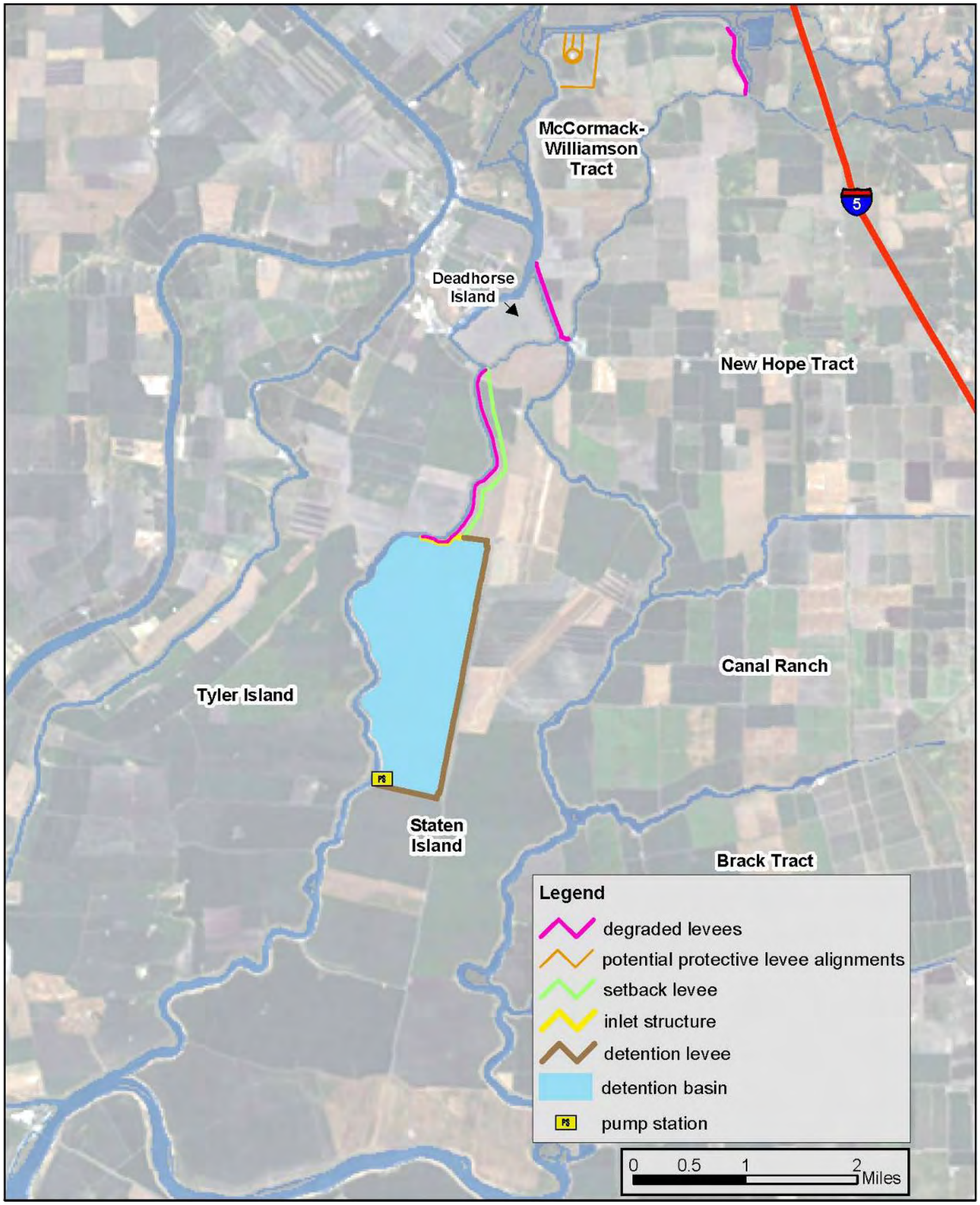


Figure 46: West Staten detention basin alternative (E)

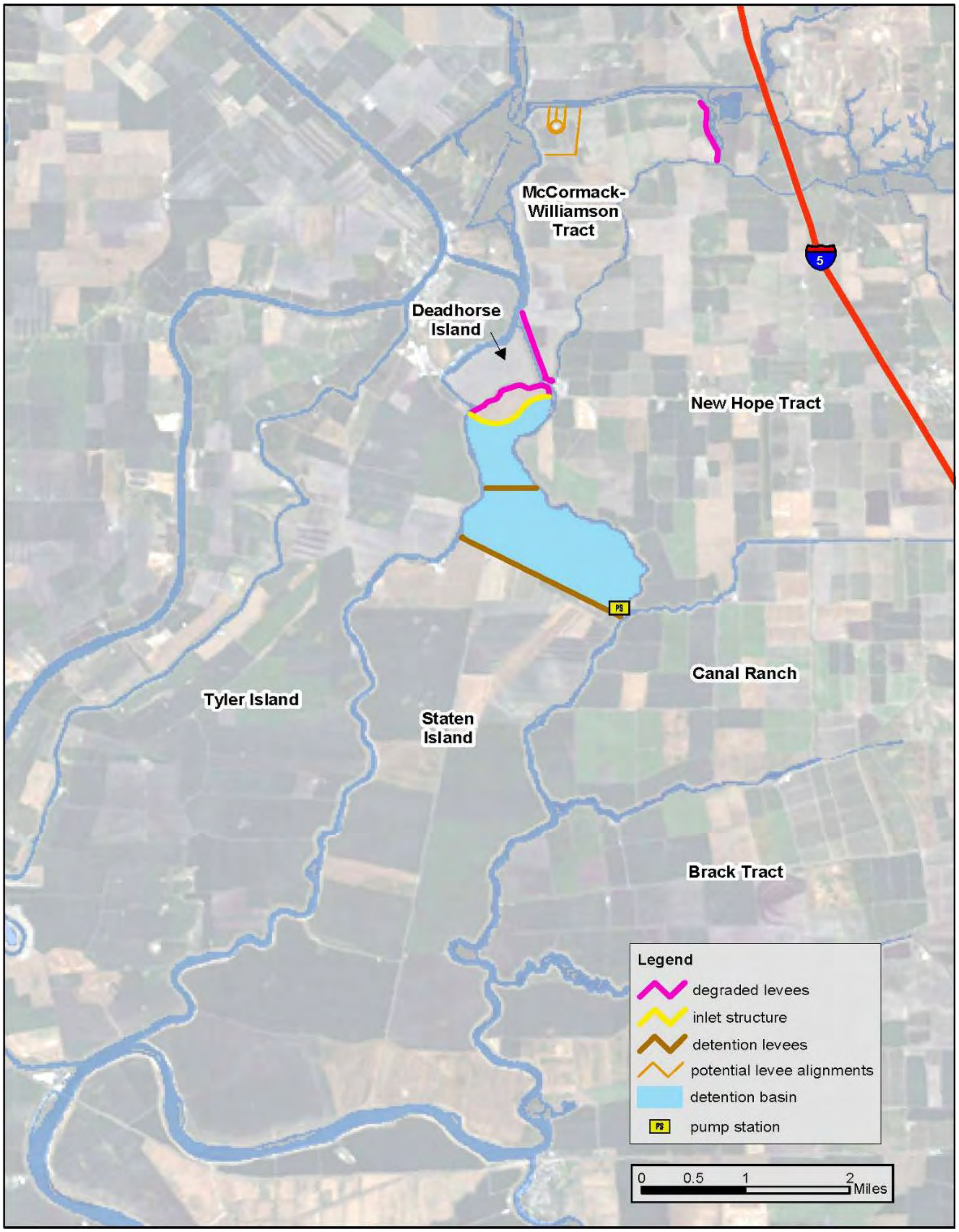


Figure 47: North Staten detention basin alternative (C_1 and Run #4)

Table 7: Additional Staten Island Detention Basin Alternatives Description

Model Run	Description
A.1_2	*3000' breach of M-W E. levee to an elev. of 8.5' *Breach entire SW M-W levee to existing topography (~-2') *Incised channels branching from the Mokelumne River (100' wide and 0.0' channel bottom elev.) and Middle Slough (width to be the same as Middle Sl. and 0.0' channel bottom elev.) across the Dixon property. *Protective berm (9') around Kirkham property. *Ring levee for KCRA protection *Setback levees on the S. Fork from the northern end of Staten Island to the East detention basin *Inlet weir length and height are 3000' and 8', respectively, *Storage capacity on Staten Island limited to 1000 acres
E	*3000' breach of M-W E. levee to an elev. of 8.5' *Breach entire SW M-W levee to existing topography (~-2') *Incised channels branching from the Mokelumne River (100' wide and 0.0' channel bottom elev.) and Middle Slough (width to be the same as Middle Sl. and 0.0' channel bottom elev.) across the Dixon property. *Protective berm (9') around Kirkham property. *Ring levee for KCRA protection *Setback levee (1000' from channel) on the N. Fork from the northern end of Staten Island to the West detention basin *Inlet weir length and height are 3000' and 8', respectively, *Storage capacity on Staten is limited to 1000 acres. *Breach 5000' Mokelumne River levee on McCormack to (~-2') *Note: model refinement on how water exits McCormack
C_1	*3000' breach of M-W E. levee to an elev. of 8.5' *Breach entire SW M-W levee to existing topography (~-2') *Incised channels branching from the Mokelumne River (100' wide and 0.0' channel bottom elev.) and Middle Slough (width to be the same as Middle Sl. and 0.0' channel bottom elev.) across the Dixon property. *Protective berm (9') around Kirkham property. *Ring levee for KCRA protection *8' high inlet weir with a length of 3000' at northern Staten Island, which should follow the existing county road. *Cross levee at approximately the middle of Staten Island (to detain waters from the northern portion of Staten) *Unlimited storage capacity on Staten Island.
Run #4	Similar to C_1, except the SW M-W levee is degraded to 5.5 feet

Table 8: Additional Staten Island Detention Basin Alternatives Model Results (for 1997 flood event)

Peak Stage (feet-NGVD)						
Index Point	Location	Base w/ Levee Failures	A.1_2	E	C_1	Run #4
1	Mokelumne River (Benson's Ferry)	18.71	-1.29	-2.02	-1.66	-1.54
2	Mokelumne River	15.74	-2.05	-1.97	-3.20	-3.24
3	Snodgrass Slough	13.76	-0.11	-0.62	-0.70	-0.65
4	Snodgrass Slough at Lost Slough	14.06	-0.14	-0.80	-0.89	-0.83
5	South Fork Mokelumne (New Hope)	13.42	-1.05	-1.31	-2.62	-2.69
6	South Fork Mokelumne at Beaver Slough	9.94	-0.35	-0.77	-1.57	-1.62
7	South Fork Mokelumne at Hog Slough	7.81	-0.28	-0.24	-0.69	-0.71
8	South Fork Mokelumne at Sycamore Sl.	7.18	-0.12	-0.03	-0.38	-0.40
9	South Fork Mokelumne at Little Potato	6.94	-0.06	0.05	-0.26	-0.28
10	North Fork Mokelumne (Millers Ferry)	12.25	-0.26	-0.03	-1.33	-1.40
11	North Fork Mokelumne	10.95	-0.21	0.95	-1.09	-1.15
12	North Fork Mokelumne	9.77	-0.15	1.38	-0.85	-0.90
13	North Fork Mokelumne	9.08	-0.13	1.13	-0.70	-0.74
14	North Fork Mokelumne	8.28	-0.10	0.74	-0.53	-0.56
15	Lower Mokelumne at N&S Fork Confluence	7.09	-0.04	0.20	-0.25	-0.27
16	Little Potato Sl at White Sl	6.49	-0.01	-0.02	-0.01	-0.01
17	Morrison Creek at Beach Lake	11.75	-0.10	-0.62	-0.60	-0.56
18	Staten	N/A	N/A	N/A	N/A	N/A
19	Dead Horse Island (SA 46)	No Flooding	N/A	N/A	N/A	N/A
20	McCormack Williamson (SA 44)	15.68	-0.86	-2.06	-1.72	-1.40
21	Point Pleasant (SA 7.1)	13.61	-0.17	-0.24	-0.21	-0.20
22	Stone Lake u/s Lambert Road (SA 3.1)	12.25	-0.23	-1.15	-1.14	-1.08

Mike11 Modeling for Alternatives Refinement

Early project concepts were developed using the HEC-RAS model described earlier in this document for rough analysis. Subsequently, a Mike11 model was used for alternatives refinement and impact analysis. The Mike11 model had been previously developed for the area through CALFED funded studies on McCormack-Williamson Tract. The section describes the rationale for the shift in model platforms and presents results of subsequent key model runs for alternatives refinement.

The North Delta HEC-RAS was calibrated to a specific high flow event (1997 event) instead of a range of flows. However, calibrating to a specific high flow event does not allow the flexibility to model low flow events accurately because models suitable for simulating a wide range of flows should be calibrated so that the model can accurately predict changes to a system for a wide range of events. Because of the need for flexibility, in the face of funding shortages, and because the Mike11 model was available through separately-funded CALFED research activities and more readily able to model a range of flows, a switch was made to the Mike11 platform to refine alternatives and perform impacts analysis for the environmental document.

A Mike11 model was developed through a CALFED-funded grant to study hydraulics in the vicinity of McCormack-Williamson Tract. Further ecosystem restoration, sediment transport and water quality modeling necessitated that the Mike 11 model boundaries be expanded to the area shown in Figure 48. The model was calibrated for a wide range of flows (~2.5 year event to ~100 year event at Michigan Bar).

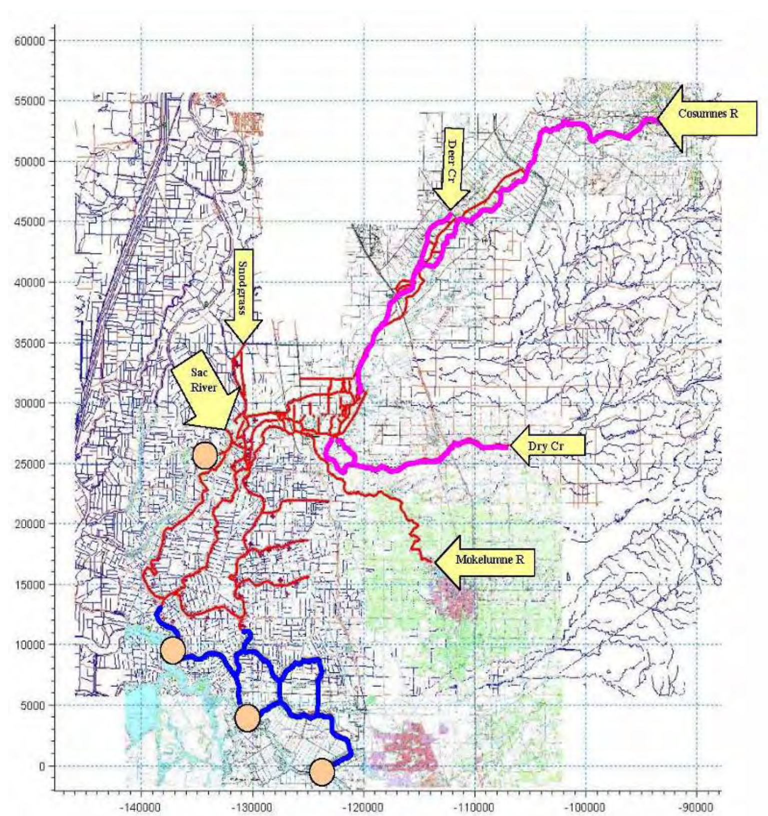


Figure 48: Extended North Delta Mike 11 Model Domain

The Mike11 model was expanded and calibrated to the 1997 event as well as other events including the 1986, 1998, 1999, and year 2000 event. Levee failure criteria for flood modeling were developed based on DWR and stakeholder input. Results of the Mike11 calibration and verification modeling and other pertinent technical details are presented as an appendix to the North Delta EIR. Mike11 modeling was used to make alternative refinements and to perform impact analysis in the EIR. The impact analysis is presented in the EIR, while the following text details key modeling studies that informed alternatives refinement. Model stage results, where presented, are referenced to index points for the Mike11 model as shown in Figure 49.

North Delta MIKE 11 Index Points

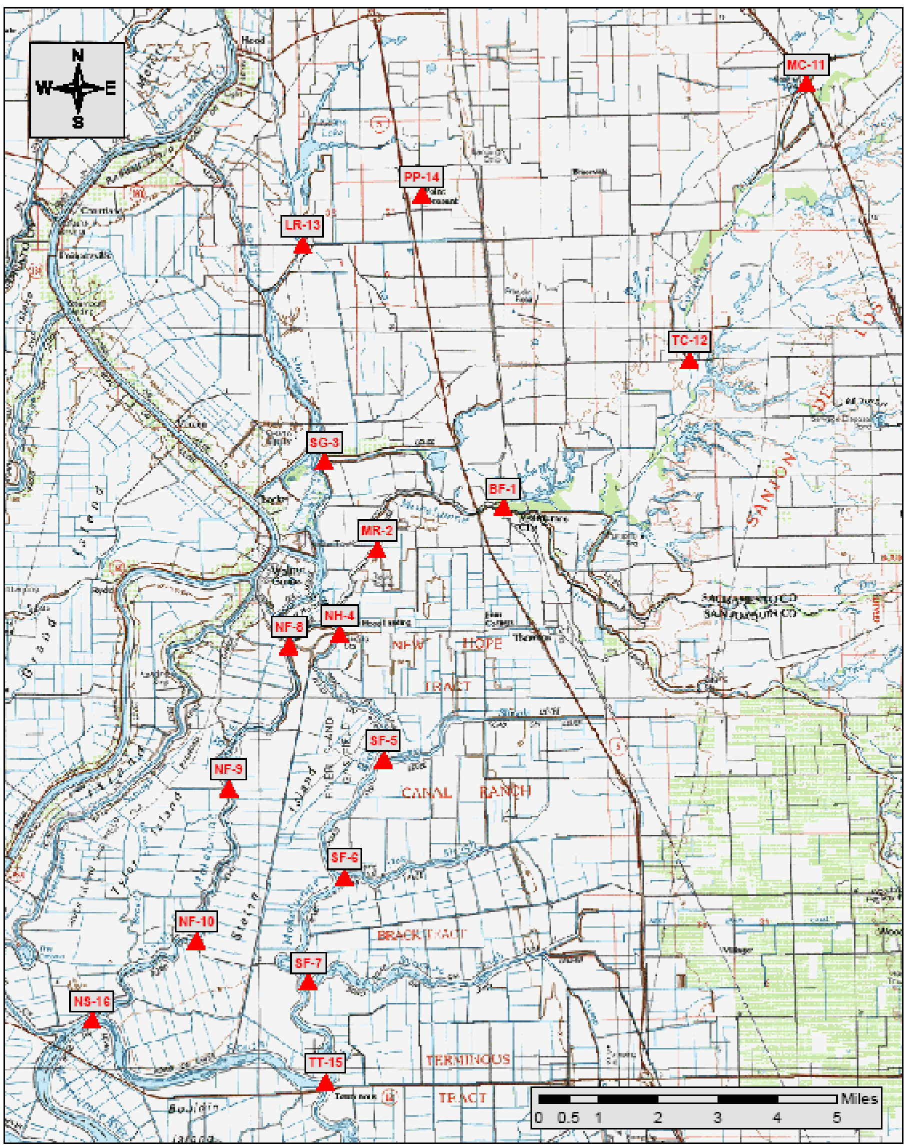


Figure 49. Mike11 Model Index Points

Modeling to Satisfy the Terms of the KCRA Agreement on McCormack-Williamson Tract

There is a transmission tower located on McCormack Williamson Tract that is leased by KCRA from the current owner of McCormack-Williamson Tract (The Nature Conservancy). To implement any flood control and ecosystem restoration project on McCormackWilliamsonTract, it is necessary to abide by the KCRA lease agreement. The terms of the lease specify that KCRA's existing flood protection level can not be compromised by project components by any means. For that purpose, Mike11 model was used to determine the height of a protective levee around the KCRA transmission tower that would be required in order to provide current level of protection to the tower, if the McCormack-Williamson Tract's East and southwest levees were degraded for more frequent flooding. The task was performed in two steps as described below.

In the first step, a synthetic flood event hydrograph was estimated that would be significant enough to overtop the east levee on McCormack-Williamson Tract (MWT) and consequently inundate the KCRA tower area. To do this, a synthetic hydrograph was estimated which would result in a water elevation equal to 18.5 ft at Benson's Ferry. Stages at Benson's Ferry are analogous to the state at the east levee of McCormack-Williamson Tract and 18.5 ft is the lowest elevation on the eastern levee on MWT, above which flow entered historically on to the Tract by overtopping. The second step involved determining the water elevation on the MWT due to this estimated flood event with the east and southwest levees degraded according to the project alternatives. The simulated water elevation for the estimated hydrograph would give the minimum height of any protective levee around the tower to maintain protection equal to the current level.

Step One:

With flood failures on MWT occurring in 1986 and 1997, the 10-year return interval storm was selected as the starting point for inflow to the modeled system. Historical record suggests that an approximate 10-year return interval flood event occurred in 1998 with no levee failure on MWT. In the MIKE 11 modeling, the 998 flood (10-year return interval flow) was applied as inflow at Michigan Bar. The model simulation for the 1998 flow scenario did not cause any overtopping to MWT. To estimate the overtopping flow, the 1998 hydrograph flow peak at Michigan Bar was systematically increased to determine the flow necessary for the east levee to over-top. The flow was increased using the same slope of the climbing and recession limbs on the hydrograph experienced in 1998. In addition to inflow increase at Michigan Bar, the inflow was also increased at Dry Creek under the assumption that Dry Creek flows at 40% of the flow at Michigan Bar. This assumption regarding Dry Creek flow was made based on historical records spanning 2.5-100 years (Hammersmark 2003). The Dry Creek inflow was applied with a 6-hour time lag in reference to Michigan Bar, as indicated by the limited recorded data available. The process of incremental increases in flow determined that a peak flow of 60,000 cfs at Michigan Bar (27,000 cfs was required to be added to the 1998 peak flow) would cause water over-top the east levee of MWT. Figure 50 shows the 1998 flow hydrograph and the estimated hydrograph.

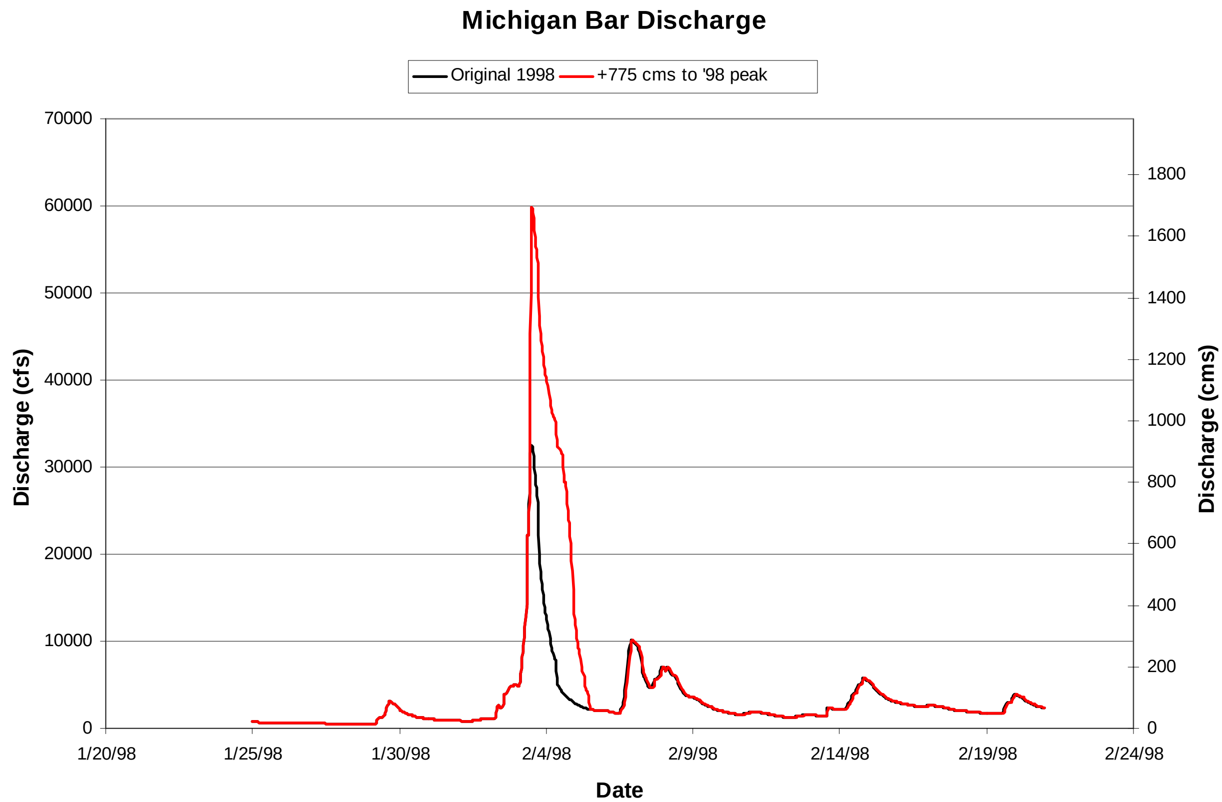


Figure 50. Original 1998 hydrograph from the Cosumnes River at Michigan Bar with a hydrograph that has 27,000 cfs added to the peak.

Step Two:

In the second step, the required levee height around the KCRA tower to provide the same level of protection as current conditions when the east and southwest levees would be degraded was determined. The same level of protection would ensure that the KCRA area would not be flooded more frequently. Two scenarios were modeled with the synthetic hydrograph found in step one. Both scenarios have the east levee of MWT lowered to +8.5ft NGVD29. In the first scenario, the southwest levee was lowered to grade at –2.5 ft NGVD29 and a 300-ft wide notch was added on the Mokelumne levee side of MWT. In the second scenario the southwest levee was lowered to +5.5ft with no notch on the Mokelumne River. The water levels simulated by the model on MWT near the KCRA tower are shown in Figure 51 for scenarios 1 and 2. The levee height required to provide the same flood protection was found to be 11.5 ft. This height would prevent flooding of the KCRA transmission area. Subsequent project descriptions were refined to include a levee around the KCRA tower with a crest of 12.5 feet NGVD29 (11.5 feet required plus an additional foot of freeboard).

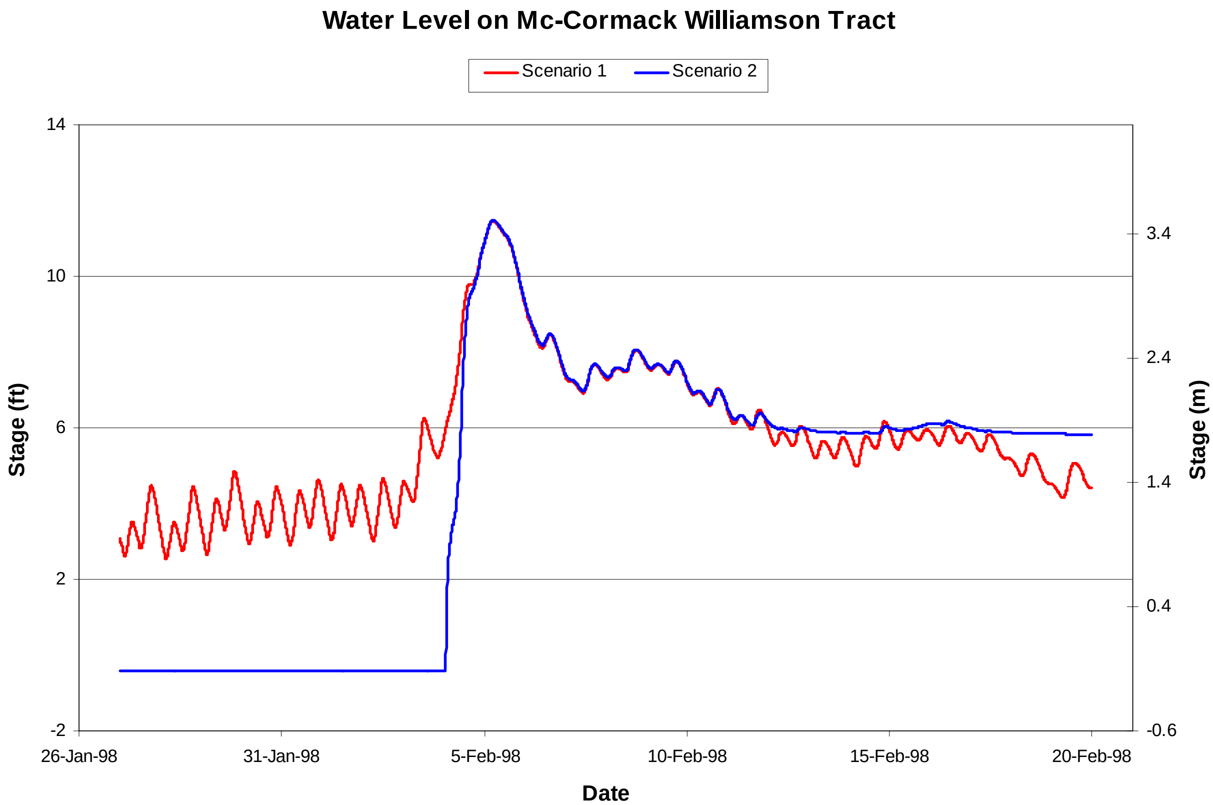


Figure 51. Water level on MWT near the KCRA tower with stages from scenario 1 and scenario 2 using the synthetic hydrographs produced in Step one.

Determination of Detention Basin Weir Heights to Satisfy Escrow Agreement Provisions on Staten Island

Flood control and ecosystem restoration planning on Staten Island must meet the requirements of the escrow agreements for the purchase of Staten Island. The provisions of the Staten escrow agreement specify that Staten Island should not be inundated more frequently than the 1:10 statistical event so that important crane populations on the island will not be impacted. A 1992 study by the US Army Corps of Engineers, "Sacramento-San Joaquin Delta California Special Study Hydrology" produced a stage frequency curve at New Hope that depicts the 10-yr flood return interval at the New Hope gage as 10 feet. Therefore, the weir height for all flood control detention basin options was set at 10 feet for the initial runs. For the East and West detention basins, the height was later adjusted to 9 feet to take into consideration the slope of the water surface in the rivers, while the North Staten detention basin weir height was 10 feet.

Sensitivity of Detention Basin Performance to Weir Height

To more accurately understand the hydrodynamics and the flood benefit potential of using Staten Island as a detention basin, the MIKE 11 model was used in simulations that vary the weir height from 10-foot down to 6-foot. The North Staten detention basin alternative was chosen as the best case to perform a sensitivity analysis with because it achieved the best stage reduction of the scenarios.

All the hydrology used in these simulations was from the 1997 event but with a controlled 'failure' mode involving degraded levees on the East and southwest levees on McCormack-Williamson Tract (MWT) rather than the levee failures experienced on MWT in the actual 1997 event.

All simulations use a scenario with the east levee on McCormack-Williamson Tract lowered to 8.5 feet, the southwest levee lowered to 8.5, and a detention basin on North Staten Island. The North Staten detention basin incorporates a weir in place of the current road between the New Hope and Miller's Ferry bridges and the levee along the north side of Staten Island between the two bridges is lowered to 6 feet.

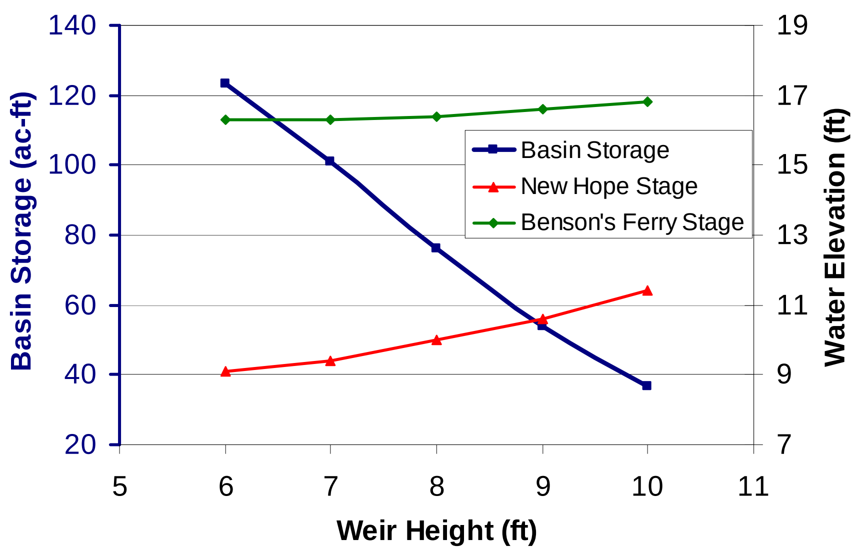


Figure 52 Basin storage and stages at New Hope and Benson's Ferry for a range of weir heights

Figure 52 shows the sensitivity results in terms of the maximum possible basin storage and stage change at Benson's Ferry and New Hope versus weir height. Peak stages for other locations in the north delta are presented in Table 9. (The index locations of points given in Table 9 are detailed in Figure 50). For comparison, Table 9 also includes simulations that represent the peak stages for the actual 1997 flood, stages for 1997 if the MWT levees had not failed, and stages for degraded east and southwest McCormack-Williamson Tract levees alone without the benefit of a detention basin (the Base Case).

According to the model results, basin storage increases substantially as the weir height is lowered. Stage benefits at New Hope are realized, but little stage reduction is experienced at Benson's Ferry and nearly nothing upstream of Benson's Ferry at Twin Cities and McConnell. Point Pleasant receives minor stage benefits primarily from the reduction in stages south of Lambert Road. The southern extremities of the system experience little or no help in stage reduction due to their proximity to the lower boundary condition, the San Joaquin River.

The 1997 hydrograph is so sharp a peak, and without any improvements to conveyance in the upper Cosumnes, little or no improvements are predicted in stages at Twin Cities Bridges or McConnell.

Table 9. Peak stages and basin storage for Degraded MWT levees with North Staten Detention applied for several weir heights

		Peak Stage (ft NGVD 29)							
		1997	No	Base	Degraded MWT Levees/North Staten Detention basin weir height				
Point	Location	Flood	Failures	Case	10-ft	9-ft	8-ft	7-ft	6-ft
BF-1	Benson's Ferry	19.2	19.9	17.4	16.8	16.6	16.4	16.3	16.3
MR-2	Mokelumne River	16.1	16.9	14.6	12.1	11.5	11.0	10.6	10.3
SG-3	Snodgrass Slough	15.0	16.3	15.4	13.9	13.4	11.1	11.0	11.0
NH-4	New Hope	14.3	14.5	14.3	11.4	10.6	10.0	9.4	9.1
SF-5	SF Mokelumne	9.6	9.7	9.7	7.9	7.5	7.2	6.9	6.8
SF-6	SF Mokelumne	7.2	8.3	7.2	6.4	6.2	6.1	6.0	5.9
SF-7	SF Mokelumne	6.7	6.8	6.7	6.2	6.0	5.9	5.9	5.9
NF-8	NF Mokelumne	13.4	13.6	13.6	11.1	10.3	9.6	8.9	8.4
NF-9	NF Mokelumne	9.9	10.0	10.1	8.4	8.0	7.6	7.2	6.9
NF-10	NF Mokelumne	7.7	7.8	7.8	6.9	6.7	6.5	6.4	6.3
MC-11	McConnell	49.8	49.8	49.8	49.7	49.7	49.7	49.7	49.7
TC-12	Twin Cities Road	25.8	25.8	25.6	25.6	25.6	25.6	25.6	25.5
LR-13	Lambert Road	15.0	16.3	15.4	13.9	13.4	11.1	11.0	11.0
PP-14	Point Pleasant	12.5	12.7	12.5	12.3	12.1	12.1	12.1	12.1
TT-15	Terminous Tract	6.5	6.5	6.5	6.0	6.0	5.9	5.9	5.8
NS-16	Conf of NF and SF	6.7	6.7	6.7	6.3	6.3	6.2	6.2	6.2
	Detention basin volume (ac-ft)				36,900	54,000	76,100	101,200	123,100

In determining the significance of the above analysis to planning decisions, it is important to consider the following:

a) Although the results indicate significant additional stage decreases at New Hope with lower weir heights, the 10' weir height achieves a stage at New Hope of 11.4' which already meets the target stage goal at New Hope of 12'.

b) Achieving a weir height lower than 10' on the Staten North detention basin (the statistical 1 in 10 year height) would necessitate an operable structure or other variable height structure such as an erodible crest weir. The additional cost of such a feature can be prohibitive. As well, operable weirs carry significant maintenance and liability concerns that would need to be addressed.

c) Although significant stage reductions are achieved at New Hope, the stage decreases at other areas are marginal with lowered weir heights, while the amount of the detention basin volume required increases greatly. Increasing the volume of the detention basin increases impacts associated with the detention basins including: crane impacts, organic carbon and water quality impacts, fish stranding, seepage, internal erosion, farm operation impacts, reclamation costs, vector control, country road and access. For greater volumes, whole or near-whole island detention would be required which would necessitate the greatest length of internal erosion control on interior levees, protective levees for the farm infrastructure and would require the largest volume to be pumped with the least help from gravity flow because the basin footprint would need to expand further south on the island where the land surface elevations become increasingly lower.

In light of the above considerations, the alternatives including detention basins that were taken forward for impact analysis included: a 10' weir for the North Staten detention basin and 9' weir for each of the East and West Staten Island detention basins which corresponds to the one in ten year statistical elevation at the locations of the East and West Staten Island weirs.

Modeling to Determine Sensitivity to Setback Levee Width

A model sensitivity analysis was done to determine how sensitive the operation of the Staten Island detention basins are to the width of the setback levee along the Mokelumne River upstream of the detention basin inlet weir. Table 10 shows the results for the West Staten detention basin with a 250-ft and 125-ft wide setback levee for the 1986 hydrology. The results show minimal stage difference at the model index points between the 125-foot setback and 250-ft setback results. Design-level considerations and more detailed modeling will help determine the optimal setback levee width. The East and West detention basin alternatives put forth in the EIR have a setback levee width range of from 125-500 feet.

Modeling to Determine the Effectiveness of Dead Horse Island for Flood Control

Early HEC-RAS modeling results did not show much effect to flood control from opening up Dead Horse island to flood flow. Some MIKE11 modeling runs were performed to see if degrading Dead Horse Island levees and allow flood flow through Dead Horse Island may be effective at lowering stages in combination with Staten Island detention. The modeling results are shown below in Table 11. The column labeled "West Staten Detention without DHI" presents results for the West Staten Island detention scenario in coordination with degraded Dead Horse Island levees. The results indicate that localized stage drops in the vicinity of Dead Horse at New Hope and at Snodgrass Slough can be achieved. These model runs were performed with the 1997 hydrology with degraded McCormack-Williamson Tract levees in coordination with West Staten detention. These model results were taken into consideration along with the potential cost of degrading Dead Horse Island, Dead Horse Island's potential for integrated ecosystem restoration, and the fact that the Island is in private ownership. Dead Horse Island actions were not taken forward in the EIR; however, it has been recommended that future flood control and ecosystem restoration actions on Dead Horse Island be considered if the potential future habitat at the southern tip of the McCormack-Williamson Tract in tidal conditions, which serves as a good indicator of the potential quality of Dead Horse Island habitat, proves to be successful (see further discussion regarding this in the preceding section on Post-Scoping Ecosystem Restoration developments).

Table 10. 1986 Peak Stages for Staten Detention Basins with 250-ft and 125-ft Levee Setbacks

Index Point	Location	Peak Stage (ft NGVD 29) 1986 Flood	1986 No Failures	Degraded MWT Levees Base Case	Degraded MWT Levees With Flood Option: West Staten Detention	West Staten Detention w/ narrow levee3
BF-1	Benson's Ferry	17.8	18.8	16.3	15.8	15.8
MR-2	Mokelumne River	14.4	15.6	13.6	12.5	12.6
SG-3	Snodgrass Slough	12.9	15.0	14.3	13.4	13.5
NH-4	New Hope	12.5	13.3	13.3	12.1	12.2
SF-5	SF Mokelumne	8.7	9.4	9.3	8.7	8.8
SF-6	SF Mokelumne	7.2	7.6	7.6	7.3	7.3
SF-7	SF Mokelumne	6.9	7.3	7.3	7.1	7.1
NF-8	NF Mokelumne	11.3	12.5	12.7	11.2	11.4
NF-9	NF Mokelumne	8.4	9.6	9.7	8.8	8.7
NF-10	NF Mokelumne	6.9	7.9	7.9	7.5	7.5
MC-11	McConnell	46.3	46.3	46.3	46.2	46.3
TC-12	Twin Cities Road	24.9	24.9	24.7	24.6	24.6
LR-13	Lambert Road	12.9	15.0	14.3	13.4	13.5
PP-14	Point Pleasant	13.5	13.9	13.5	13.4	13.4
TT-15	Terminous Tract	6.8	7.1	7.2	7.0	7.0
NS-16	Conf of NF and SF	6.8	7.2	7.2	7.0	7.0
	Detention basin volume (ac-ft)				35,600[1]	32,900[2]

[1] 9-foot high weir
[2] levee setback was changed from 250-ft to 125-ft

Table 11. Staten Detention Basin Effectiveness with and without DHI- 1997 Flood Event

Index Point	Location	Peak Stage (ft NGVD 29) 1997 Flood	1997 No Failures	Degraded MTW Levees Base Case	Degraded MTW Levees With Flood Option: West Staten Detention	West Staten Detention w/o DHI
BF-1	Benson's Ferry	19.2	19.9	17.4	17.2	17.2
MR-2	Mokelumne River	16.1	16.9	14.6	13.3	12.9
SG-3	Snodgrass Slough	15.0	16.3	15.4	14.4	14
NH-4	New Hope	14.3	14.5	14.3	12.7	12.2
SF-5	SF Mokelumne	9.6	9.7	9.7	8.7	8.4
SF-6	SF Mokelumne	7.2	8.3	7.2	6.7	6.6
SF-7	SF Mokelumne	6.7	6.8	6.7	6.4	6.3
NF-8	NF Mokelumne	13.4	13.6	13.6	11.5	11.6
NF-9	NF Mokelumne	9.9	10.0	10.1	8.8	8.8
NF-10	NF Mokelumne	7.7	7.8	7.8	7.1	7.1
MC-11	McConnell	49.8	49.8	49.8	49.7	49.7
TC-12	Twin Cities Road	25.8	25.8	25.6	25.6	25.6
LR-13	Lambert Road	15.0	16.3	15.4	14.4	14
PP-14	Point Pleasant	12.5	12.7	12.5	12.4	12.3
T-15	Terminous Tract	6.5	6.5	6.5	6.2	6.1
NS-16	Conf of NF and SF	6.7	6.7	6.7	6.4	6.4
	Detention basin volume (ac-ft)				24,800[1]	27,061

[1] 9-foot high weir

Post Scoping Ecosystem Restoration Alternatives Development

Ecosystem restoration concepts that were presented at the Public scoping sessions were very general and not as well developed as the general flood control concepts. In addition, it was acknowledged that ecosystem restoration and flood control needed to be integrated through an iterative process to achieve the best scenarios to support both flood control and ecosystem restoration goals. In recognition of the points, DWR convened a group of Agency and nonprofit scientists, the Ecological Restoration Coordination Team (ERCT), to further develop ecosystem restoration scenarios for North Delta. As well, DWR arranged for Science panel review of project alternative concepts. The science panel was formed to provide an advisory role regarding the science issues concerning potential alternatives and was not intended to directly influence planning or policy decisions made by DWR and other project proponents. The integrated flood control and ecosystem restoration scenarios were then developed through an iterative process among the science panel, the ERCT, and other stakeholder groups such as the North Delta Improvements Group.

The ERCT consisted of representatives from the State Department of Fish and Game, U.S. Fish and Wildlife Service, NOAA Fisheries, The Nature Conservancy and the California Bay-Delta Authority. The following section describes the results of the Team's initial ecological brainstorming meetings. These ideas were incorporated in an iterative fashion into alternatives that also addressed flood control goals and were subjected to the science panel for feedback.

<u>Initial ERCT Restoration Concepts</u>

Dixon Property (Riparian Channels Reconnecting the Floodplain):

To facilitate floodplain restoration on the northern section of McCormack-Williamson Tract, a Mokelumne River side channel through the DWR-owned Dixon property east of McCormack-Williamson Tract was proposed (Figures 53 & 54). This concept was named "the big carve." The weir height would be sized to only allow water onto the property above low mean tide (or higher). The elevations would be tapered to increase towards Lost Slough. There would be a levee to protect the privately-owned property to the east.

An inverse channel through the Dixon property was considered. This would be an elevated area in the center of the Dixon property with various peninsulas. The land would decrease in elevation towards the Mokelumne River to prevent fish stranding (Figures 55 &56).

McCormack-Williamson Tract:

The northern section of McCormack-Williamson Tract could be floodplain. It would be important that the floodplain drain completely by late spring (no perennial water). The northern floodplain could support anastomosing channels (Figure 57). Although scour ponds that would strand floodplain fish should be avoided, some topographic variation would facilitate sediment deposition on the floodplain. Riparian forest might develop on the floodplain.

A dendritic intertidal wetlands scenario was discussed for the central portion of the Tract (Figure 58). These would form naturally over time after opening the Tract to tidal influence. There is a certain amount of scientific uncertainty as to how exactly they would develop, but these wetlands would be monitored over time to study these processes.

Several options were presented for the southern portion of the Tract. Self-regulating tide gates could be installed to control tidal pumping and create a microtidal wetland. Alternatively, the southern portion of the Tract could be leveed off and isolated from tidal influence (Figure 59). Another option would be to establish a tule marsh in the southern portion of the Tract, open the area to tidal influence, and allow the tules to enhance sediment accretion and minimize submerged aquatic vegetation (by the density of tules preventing SAV from establishment).

In another option, several ecological restoration ideas were combined, adding interior islands to break up wind-wave fetch and to provide riparian habitat. The backside of the east levee would be reinforced to prevent erosion, and wildlife-friendly (low slope) levees would be placed around the interior of the Tract to provide habitat and prevent erosion (Figure 60). The wildlife-friendly levees are incorporated in the project design to increase riparian habitat, provide erosion control and reduce potential maintenance costs to the levees. However, the restoration designs are not dependent upon the entire extent of the levee being reinforced with lower slope wildlife-friendly levees. To the extent levees are reinforced with wildlife-friendly levees, maintenance costs will decrease.

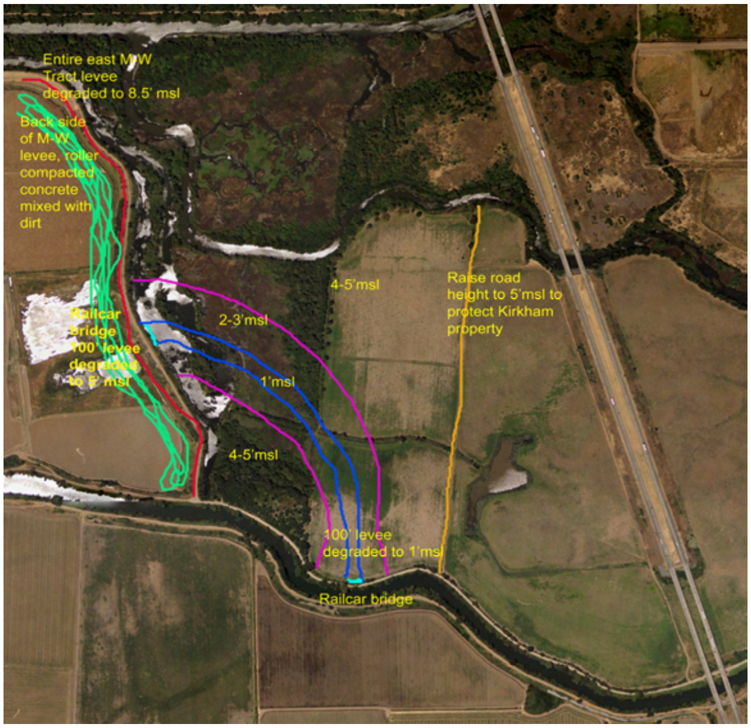


Figure 53: Dixon Property side channel concept (1)

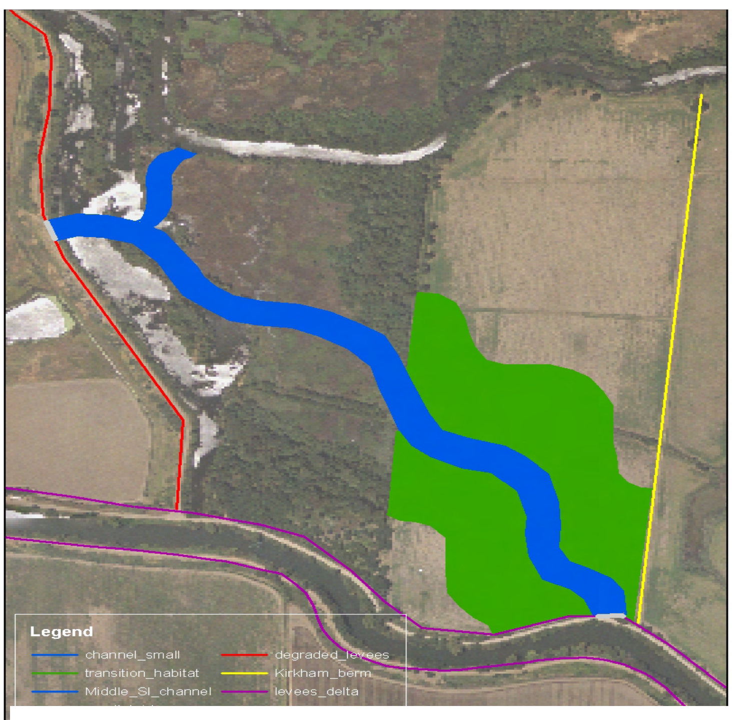


Figure 54: Dixon Property side channel concept (2)

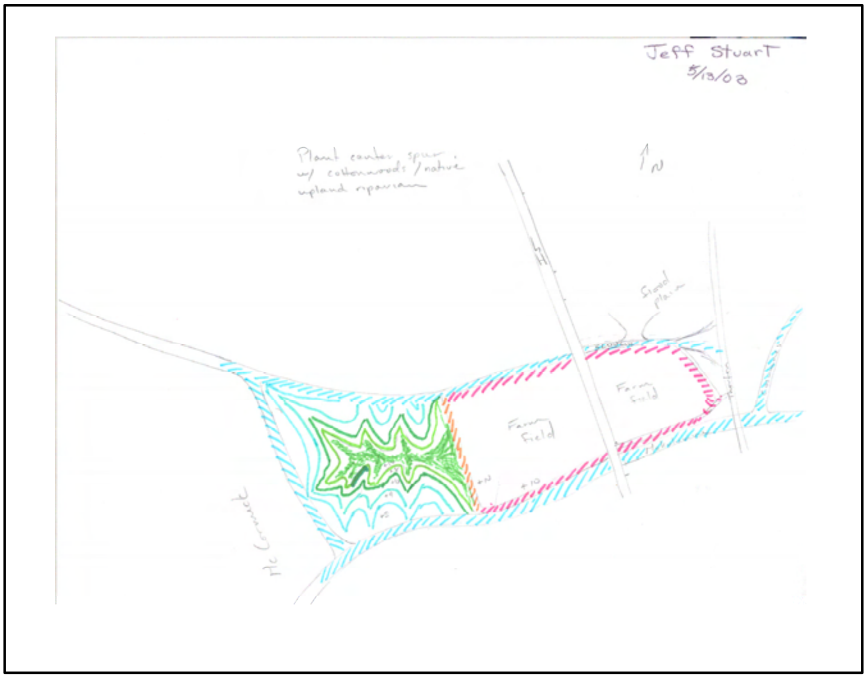


Figure 55: Dixon Property inverse channel concept (plan view)

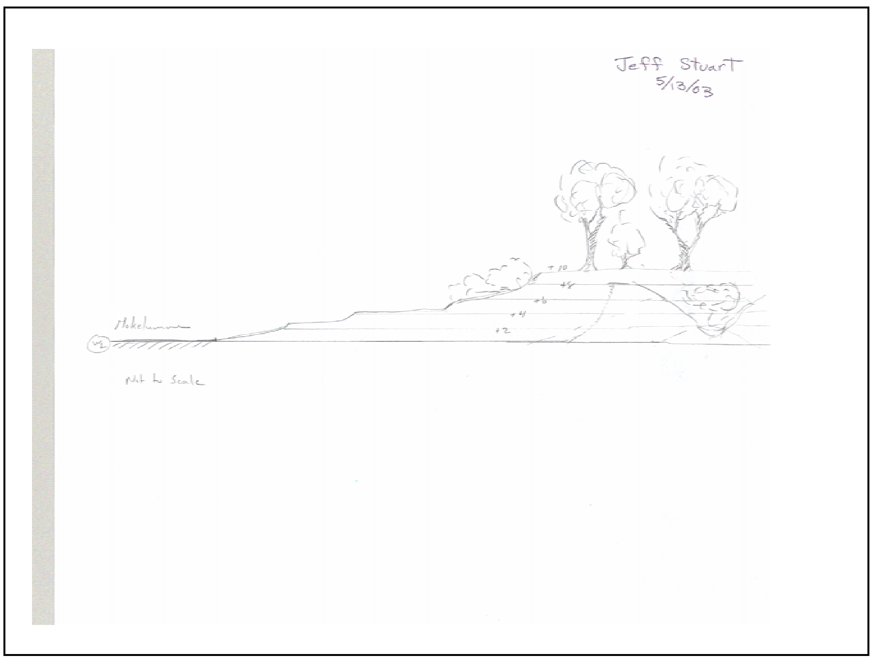


Figure 56: Dixon Property inverse channel concept (cross-section)

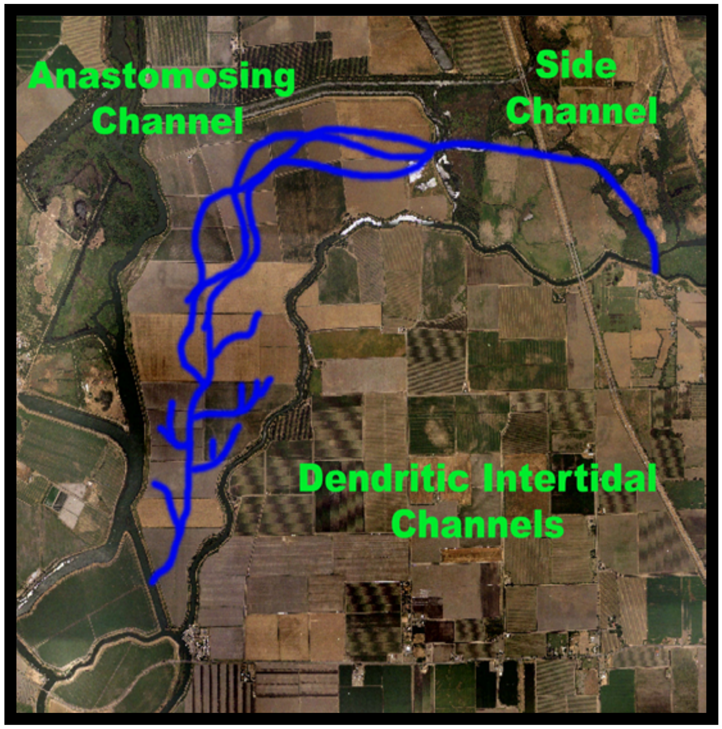


Figure 57: Anastomosing channel concept

Figure 58: Dendritic intertidal channels concept

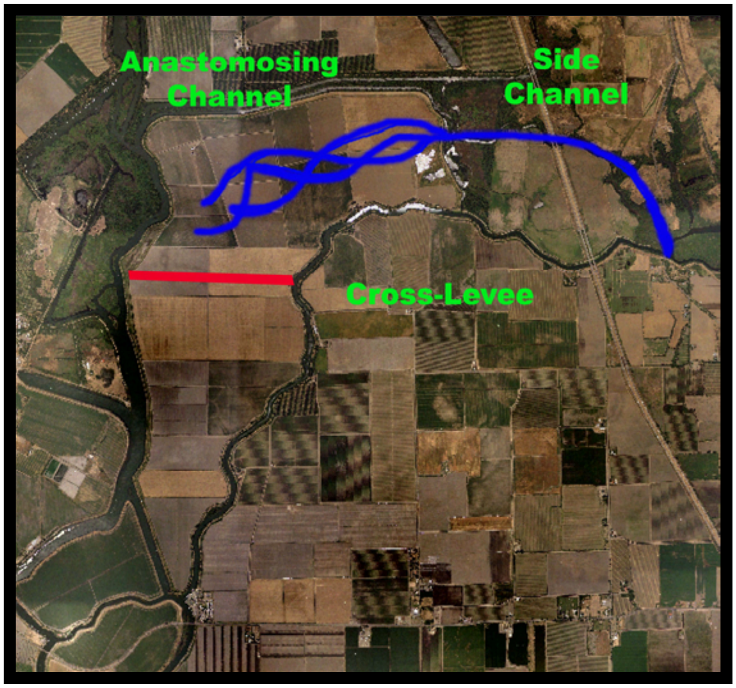


Figure 59: Anastomosing channel with cross levee concept

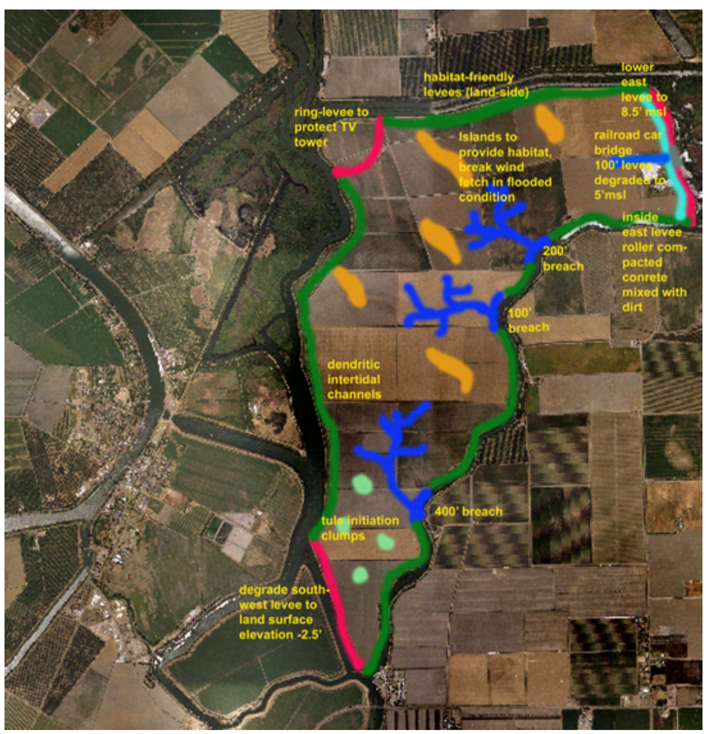


Figure 60: McCormack-Williamson Tract ecological restoration concept

Another concept put forth by the ERCT was setback levees along the Mokelumne River. It was acknowledged that setback levees could allow for levee benches and associated riparian and shaded riverine aquatic habitat. Levee setbacks accentuating bends and allowing the new setback area to become the channel thalweg might preserve channel energy and discourage exotics. In other areas bedload sediment might be deposited. Any subsequent dredging might provide material for restoration. The comparative benefits of restoring the North versus the South Fork of the Mokelumne were discussed. The North Fork has faster flows and less available habitat. Levee setbacks would increase channel complexity and habitat types and provide opportunities for erosion and sedimentation. The South Fork Mokelumne has much great habitat already available, but perhaps too slow flows (too much sedimentation) resulting in favorable conditions for exotic species. Levee setbacks on the South Fork Mokelumne could connect to existing habitat. Opportunities to increase flow on the South Fork Mokelumne might improve conditions for native fish.

Ecological Restoration at Other Islands/Tracts

There was desire to broaden the ecological restoration to Tracts adjacent to McCormack-Williamson Tract and Staten Island. The possibility of applying the setback concept to New Hope Tract levees was considered but set aside because the landowner is unwilling and because there is opportunity on the adjacent non-privately owned McCormack-Williamson Tract with a willing landowner that would address the same constriction area. The concept of including detention or floodplain scenarios on other area Tracts was discussed, but was set aside because of the CALFED process mandate and stakeholder input to focus flood control and ecosystem restoration efforts on non-publicly owned properties. It was acknowledged that the ecological footprint of any detention facility should be minimized to minimize the effects to cranes.

Science Panel Review Meeting # 1

On November 13, 2003, DWR convened a panel to evaluate the ecological restoration conceptual ideas for the project formulated by the ERCT. The panel members were chosen in coordination with and with final approval of the CALFED Science Program. The Panel members represented the following disciplines:

Topic	Scientist	Affiliation	Expertise
Geomorphology	Jeff Mount	UCD	Fluvial processes,restoration
	Joan Florsheim	UCD	Fluvial and tidal processes, restoration
	Denise Reed	LSU and ERP ISB	Tidal processes, restoration
Hydrology and Hydraulic Modeling	Geoff Schladow	UCD	
	Bill Fleenor	UCD	
	Jon Burau	USGS	
Fish/Aquatic Biology	Peter Moyle	UCD and ERP ISB	Bay Delta Fish Biology
	Bill Bennett	UCD	Delta smelt

Ecology and Exotics	Dennis Murphy	UNevada and ERP ISB	Terrestrial Ecology
	Lars Anderson	UC Davis	Aquatic Ecology
Water Quality	Randy Dahlgren	UCD	Nutrients
	Roger Fujii	USGS	Organic carbon
Mercury	Mark Marvin DiPasquale	USGS	

The conceptual ecosystem alternatives presented to the Science Panel are outlined in the previous section. The following summary provides the advisory comments provided by the panel regarding these initial concepts developed by the ERCT.

The Science Panel thought that creating a channel through the property to the east of McCormack-Williamson Tract, or DWR-owned Dixon property, was probably not necessary to facilitate flooding in the area. The potential habitat associated with the channel at times other than winter flooding may have limited biological value and it was likely that with the cessation of farming, quality habitat would develop on its own without the channel.

The Science Panel recommended exploring more restoration alternatives for McCormack-Williamson Tract. In addition to the combination floodplain/dendritic intertidal wetlands restoration option, the Panel recommended investigating floodplain only restoration and dendritic intertidal wetlands only restoration.

The panel suggested that floodplain restoration only options could include degrading the east levee to 8.5' msl and, in addition to lowering the east levee, creating notches along the Mokelumne River (Figures 61 and 62). The Panel felt that islands intended to break up wind-wave fetch during flooding included in the ERCT concepts were not necessary and would require too much material (soil) to construct. In addition, the Panel felt that it was likely that riparian forest would develop in the northern portion of McCormack-Williamson Tract if it were flooded on a regular (such as annual or biannual) basis. Wildlife-friendly levees are included around most of the interior of the Tract to provide erosion control and additional habitat. The panel suggested they not be included in the southern portion of the Tract where a high water table may make construction infeasible. As discussed earlier, although not an essential component of the project, wildlife-friendly levees should reduce long-term levee maintenance costs.

For the option with notches along the Mokelumne River, the Panel felt that these notches should be high in the system (to the North of the M-W Tract) such that their purpose would be primarily to capture flood flows and not to introduce tidal water onto the Tract (Figure 62). As such, the notches would be degraded only to 5.5' msl (not to sea level which would allow tidal influx). The notches might lose their efficiency after a few years (as was experienced in the Cosumnes system) because sediment tends to deposit near the notches. Therefore, a suggested adaptive management option is to move the notches perhaps every 5 years or so depending upon flooding frequency when they lose their efficiency.

A new ecological concept introduced by the Science Panel was to actually divert the Mokelumne River into McCormack-Williamson Tract. This would provide channel habitat and allow the channel to meander as it did historically (Figure 63). The Panel emphasized that according to recent CALFED-funded studies McCormack-Williamson Tract was historically dominated by riverine not tidal processes. Flow down the existing Mokelumne River could be moderated perhaps with a rock berm dam to encourage flow onto the Tract (some water would have to remain in the existing channel for agricultural use).

Regarding restoration of dendritic intertidal channels, the Panel felt that most of the tidal influence would originate from the southwest opening of the island and not from breaches along the Mokelumne River (as long as the southwest levee was degraded below low tide level). Dendritic intertidal wetlands restoration scenarios would involve degrading the southwest levee of the Tract, as shown in Figure 64, or alternatively isolating the southern portion of McCormack-Williamson Tract by constructing a levee and then creating breaches to initiate dendritic intertidal habitat formation. Another scenario, shown in Figure 65, could create dendritic channels through notches and could be combined withisolating the southern portion of McCormack-Williamson Tract to provide an opportunity for a self-contained subsidence reversal demonstration project wetland.

In addition to the floodplain only and tidal wetlands only restoration options for McCormack-Williamson Tract, the Panel supported investigating hybrid floodplain/tidal wetland restoration options. Figures 66 through 69 show floodplain/wetland hybrids as well as avulsed channel/wetlands restoration alternatives.

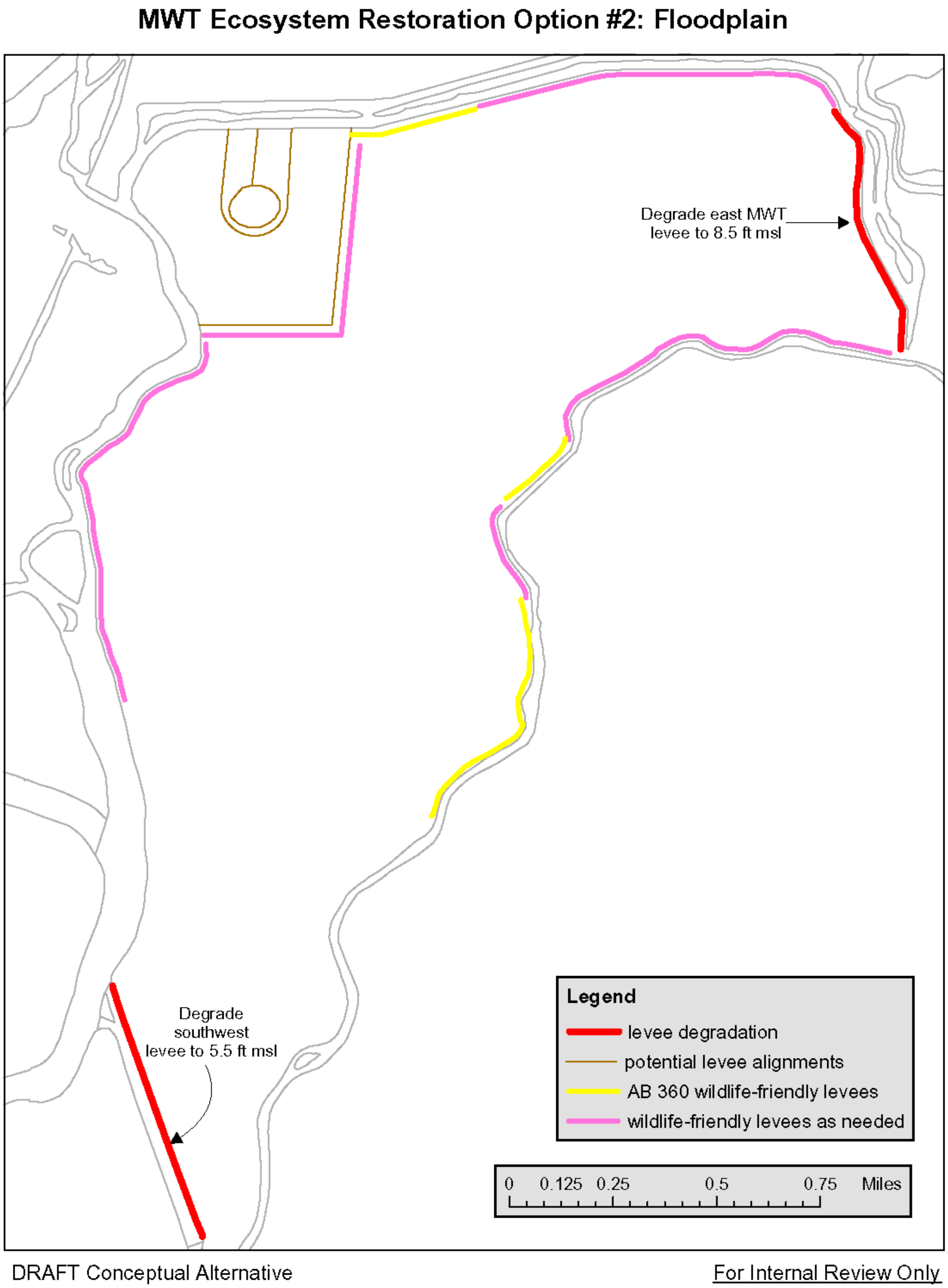


Figure 61: Floodplain restoration concept on McCormack-Williamson Tract

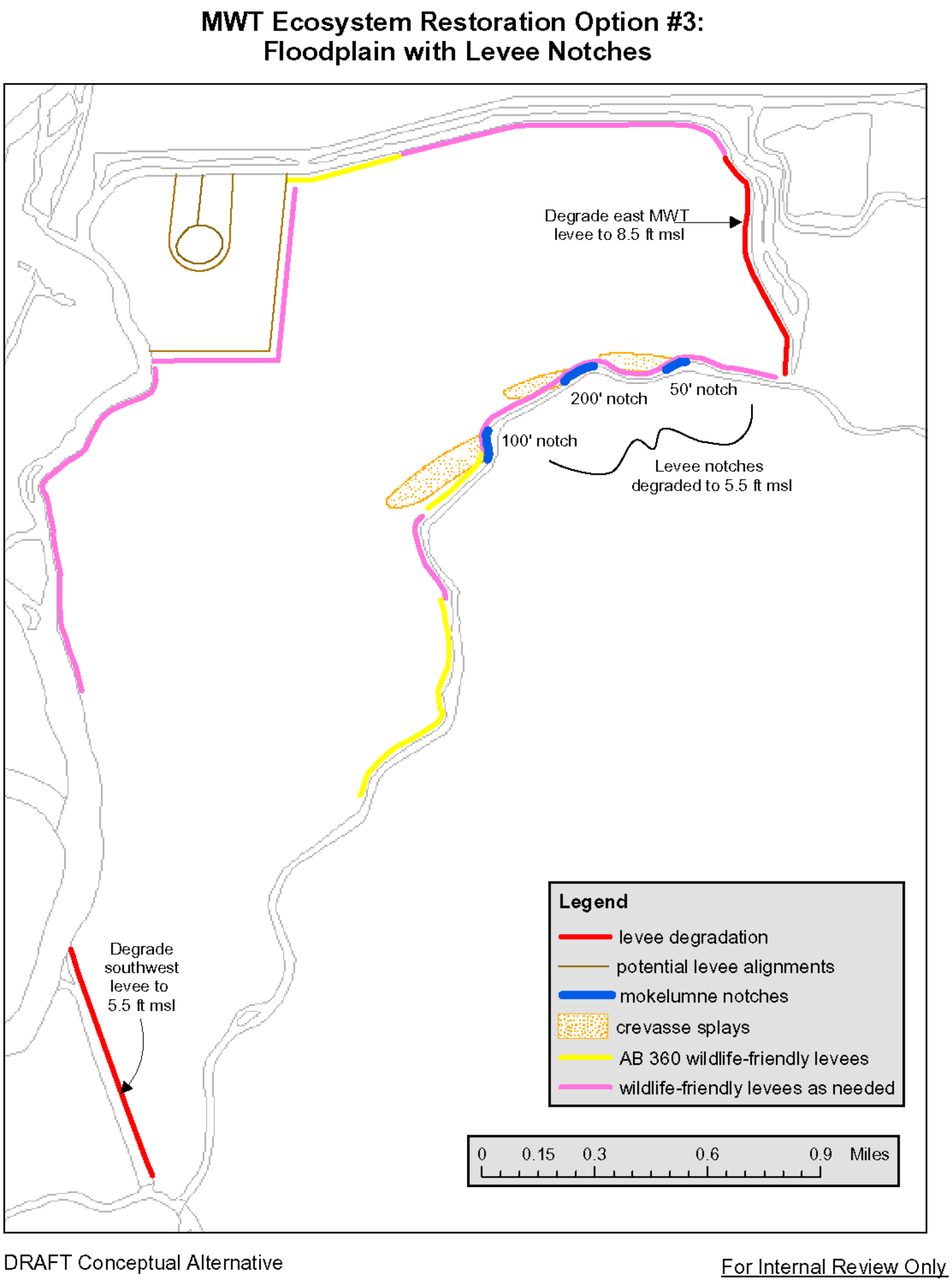


Figure 62: Floodplain with levee notches restoration concept on McCormack-Williamson Tract

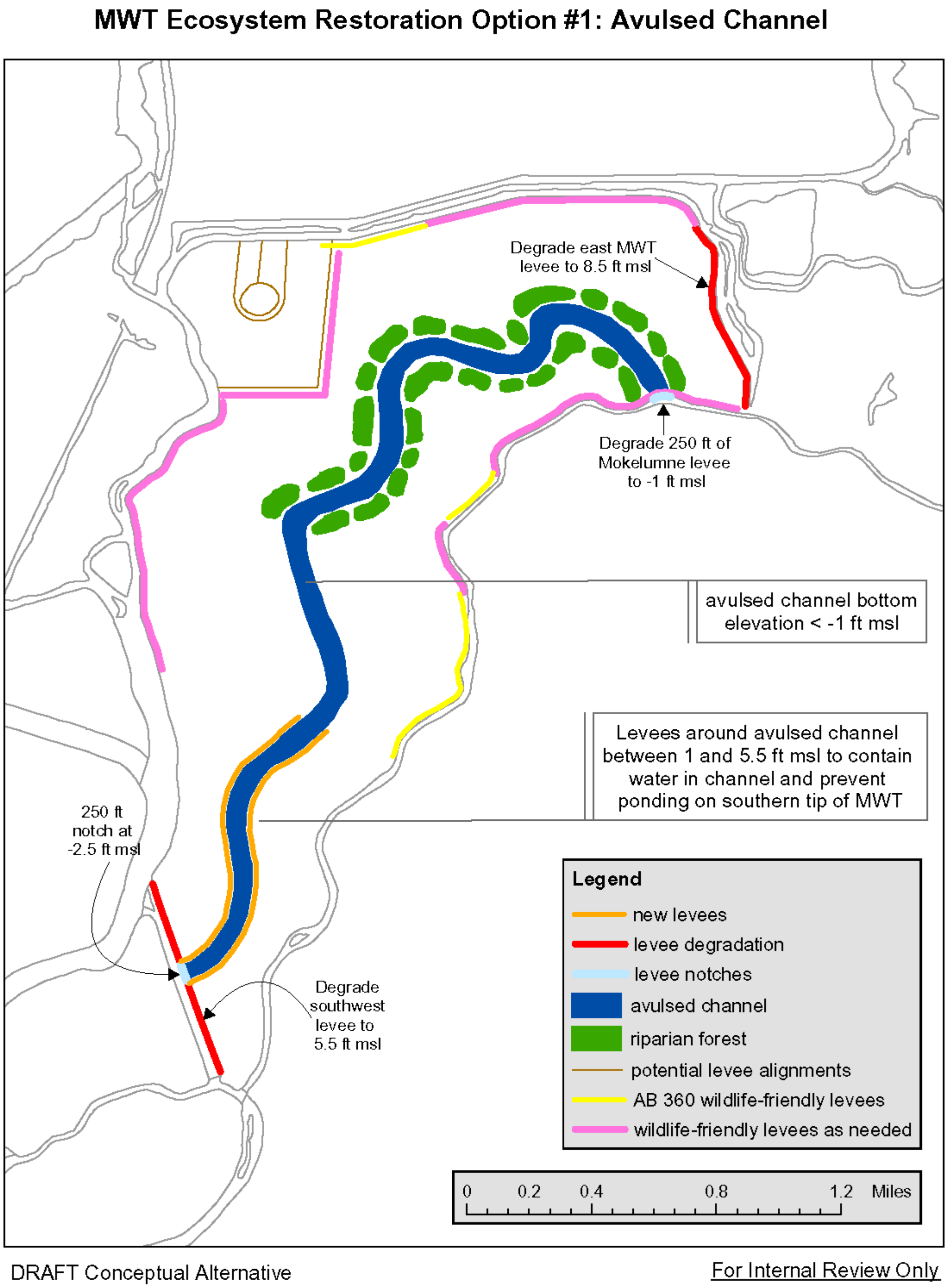


Figure 63: Avulsed channel restoration concept on McCormack-Williamson Tract

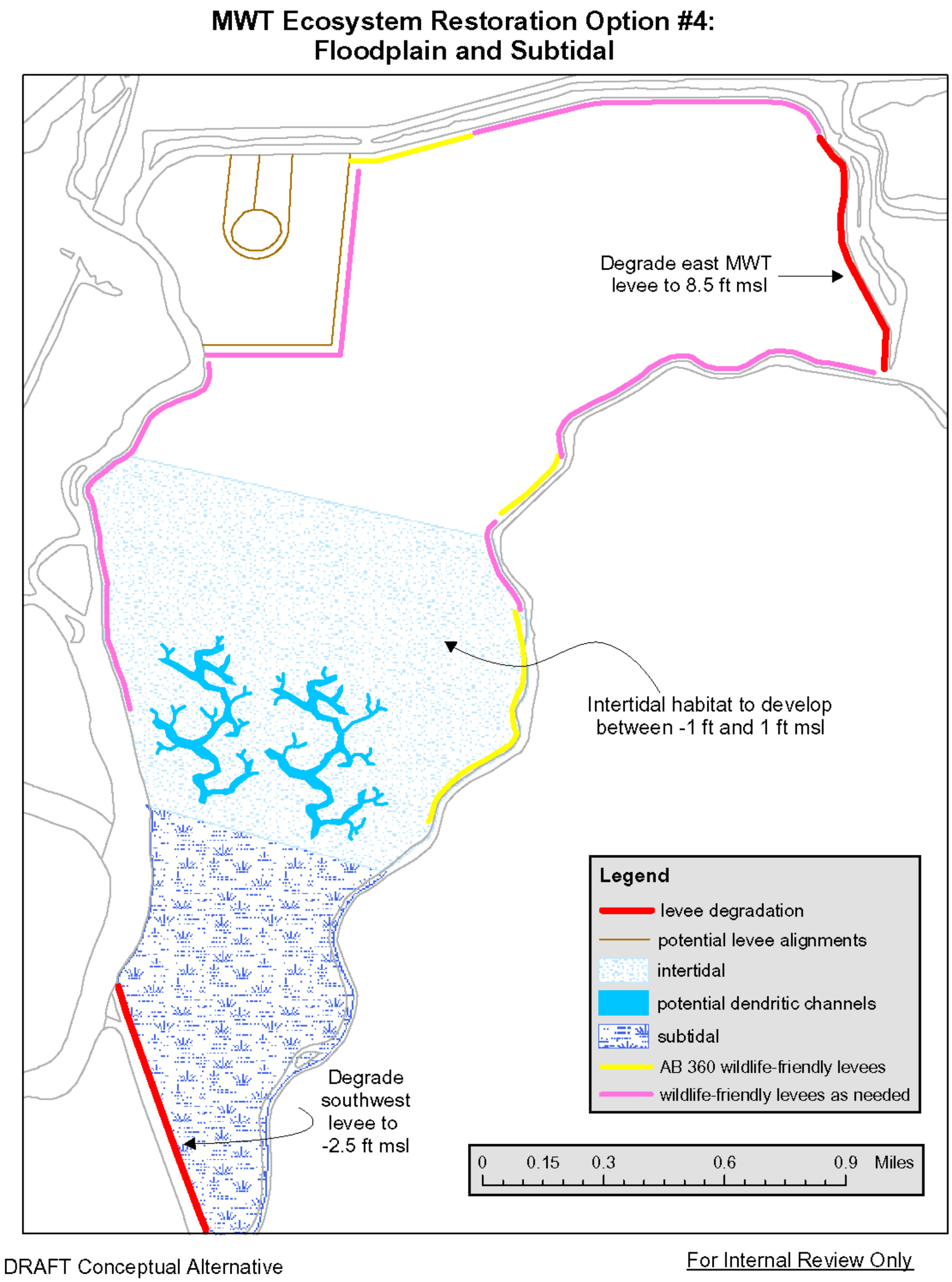


Figure 64: Floodplain and subtidal restoration concept on McCormack-Williamson Tract

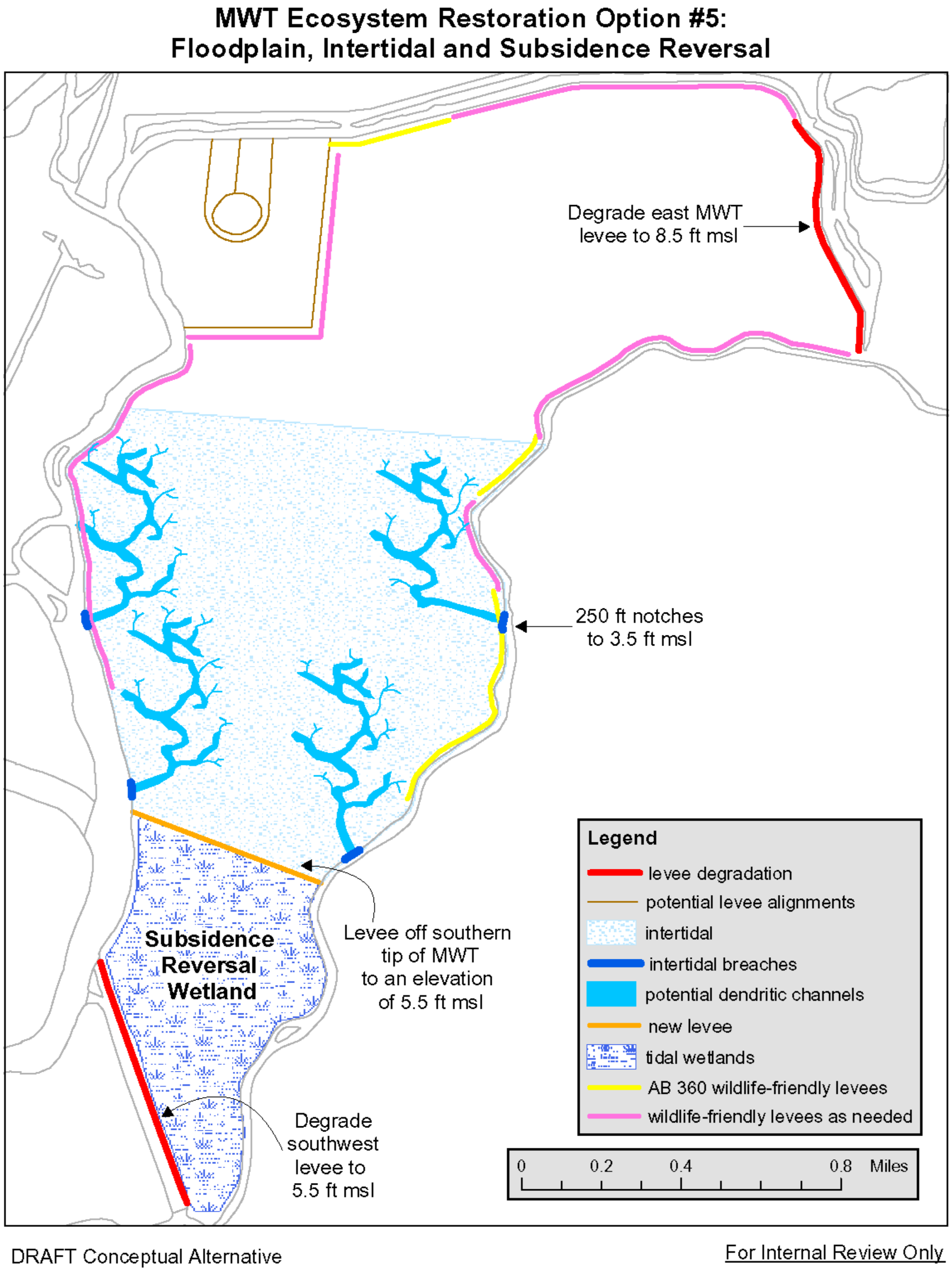


Figure 65: Floodplain, intertidal and subsidence reversal restoration concept on McCormack-Williamson Tract

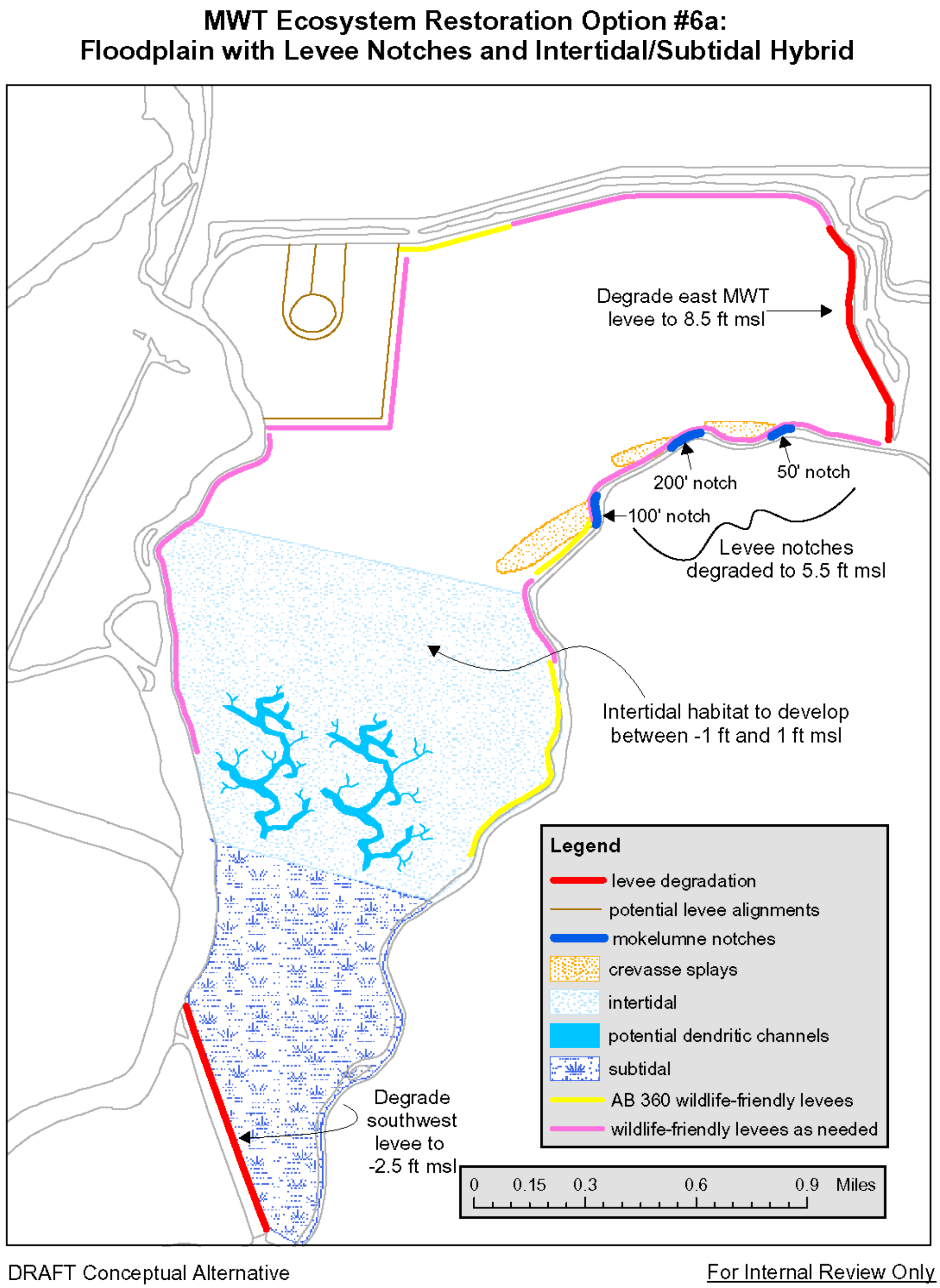


Figure 66: Floodplain with levee notches and intertidal/subtidal hybrid restoration concept on McCormack-Williamson Tract

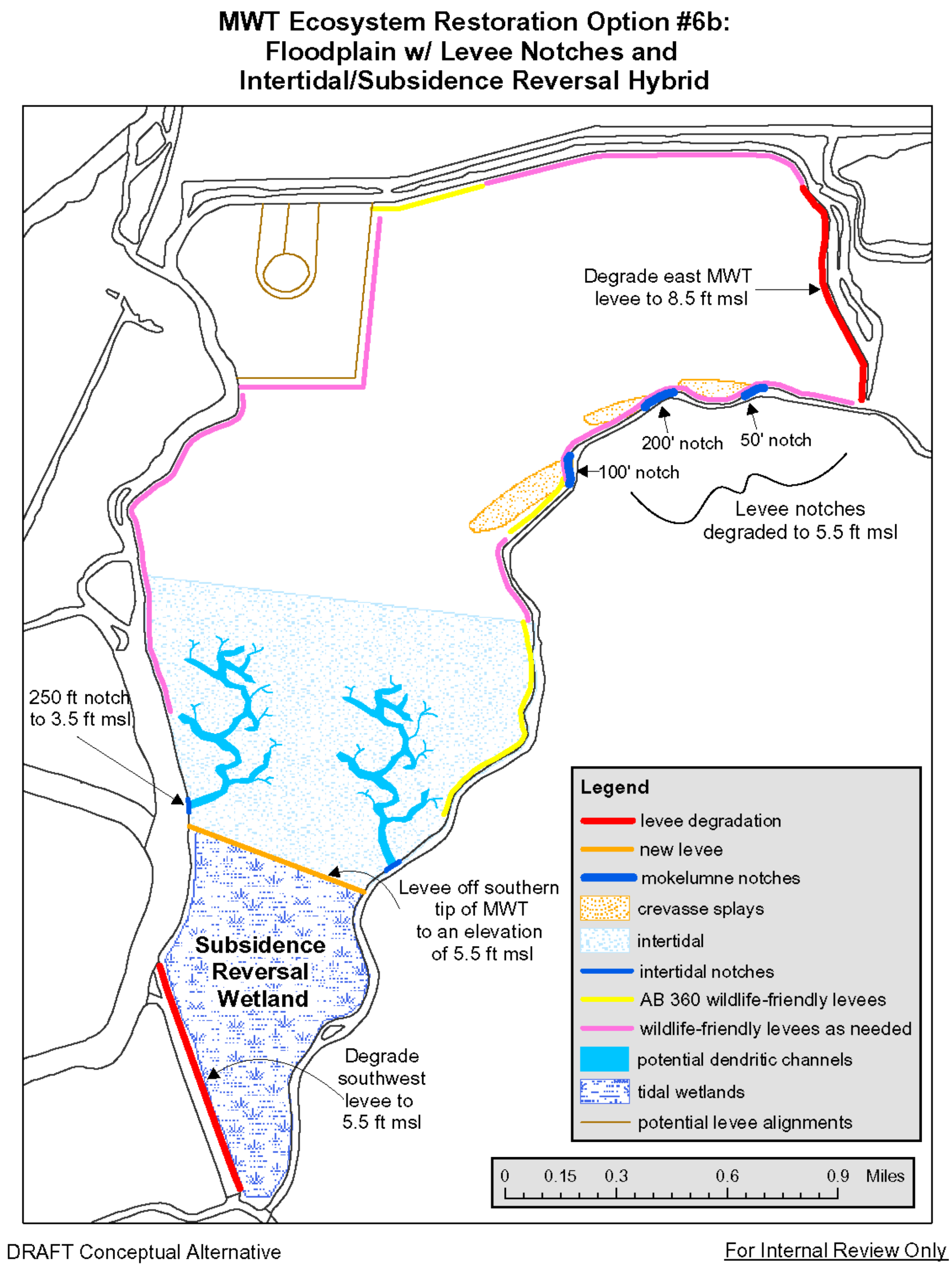


Figure 67: Floodplain with levee notches and intertidal/subsidence reversal restoration concept on McCormack-Williamson Tract

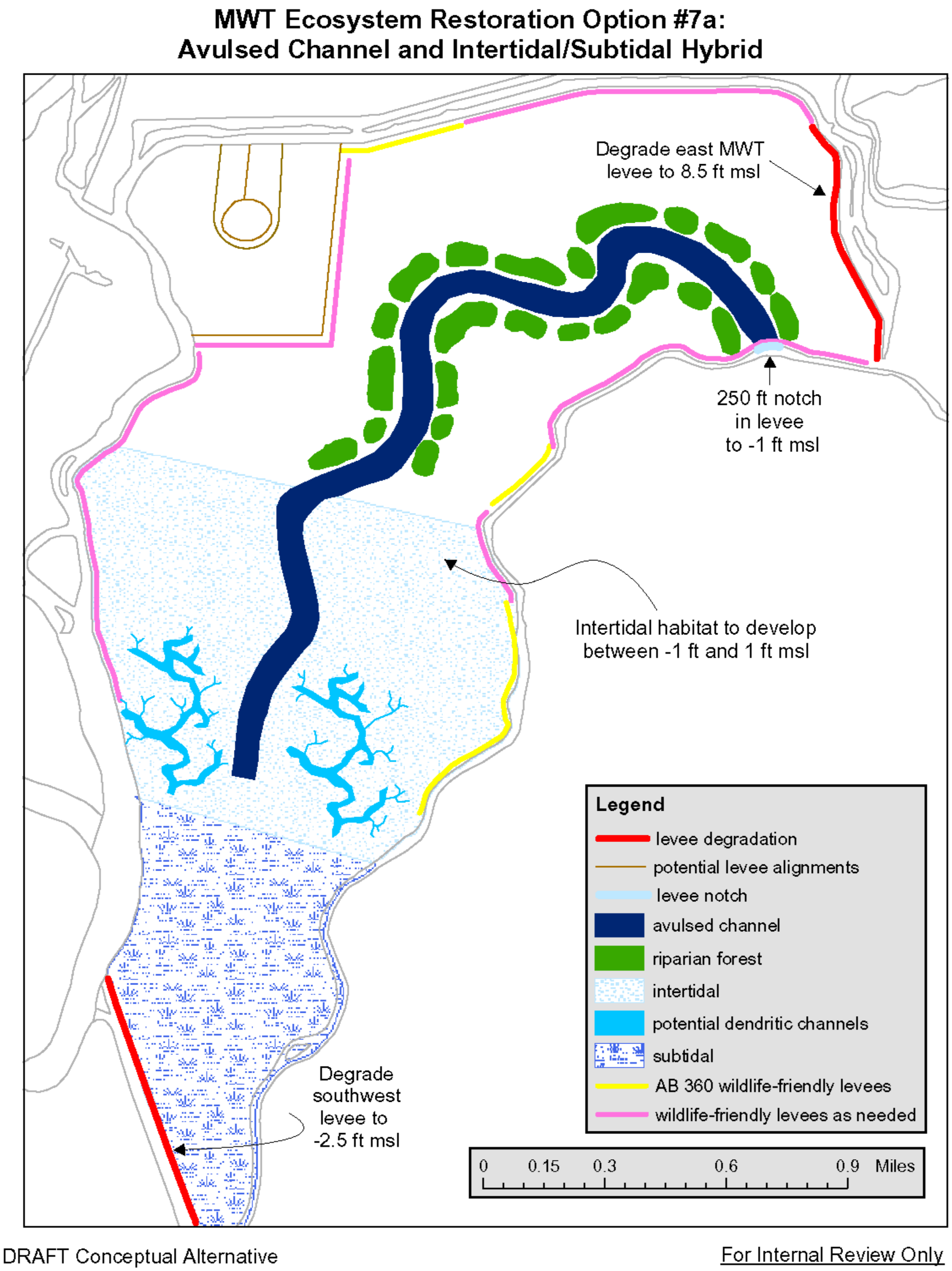


Figure 68: Avulsed channel and intertidal/subtidal hybrid restoration concept on McCormack-Williamson Tract

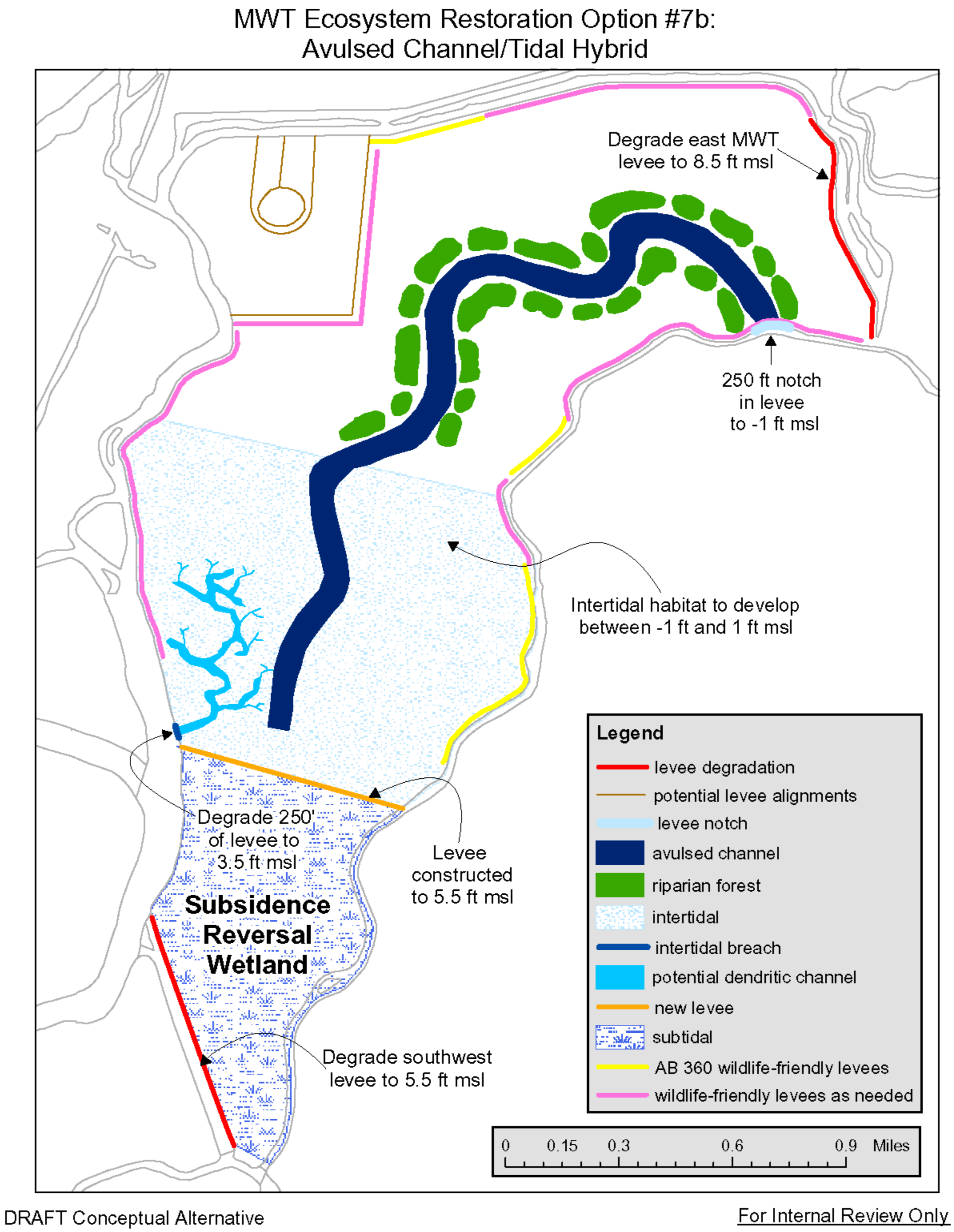


Figure 69: Avulsed channel and intertidal/subsidence reversal restoration concept on McCormack-Williamson Tract

Panel members noted they recognized the projects' potential to be a national signature program. Other feedback from the Science Panel included the fact that the Science Panel identified exotics and methylmercury as the two most important scientific uncertainties for this project. They emphasized the importance of sustainability of the project. They also advocated using a matrix to evaluate the benefits/costs of different project alternatives.

It was agreed that a subsequent panel meeting would evaluate: refined ecosystem restoration concepts including Mike11 hydraulic modeling results for the concepts; a look at "book end" scenarios or optimal ecosystem restoration scenarios without regard for flood control concerns and vice versa; and a matrix of evaluation criteria for the alternatives.

Ecological Restoration Coordination Team Alternatives Refinement

The Ecological Restoration Coordination Team revised the project ecosystem restoration concepts considering science panel input. As well, the Team formulated "bookend" scenarios as requested by the Science Panel; the purpose of identifying "bookends" was to assist the project team in "thinking outside the box" and make clear any compromises being made in the integrated flood control and ecosystem restoration scenarios. Revised concepts and bookends are discussed in the next section on Science Panel #2.

Science Panel Review Meeting #2

The second science panel meeting was held April 2004 at the University of California, Davis. The goals of the second North Delta Science Panel meeting were to: 1) review "book end" alternatives for the Project that optimized ecosystem restoration separately from flood control and vice versa; 2) review results of modeling efforts by UC Davis that evaluated Project alternatives revised with input from prior science panel advisement; and 3) to identify overarching questions and remaining uncertainties, and to propose adaptive assessment and management actions.

The first goal stated above was based on the November 03 Science Panel recommendation that the project consider ecological restoration without regard to flood control needs and the converse (flood control needs without regard to ecological restoration). There was concern that ecological alternatives were being compromised by flood goals.

At February 2004 ecological coordination team meeting maximum flood control and maximum ecological restoration scenarios were developed. There are multiple maximum ecological restoration scenarios because these scenarios vary depending upon the species or ecological process that is being maximized. In other words, a scenario that maximizes cranes benefits would not necessarily maximize fish benefits. The six maximum ecological scenarios include maximizing the following: fluvial processes, tidal processes, riparian habitat, riparian/channel habitat, sandhill crane habitat and fish/aquatic habitat.

Maximum flood control scenarios were also brainstormed with no consideration for cost or political feasibility, as assigned by the Science Panel.

Maximum Ecosystem Restoration Scenarios

The maximum ecological alternative shown in Figure 70 is targeted at fluvial processes. Emphasizing fluvial processes, the entire east McCormack levee would be degraded. The Mokelumne River would be free to meander into the Tract. Based on elevation, shallow open water and tidal wetlands may occupy much of the Tract.

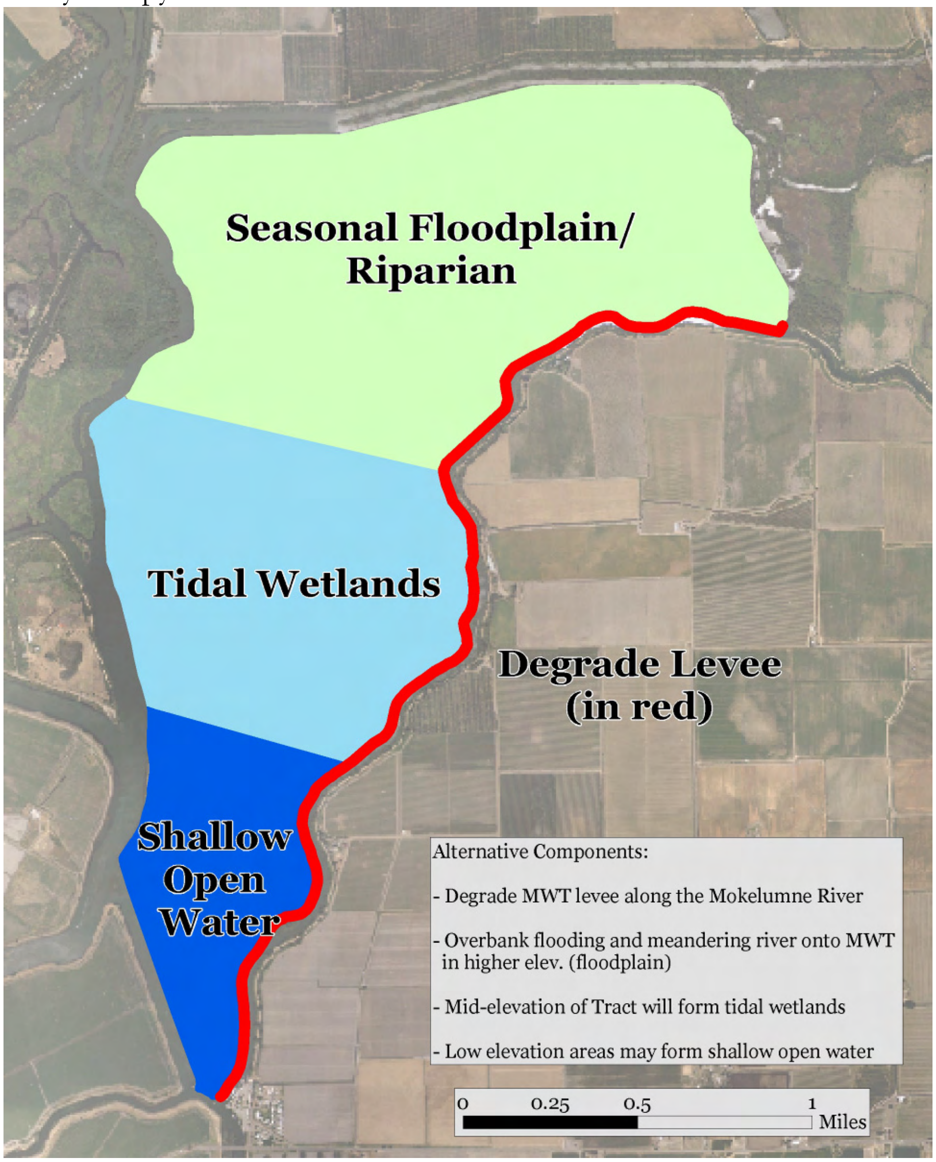


Figure 70: Maximum fluvial processes for McCormack-Williamson Tract

The maximum ecological alternative shown in Figure 71 is targeted at tidal processes. The levees would be degraded in the southern part of McCormack-Williamson Tract where tidal forces are strongest. Based on elevation, shallow open water would probably develop in the south with tidal wetlands throughout much of the Tract. Higher areas may develop into riparian forest.

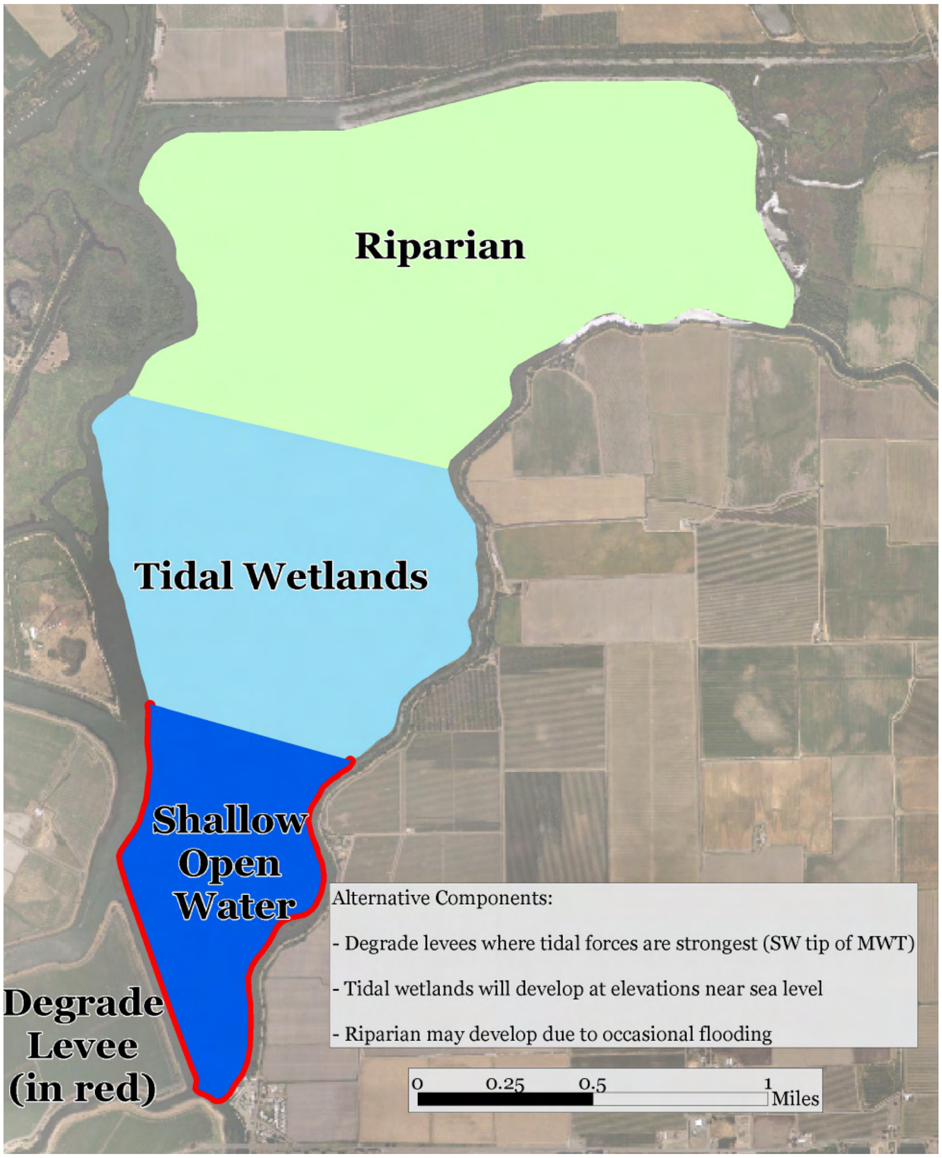


Figure 71: Maximum tidal processes for McCormack-Williamson Tract

The maximum ecological alternative shown in Figure 72 is targeted at maximizing the extent of riparian corridor. Landside areas of all perimeter levees would be regraded and planted with riparian forest. It is also expected that there would be natural colonization. The riparian forest would be especially valuable because it would provide connectivity of riparian forest with forest in the DWR lands to the east (Dixon property) and the Cosumnes Preserve.

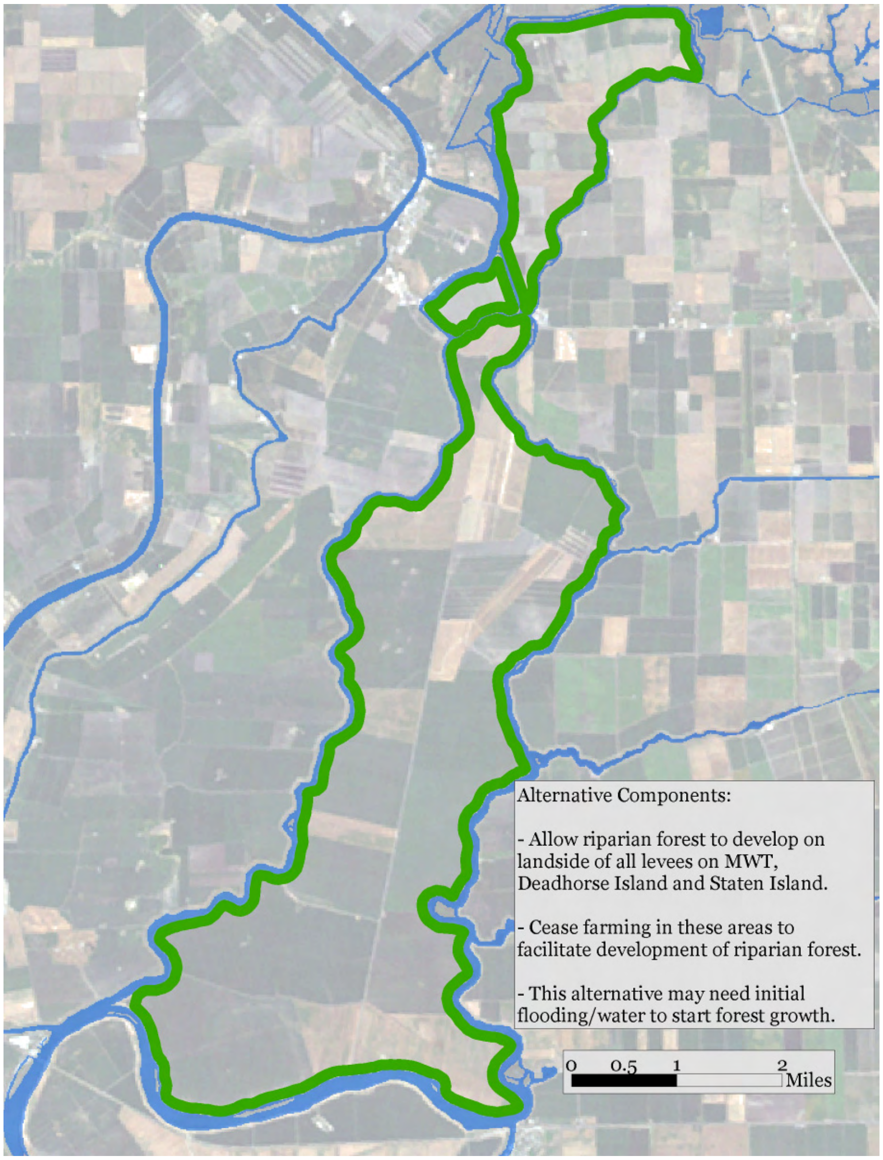


Figure 72: Riparian corridor for McCormack-Williamson Tract

The maximum ecological alternative shown in Figure 73 is targeted at creating the maximum area of riparian, channel interface. It includes creating a channel through McCormack-Williamson Tract, Dead Horse Island and Staten Island. Due to subsided elevations in McCormack-Williamson Tract, Dead Horse Island and Staten Island, levee would need to be created to contain the channel. Some in-channel islands could also be created. The riparian/channel interface is expected to benefit fish, birds and other wildlife and should contribute biological productivity to Delta channels.

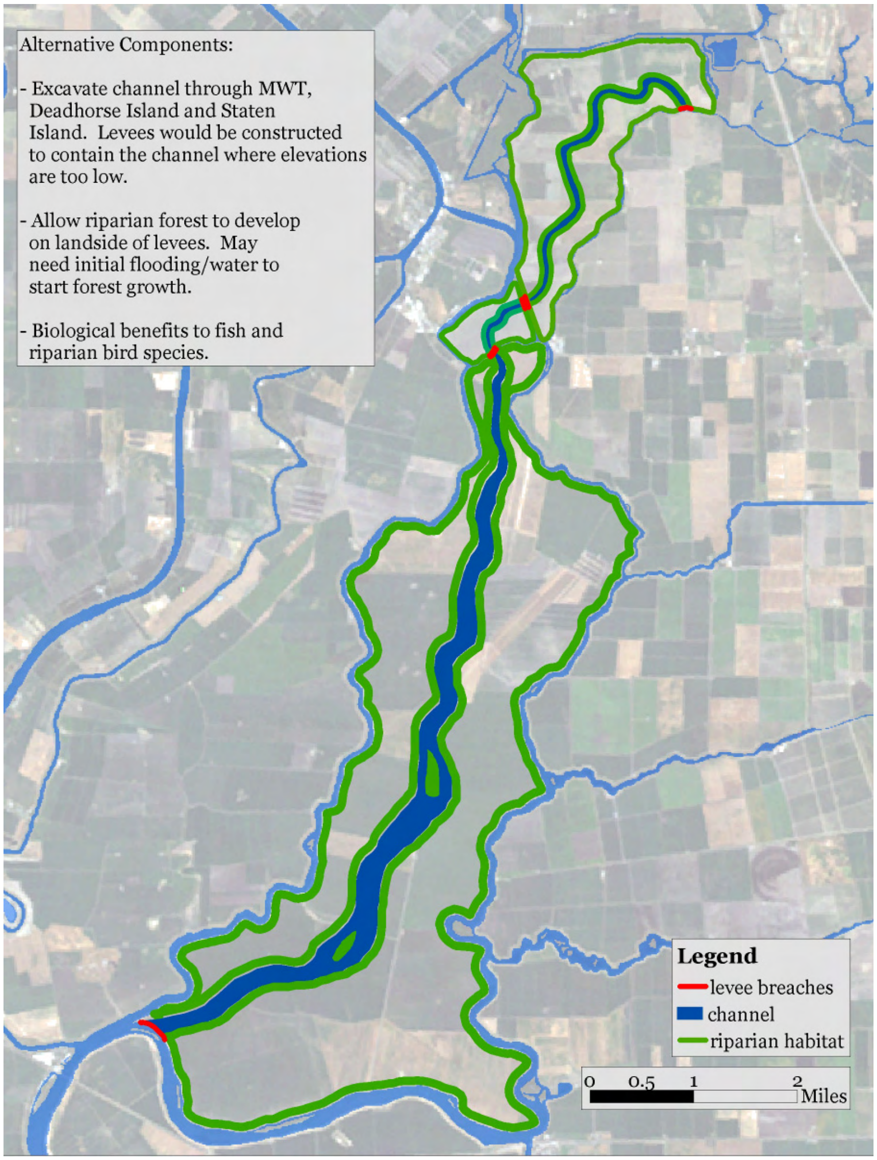


Figure 73: Riparian/channel corridor for McCormack-Williamson Tract

The maximum ecological alternative, shown in Figure 74, was targeted at benefiting greater sandhill cranes. The area of wildlife-friendly agriculture would be maximized, with some added wetlands. The agricultural fields would be shallowly flooded in the winter when the cranes are present.

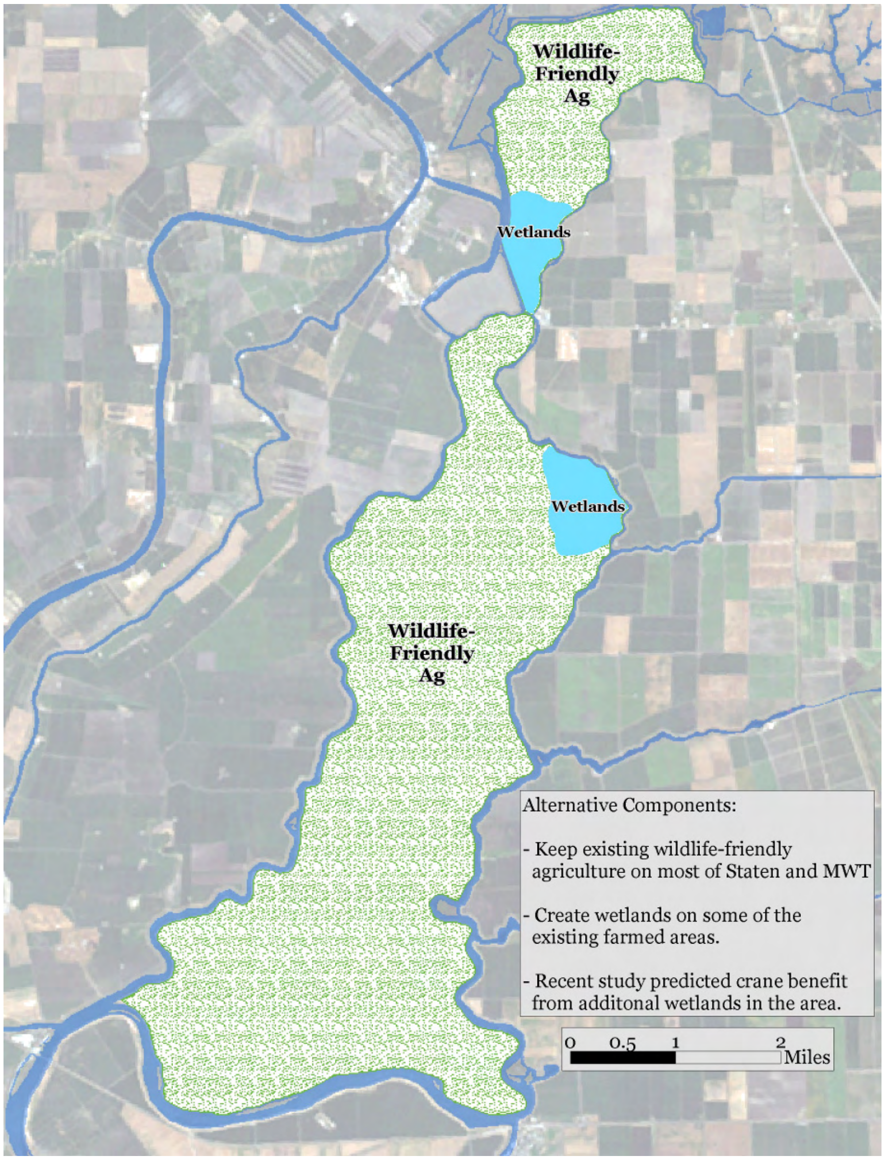


Figure 74: The ecological alternative for maximizing Greater Sandhill Crane habitat

The maximum ecological alternative shown in Figure 75 is targeted at maximizing benefits to fish by creating additional aquatic habitat. Levees will be setback on McCormack-Williamson Tract, Dead Horse Island and Staten Island. Channel Islands will be created.

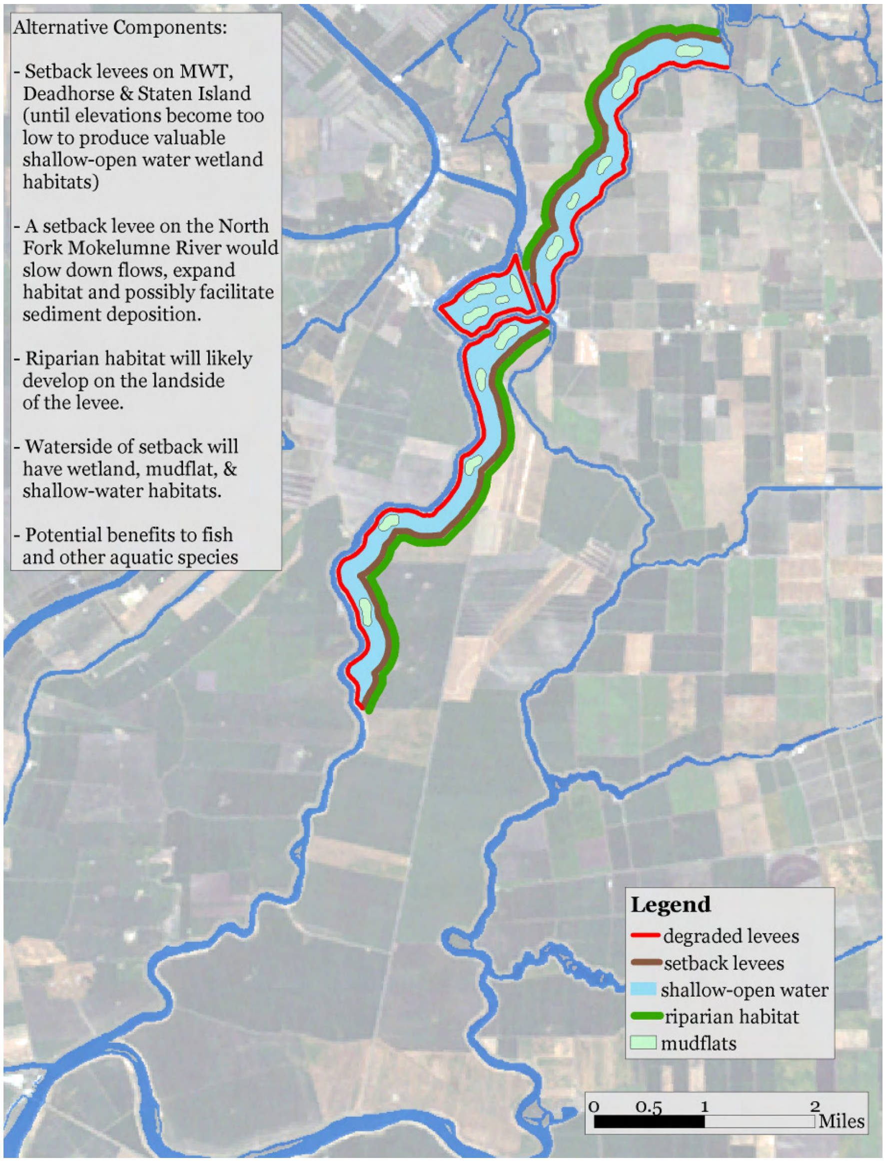


Figure 75: The ecological alternative for maximizing fish/aquatic habitat

<u>Maximum Flood Control Scenarios</u>

The maximum flood alternative shown in Figure 76 would maximize conveyance by using McCormack-Williamson Tract, Dead Horse Island, and Staten Island as a floodway.

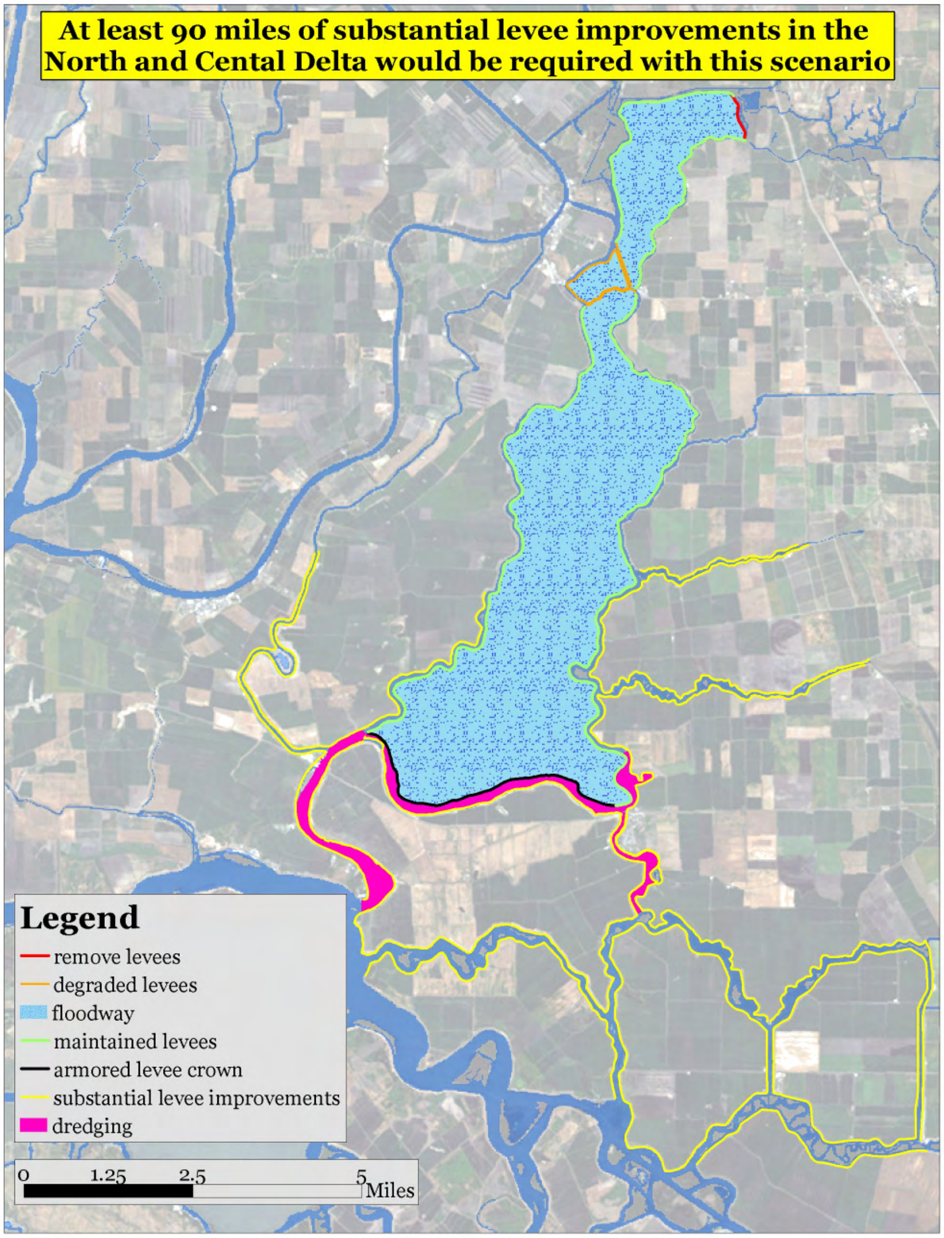


Figure 76: The flood alternative utilizing McCormack Williamson Tract, Dead Horse Island, and Staten Island as a floodway

The maximum flood alternative shown in Figure 77 would create a bypass channel to divert flood flows around the North Delta project area.

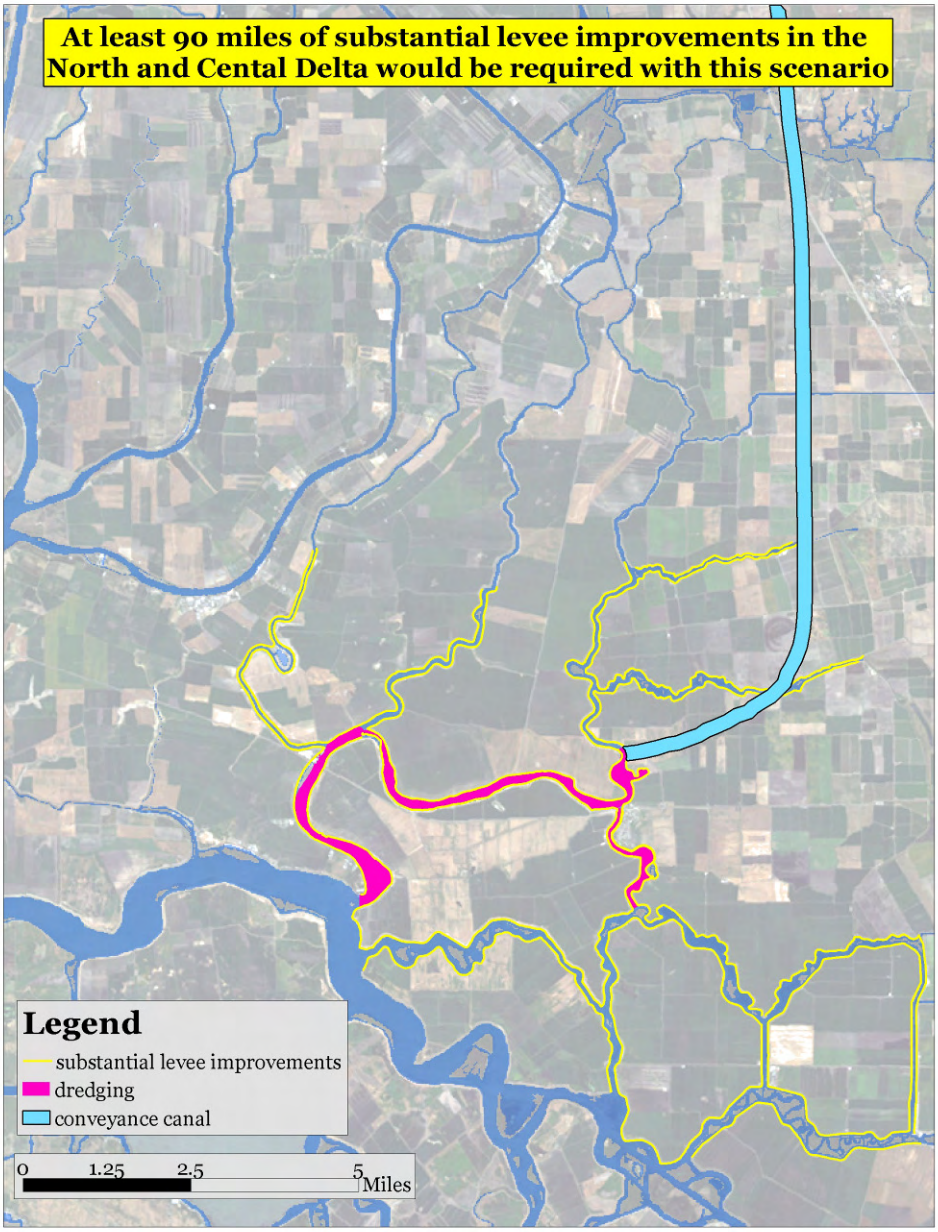


Figure 77: The flood alternative creating a bypass channel to divert floodwaters around the North Delta project

McCormack-Williamson Tract restoration scenarios developed after the first science panel meeting were presented at the second science panel meeting. Illustrations of the restoration scenarios presented are shown in Figures 61-69. These address both flood control and ecosystem restoration objectives as well as project constraints on McCormack-Williamson Tract.

DWR staff identified the following as constraints of the North Delta Flood Control and Ecosystem Restoration Project to inform the Science Panel of some key non-science related drivers behind Project alternative decisions :

- KCRA TV tower
- East MWT levee 8.5' Mean Sea Level
- Protect neighbors
- Wildlife-friendly levees
- Borrow material

There is a KCRA TV tower in Northwest corner of McCormack-Williamson Tract that needs to be protected and access to the tower must be maintained. DWR believes that existing access to the TV tower can be maintained by an 8.5' east McCormack-Williamson Tract levee. Therefore, the existing levee can be degraded from the existing 15' to 8.5'. Also lowering the East levee from its current elevation of about 15' to 8.5' will facilitate flooding on McCormack-Williamson Tract and help to achieve flood goals.

The neighboring islands must be protected from any increased flood risk due to the project. Maintaining most of the existing levees prevents extensive fetch during flooding events when MWT is flooded. Making wildlife-friendly levees will protect the levees from erosion when MWT floods. Borrow material is required for wildlife-friendly levees. The least expensive option is to obtain this material on-site.

The second goal of the science panel meeting was to review the results of modeling efforts by UC Davis that evaluated the nine restoration alternatives formulated after the first science panel meeting (Refer to Figures 61-69). Professor Geoff Schladow presented the results of the scenarios.

The following conclusions were given, in part based on the information shown in Figures 78-80 and Table 12:

- All scenarios reduce water levels at Benson's Ferry (by double the old scenarios), and 10 and 25 yr events increase water levels at New Hope
- For 10 and 25 yr events, all scenarios identical
- Potential for subtidal, intertidal, and supratidal habitat types – but small variations between scenarios
- Habitat restoration and flood peak reduction at Benson's Ferry only. Peak increase at New Hope

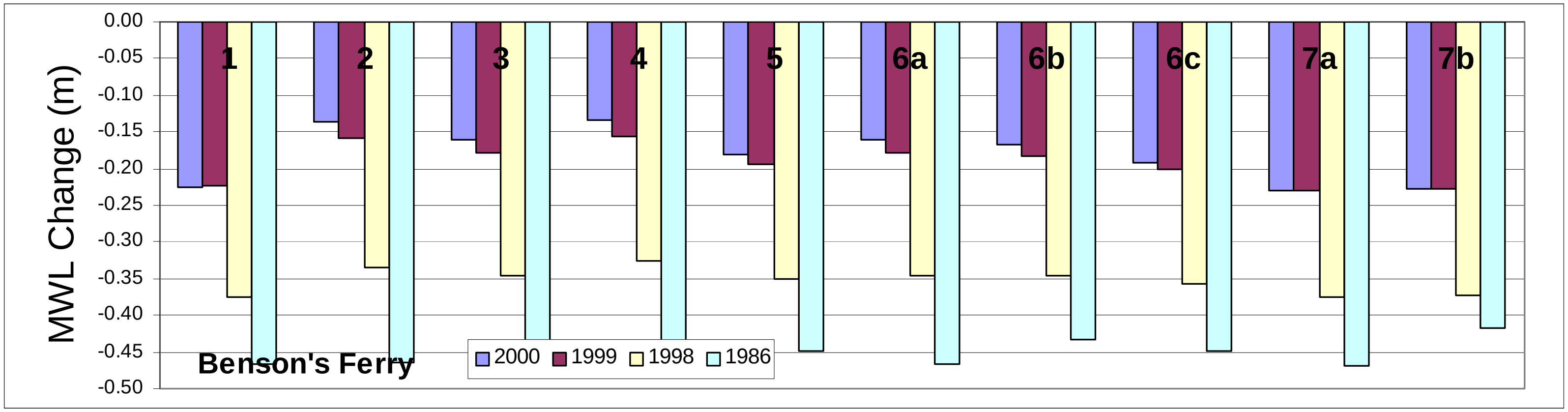


Figure 78: Mean water level change at Benson's Ferry for ecosystem restoration scenarios shown in Figures 53-61

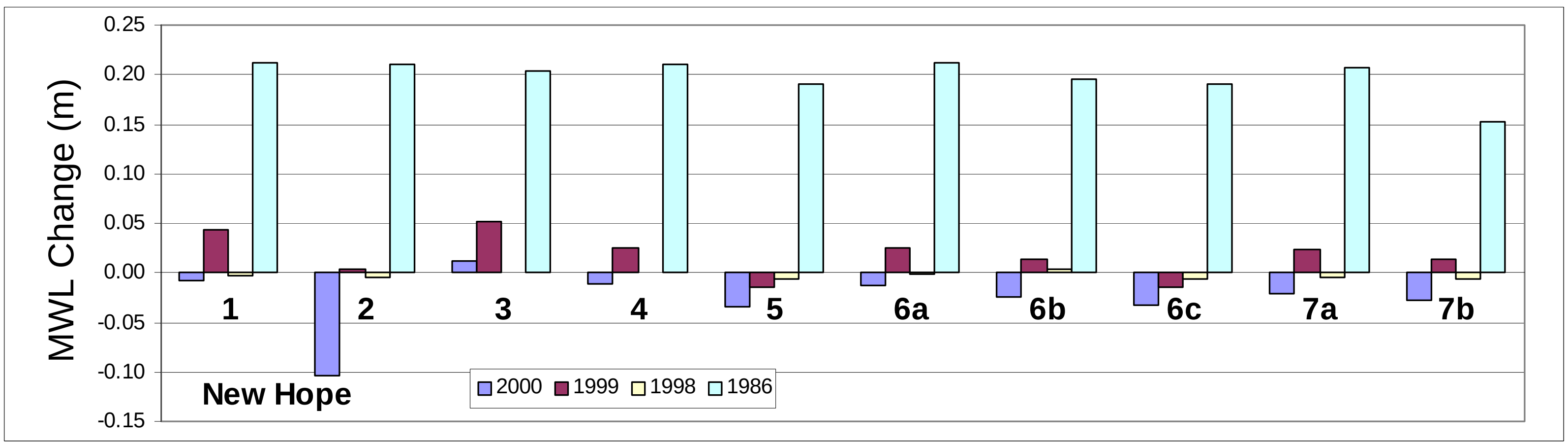


Figure 79: Mean water level change at New Hope Landing for ecosystem restoration scenarios shown in Figures 53-61

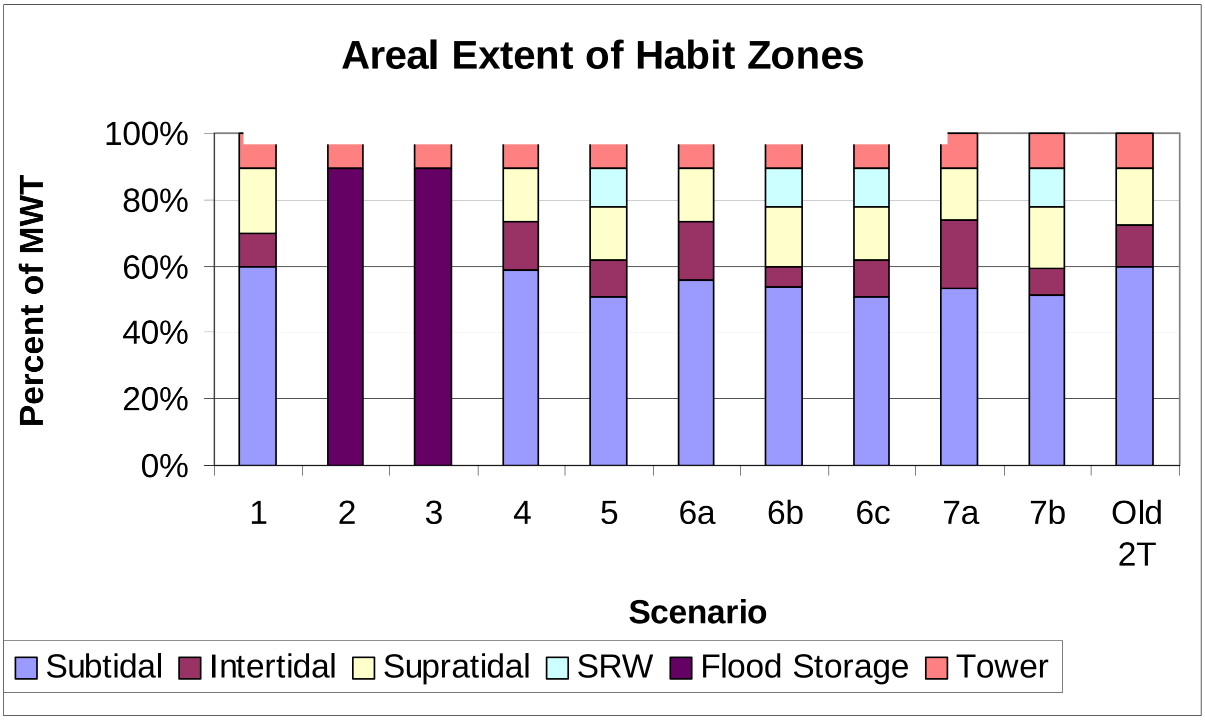


Figure 80: Areal extent of habitat zones for restoration alternatives shown in Figures 61-69

Table 12: Maximum water levels for restoration alternatives shown in Figures 61-69

	BASE	1	2	3	4	5	6a	6b	6c	7a	7B
2000											
BF	3.708	3.483	3.571	3.548	3.574	3.528	3.548	3.54	3.517	3.478	3.481
NH	2.01	2.002	1.907	2.022	1.999	1.976	1.998	1.986	1.977	1.989	1.982
1999											
BF	3.997	3.773	3.839	3.819	3.84	3.803	3.819	3.814	3.795	3.768	3.769
NH	1.851	1.895	1.854	1.902	1.876	1.836	1.876	1.865	1.837	1.874	1.865
1998											
BF	4.546	4.172	4.212	4.201	4.221	4.196	4.2	4.199	4.188	4.171	4.174
NH	2.674	2.671	2.67	2.674	2.675	2.667	2.672	2.678	2.668	2.669	2.667
1986											
BF	5.763	5.296	5.298	5.293	5.297	5.314	5.297	5.33	5.314	5.295	5.345
NH	3.771	3.983	3.981	3.975	3.982	3.961	3.983	3.966	3.961	3.978	3.923
1986-NODB											
BF	6.327	5.545	5.546	5.546	5.545	5.587	5.545	5.61	5.587	5.545	5.644
NH	4.402	4.463	4.461	4.462	4.46	4.46	4.463	4.47	4.46	4.461	4.442

Presentation of Potential Dead Horse Island Opportunities

DWR also presented possible restoration scenarios for Dead Horse Island. Dead Horse Island is an approximately 220-acre island located between MWT and Staten. It was once part of MWT but in 1890s a dredger cut was dug between Dead Horse Island and MWT.

Dead Horse Island restoration may also provide flood conveyance benefits, though hydraulic modeling to date has not shown this. Dead Horse Island is privately-owned and would need to be purchased to be incorporated into the project. The restoration option shown in Figure 81 involves breaching the perimeter levees to form channel islands. At five feet below sea level elevation, much of the Island will form shallow-water habitat. The restoration option shown in Figure 82 would most likely support shallow water habitat and potentially intertidal habitat.

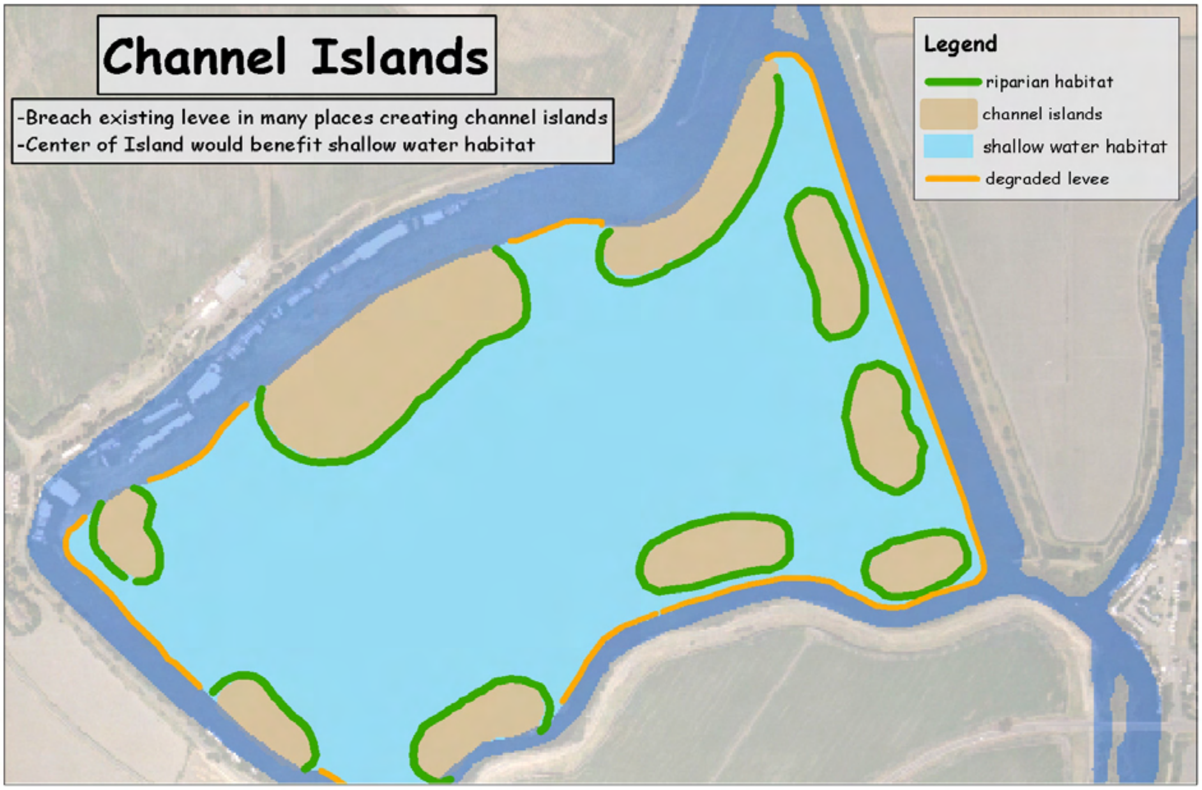


Figure 81: Dead Horse Island restoration Option 1 - Formation of shallow water habitat

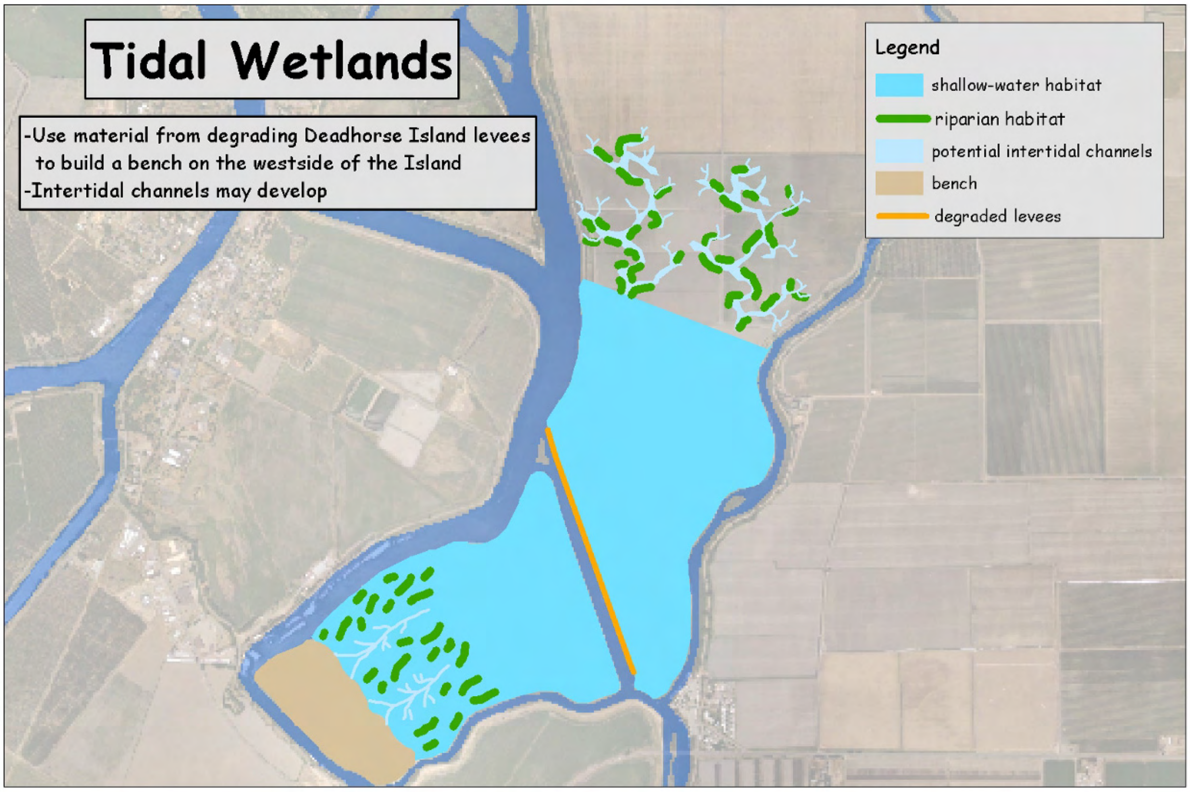


Figure 82: Dead Horse Island restoration Option 2 - Formation of shallow water and potentially intertidal habitat

Science panel conclusions

After presentation of supplemental information and revised conceptual alternatives by DWR, the Science panel held break-out groups to discuss alternatives in terms of science uncertainties. A written summary of Science Panel recommendations was provided after the panel meeting for the Project team's use in refining alternatives. A full summary of the Science Panel recommendations is available under separate cover from DWR.

Alternative Refinements from Science Panel Review

Subsequent to the Science Panel meeting, the Ecological Coordination Team met to refine ecosystem alternatives. The Team eliminated the Dead Horse Island restoration alternatives from consideration. The consensus was that with the exotic species concerns regarding shallow-water habitat, the project should limit shallow-water habitat creation to McCormack-Williamson Tract and Staten Island setback levees initially. If exotic species concerns are not significant, restoration on Dead Horse Island could be pursued, or different restoration techniques could be pursued at Dead Horse Island as an adaptive management strategy.

McCormack-Williamson Tract Option Refinement

The Team also narrowed the eight alternatives on McCormack-Williamson Tract to three alternatives. The primary focus of the three alternatives are promoting sedimentation, providing floodplain habitat for fish while avoiding exotics species concerns, providing floodplain habitat, and using the lowest area of McCormack-Williamson Tract for subsidence reversal.

The first alternative that focuses on promoting sedimentation is an open system with a secondary channel and tidal wetlands. The other two alternatives are a more controlled system that supports floodplain habitat in the winter but is drained during the summer and fall giving more flexibility to avoid exotic species and mosquito concerns. One of the two floodplain options has a subsidence reversal demonstration project area. Low-slope wildlife-friendly levees and associated riparian habitat on the interior of levees surrounding the Tract are common to all restoration options. These levees add geotechnical stability to the levees, especially when the interior is subjected to water during the annual flooding events and allow for gradation of habitats, from upland, to riparian/scrub-shrub, and emergent marsh and mudflat when the interior is inundated. Figures 83 through 85 depict the three alternatives that are being analyzed in the EIR. Detailed conceptual models are available are an appendix to the EIR. These conceptual models explain the scientific hypothesis and intended functions of each alternative.

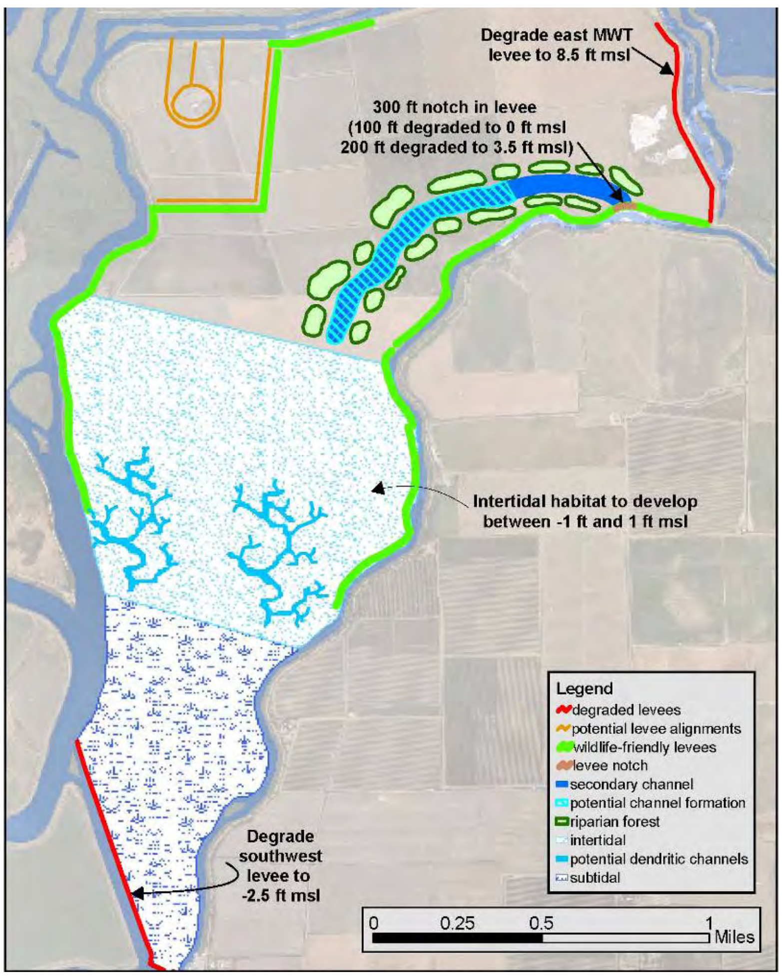


Figure 83: Ecosystem Restoration Option 1 – Fluvial Maximum (Minimum Control)

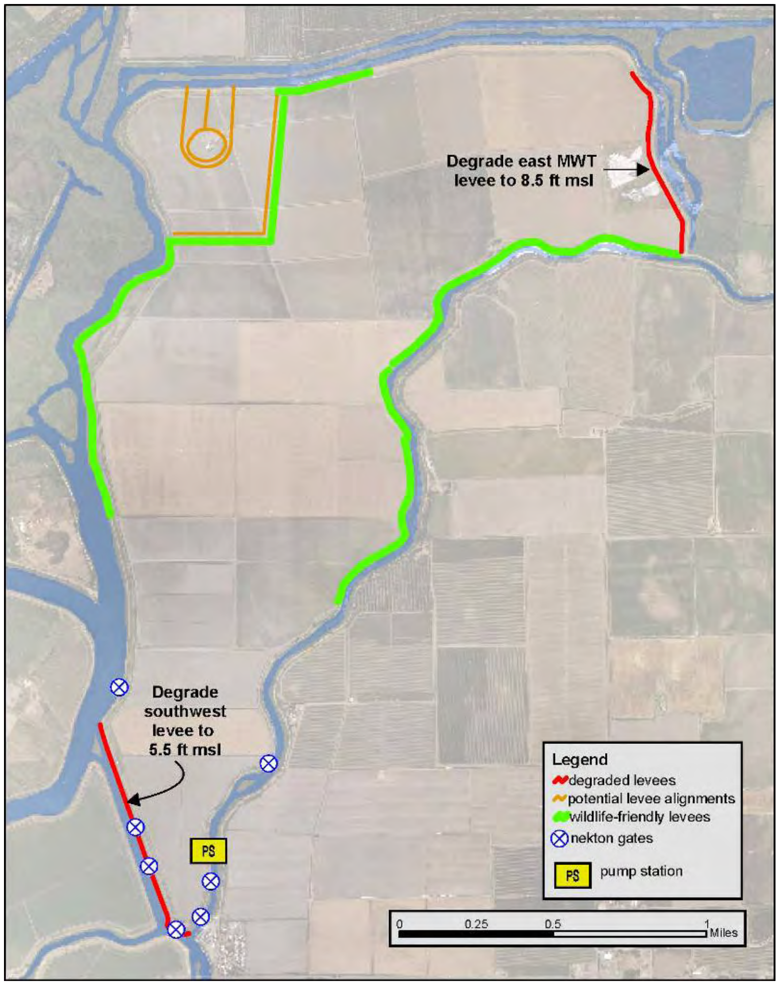


Figure 84: Ecosystem Restoration Option 2 – Fish Ecological Maximum

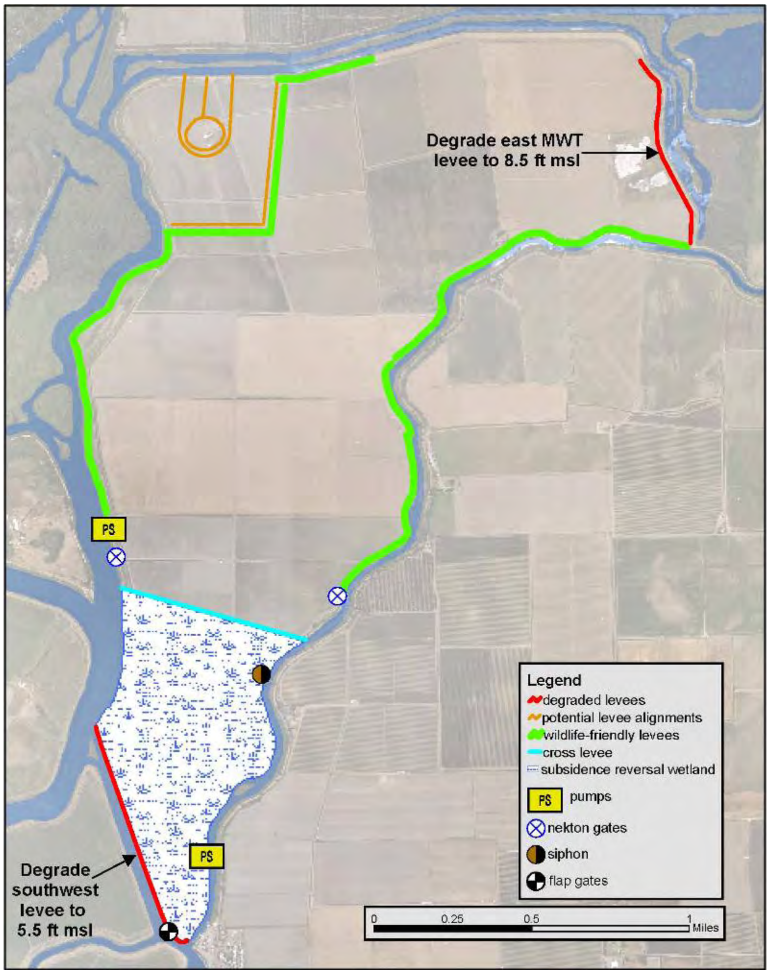


Figure 85: Ecosystem Restoration Option 3 – Hybrid Floodplain/Subsidence Reversal

Self-Regulating Tide Gates

Self-regulating tide gates are included in the McCormack-Williamson Tract floodplain options. The tide gates will allow for some water circulation and assist in a net draining of the floodplain. Water circulation is important to reduce mosquito breeding and to improve the water quality for fish. Limited inflow into the Tract and a net draining will reduce the likelihood of the Tract filling with water and reduce the amount of water that needs to be pumped from the Tract to drain it.

Science Panel Meetings to Develop Grizzly Slough Ecological Components

DWR purchased the Grizzly Slough property in 1992 with State Water Project funds for potential borrow and environmental mitigation for the North Delta project. In 1995, a DWR levee mitigation project restored riparian habitat on the northernmost 34 acres. In 2002, DWR received a CALFED Ecosystem Restoration Program grant to develop restoration plans for the entire 389 acre property. Information from the studies performed under the CALFED grant was used to develop preliminary restoration scenarios for the Grizzly Slough property which were subsequently review by the science panel. Preliminary restoration scenarios were developed to be consistent the CALFED ecosystem restoration goals and project needs.

The first priority established for Grizzly Slough is restoration of ecological processes; next is restoration of species, habitats and natural communities; and thirdly, if compatible with the ecological restoration, an opportunity for borrow and environmental mitigation for the rest of the North Delta project.

Ecological processes that can be restored in the Grizzly Slough area include: natural disturbance, floodplain flooding, erosion/deposition, channel migration, transport of seeds and woody material, riparian vegetation colonization/growth, spawning/rearing of floodplain fish and shallow flooding for greater sandhill cranes.

There is a hydrologic connection between the Grizzly Slough area and the McCormack-Williamson Tract area. This connectivity creates the potential for restoration of a riparian corridor that extends from Grizzly Slough to McCormack-Williamson Tract. There is floodplain in both areas and migratory fish use both areas.

Preliminary alternatives were developed by DWR staff for later review by the ERCT are shown in Figures 86 through Figure 93.

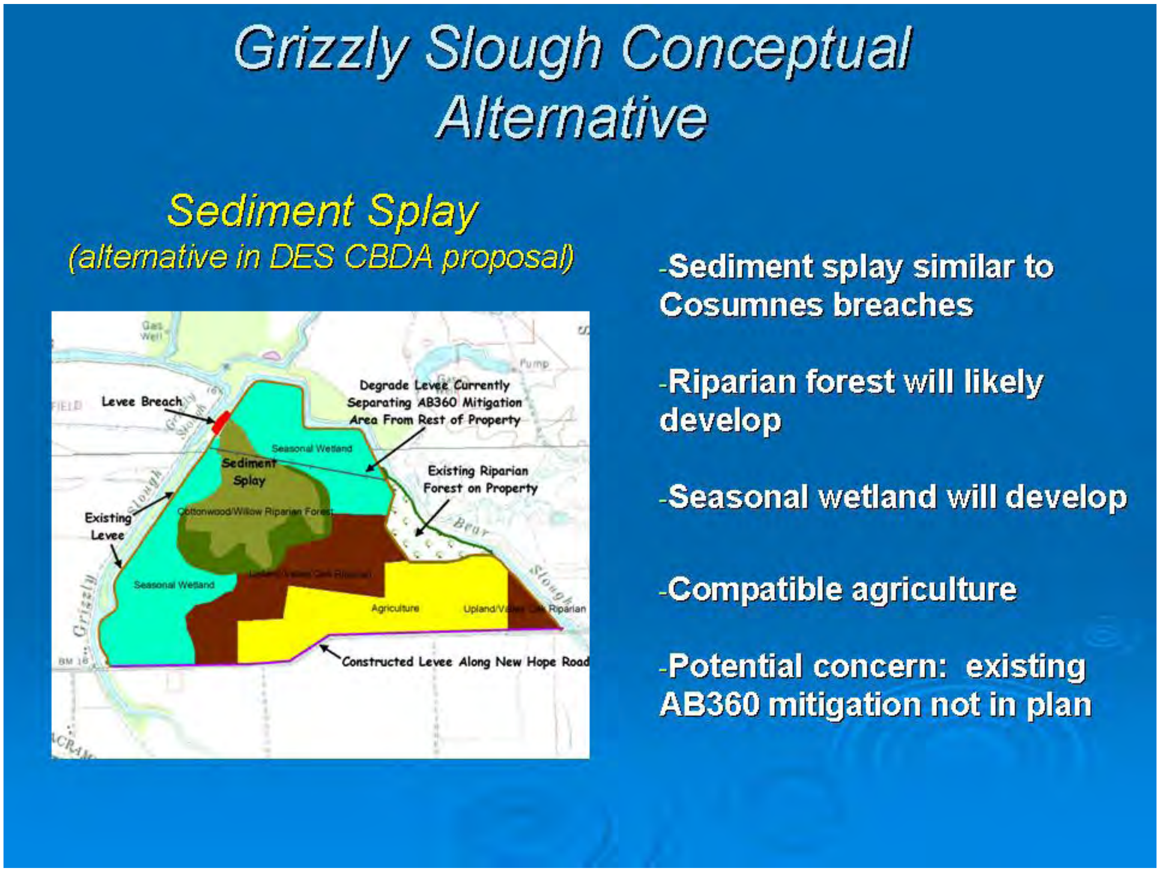


Figure 86: Grizzly Slough Conceptual Alternative #1 – Sediment Splay

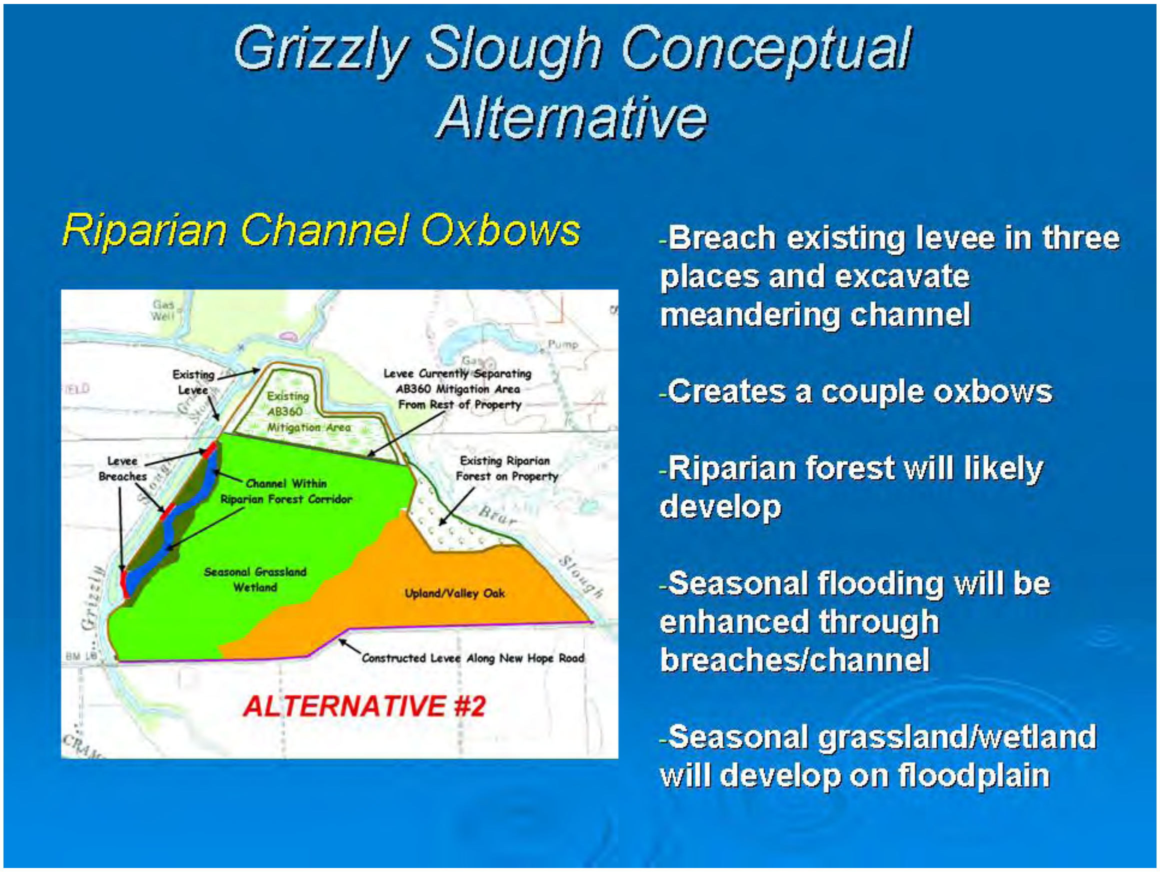


Figure 87: Grizzly Slough Conceptual Alternative #2 – Riparian Channel Oxbows

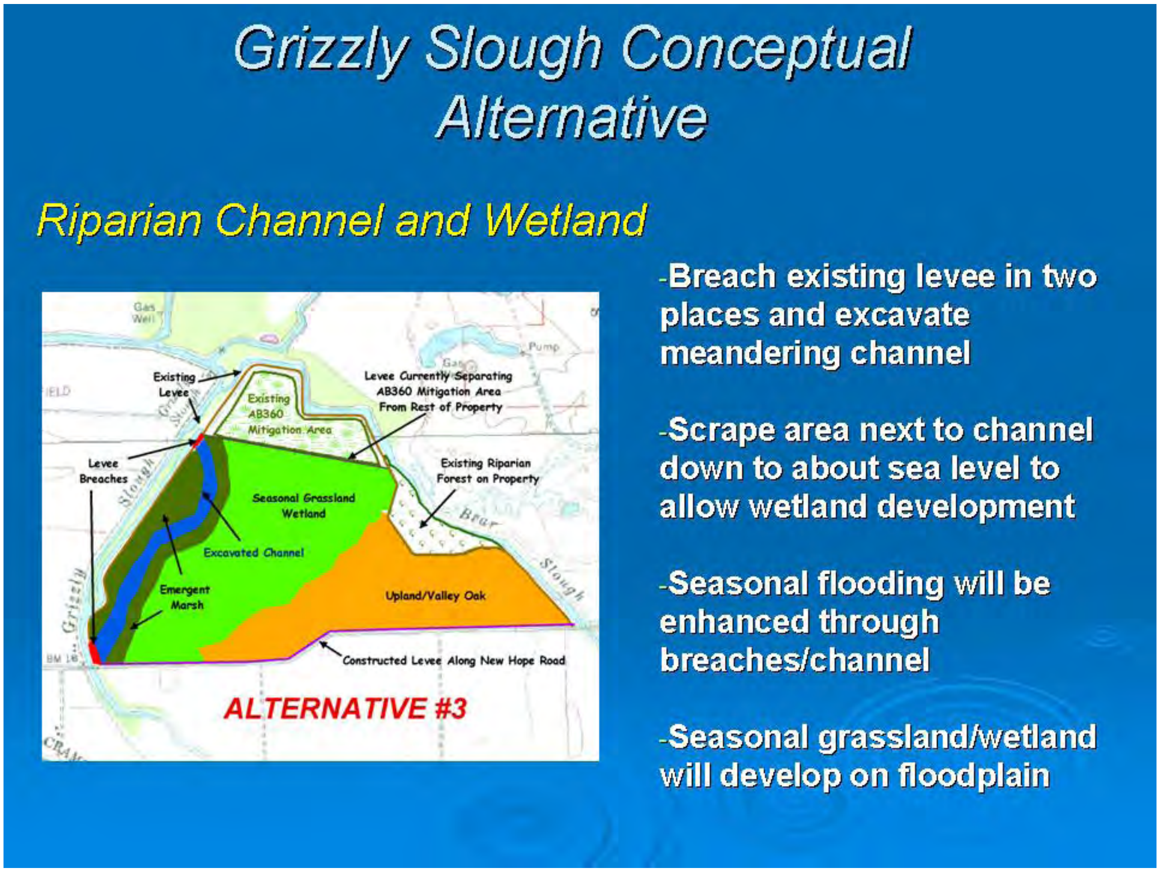


Figure 88: Grizzly Slough Conceptual Alternative #3 – Riparian Channel and Wetland

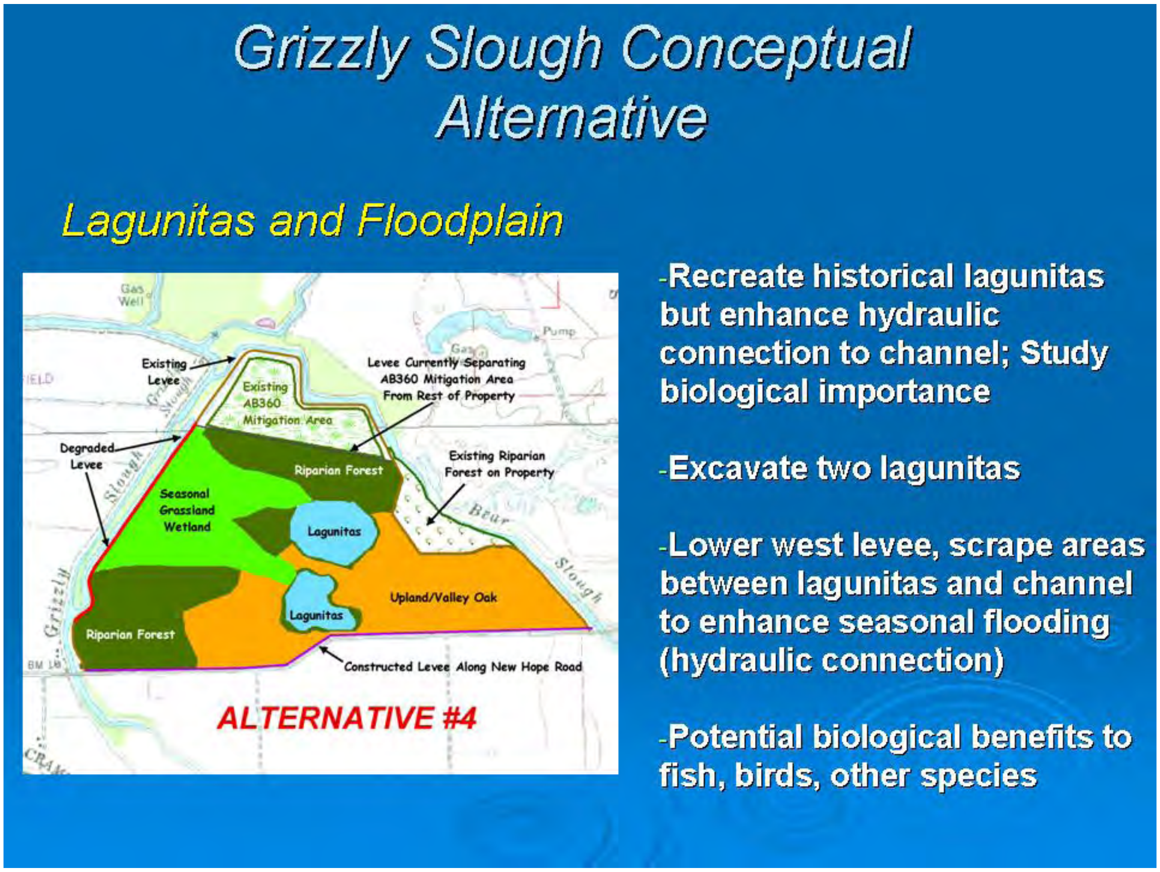


Figure 89: Grizzly Slough Conceptual Alternative #4 – Lagunitas and Floodplain

Figure 90: Grizzly Slough Conceptual Alternative #5 - Floodplain

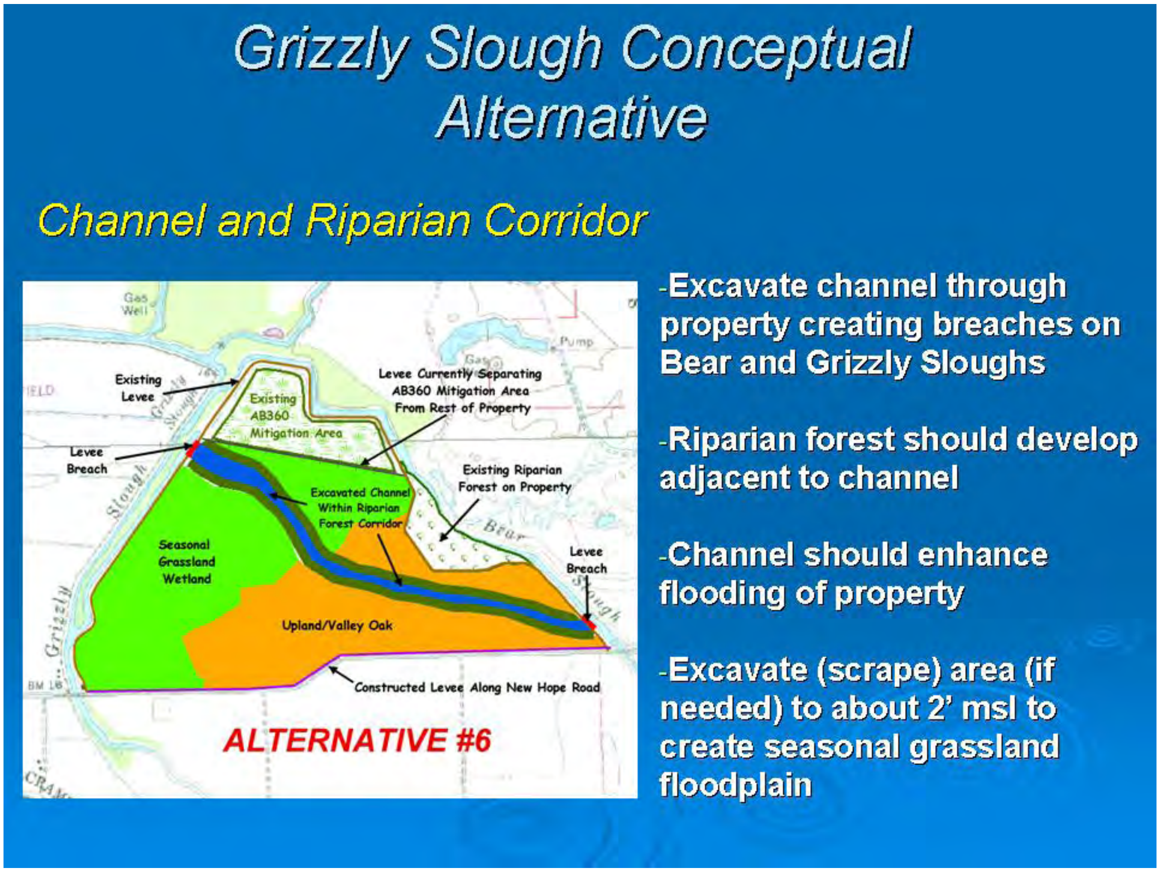


Figure 91: Grizzly Slough Conceptual Alternative #6 – Channel and Riparian Corridor

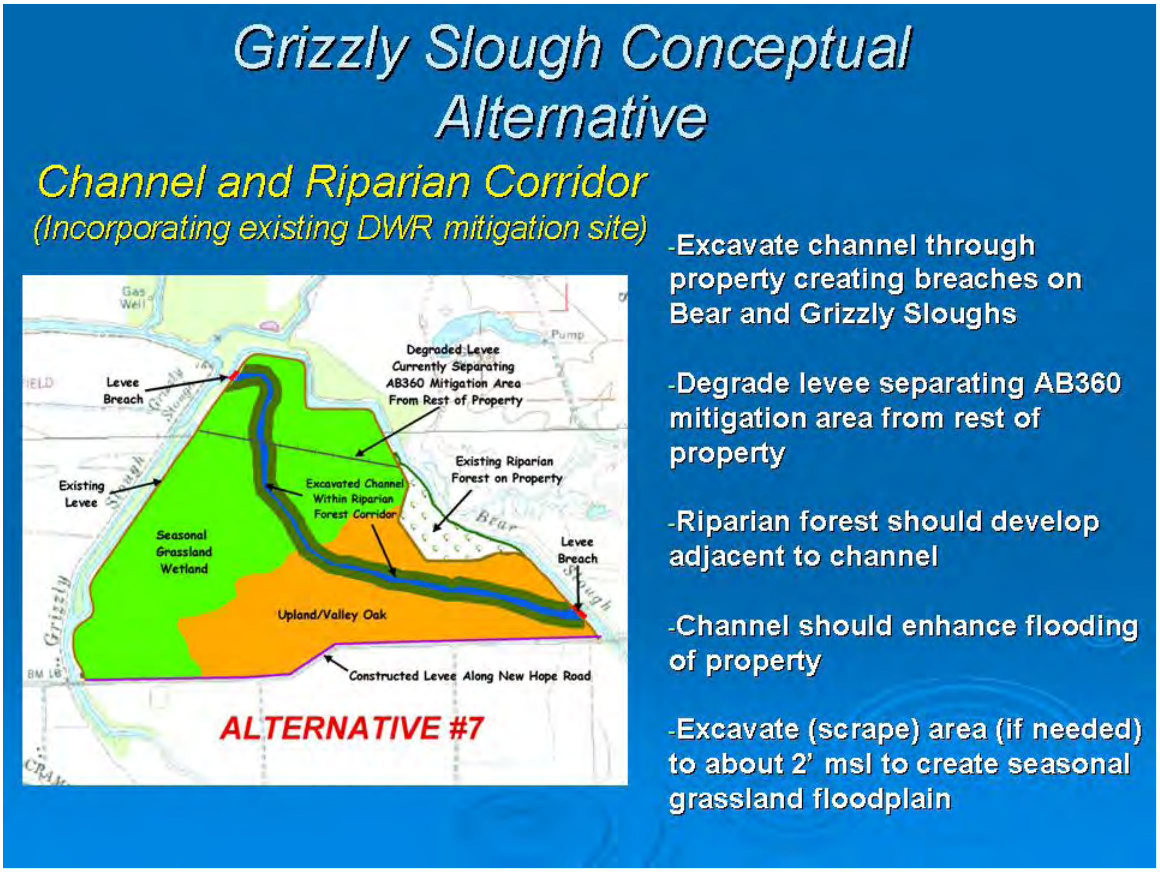


Figure 92: Grizzly Slough Conceptual Alternative #7 – Channel and Riparian Corridor with existing DWR mitigation site

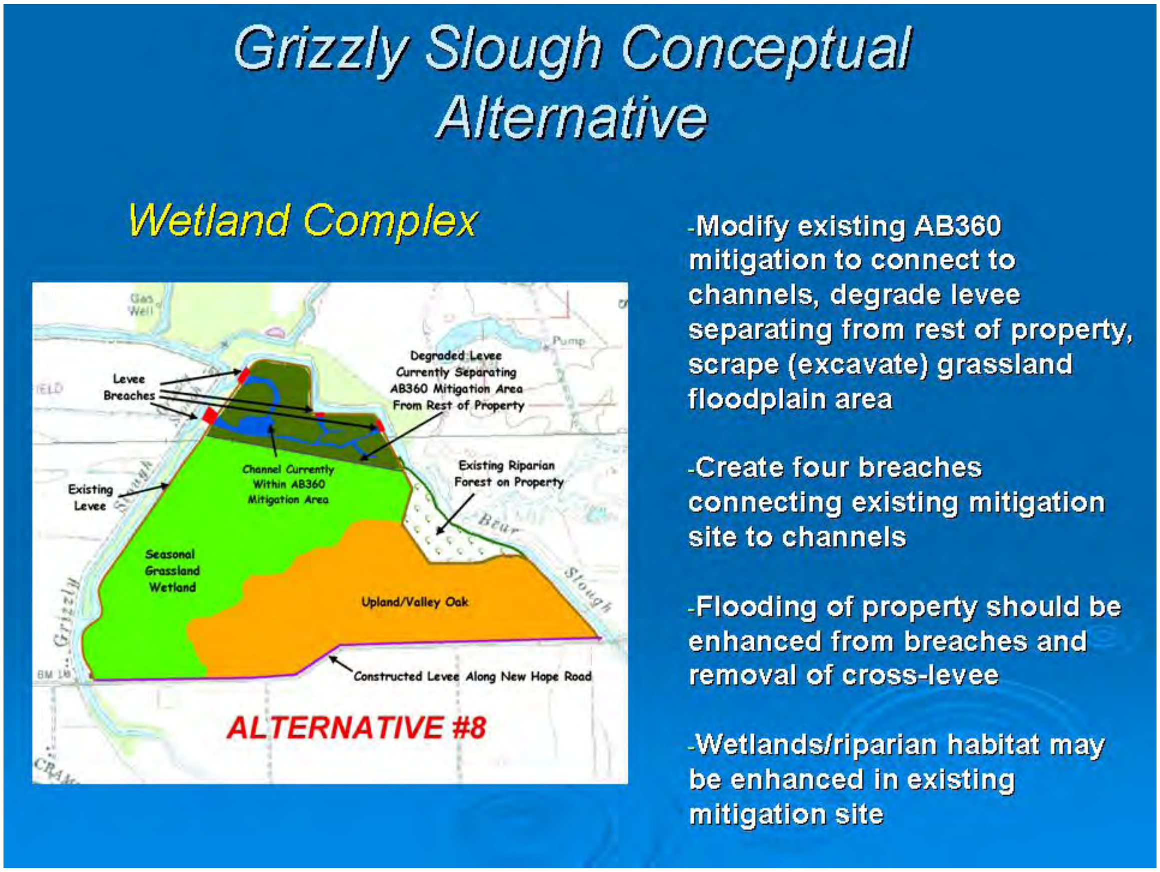


Figure 93: Grizzly Slough Conceptual Alternative #8 – Wetland Complex

The eight alternatives were narrowed down to three alternatives based on input from the project team and ERCT.

Science Panel Review of Grizzly Slough Restoration Scenarios

Alternatives below that were narrowed down by the ERCT, were presented for Science panel review. To review the Grizzly Slough alternatives, two sessions of the panel were held. One session focused on geotechnical review and one session focused on ecological review.

At the geotechnical Science Review meeting held December 15, 2004, the following draft alternatives were presented:

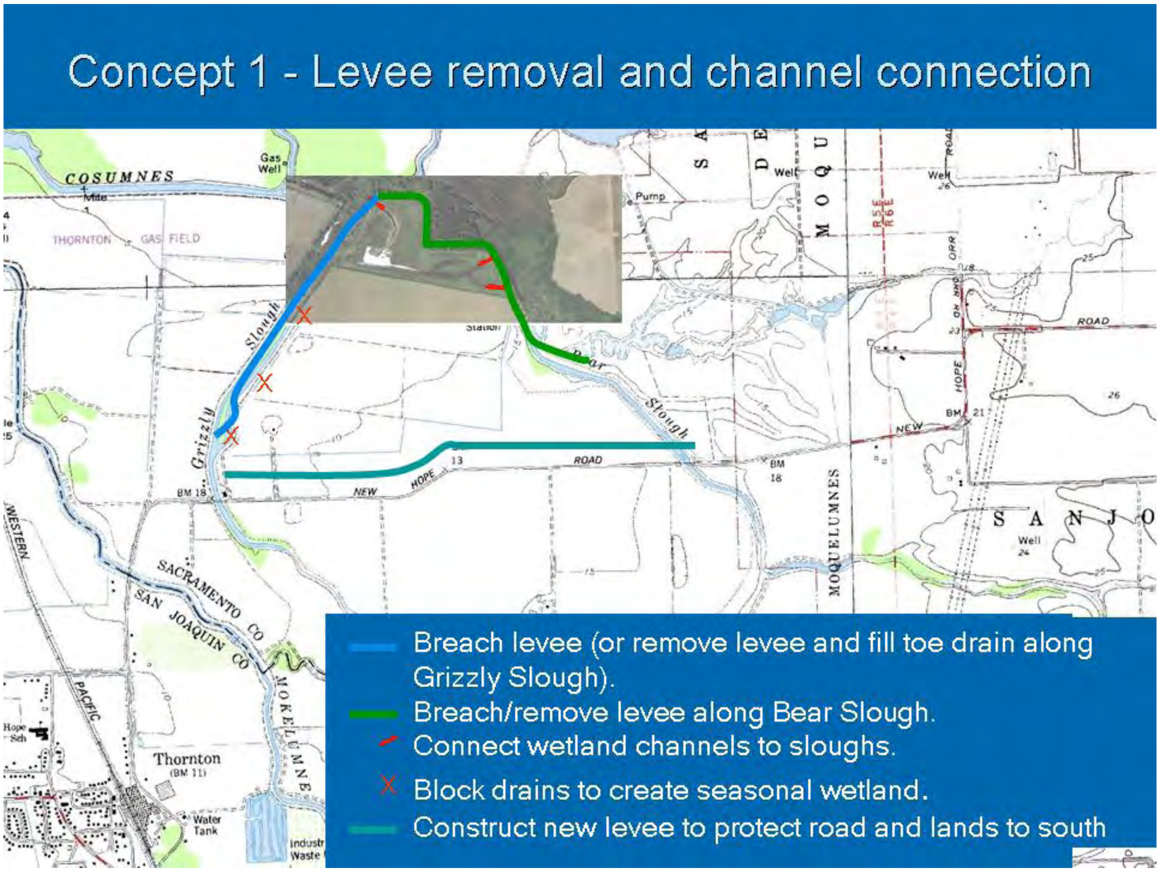


Figure 94: Concept 1 – Levee removal and channel connection

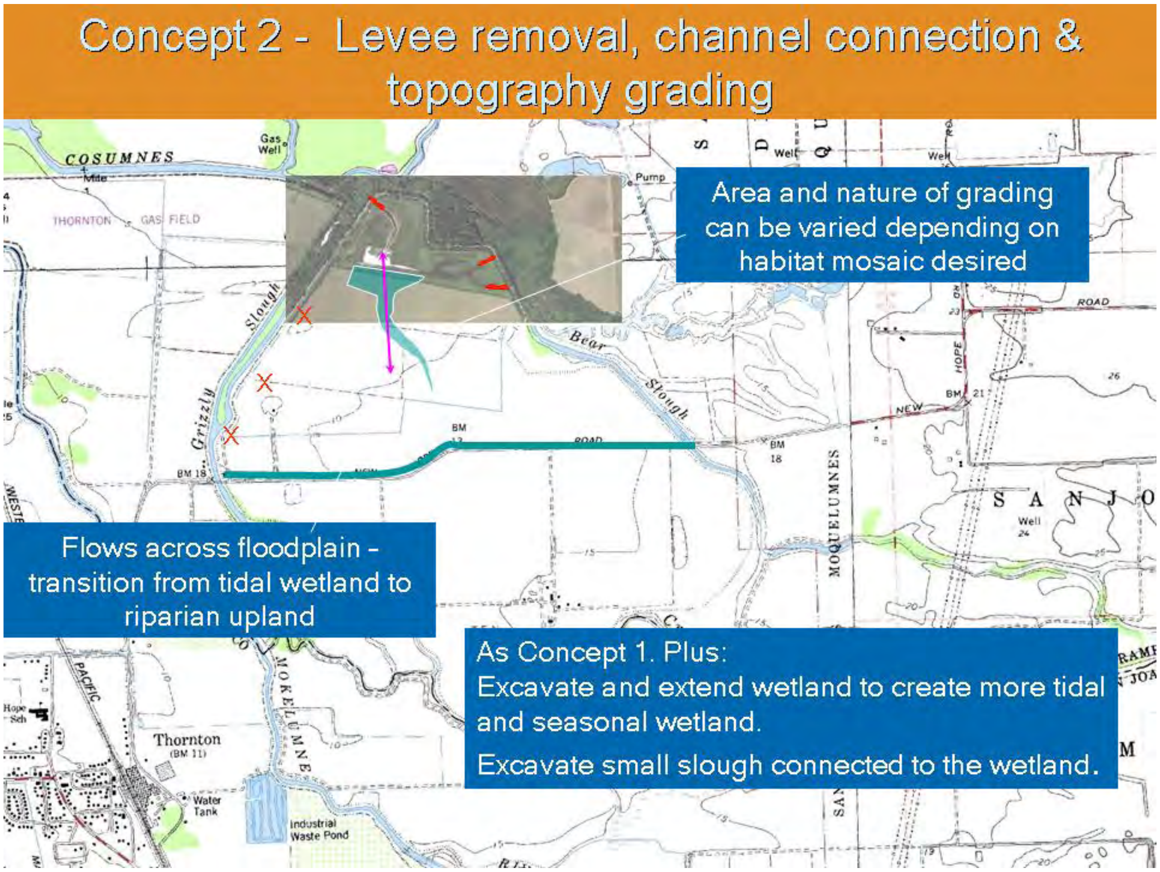


Figure 95: Concept 2 – Levee removal, channel connection and, topography grading

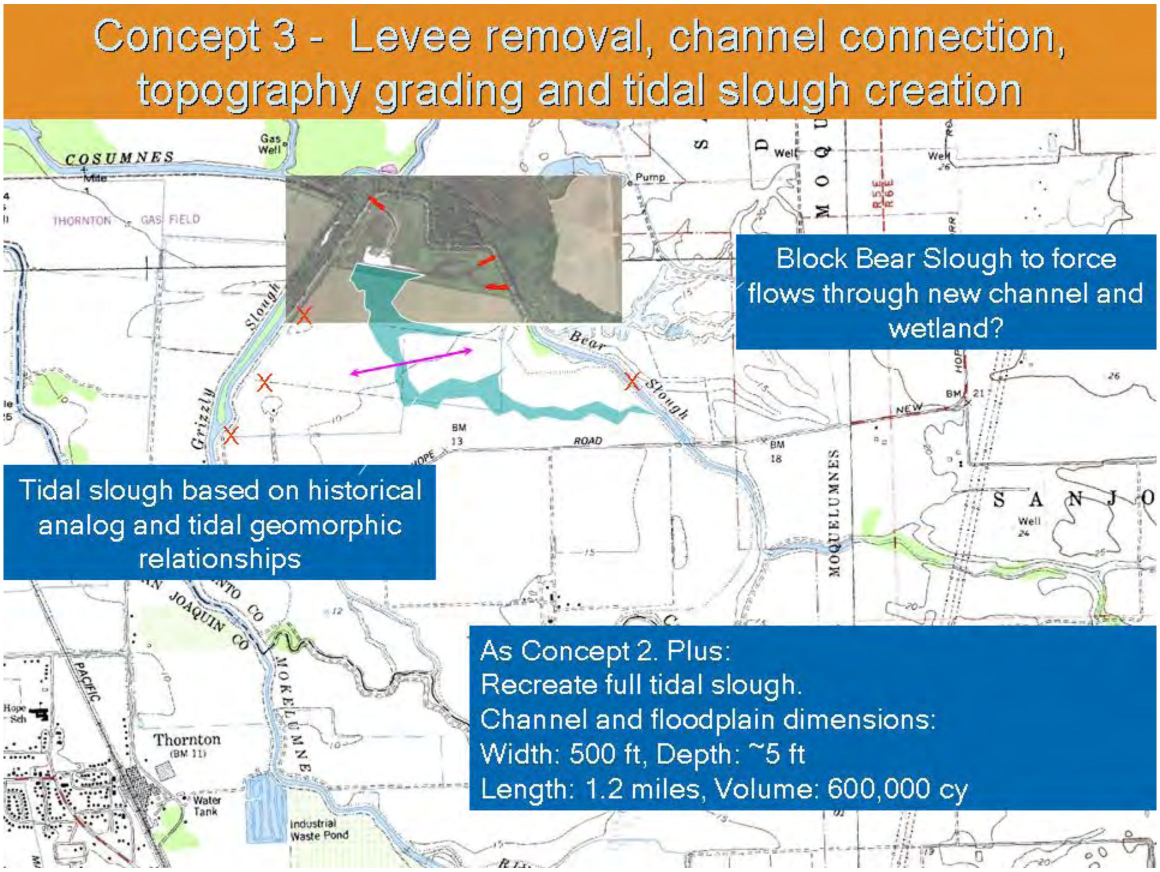


Figure 96: Concept 3 – Levee removal, channel connection, topography grading, and tidal slough creation

The goals of the Grizzly Slough geotechnical review meeting were to:

1) Review geomorphology and hydrologic modeling conducted in order to develop restoration alternatives for the Grizzly Slough Tract

2) Feedback on conceptual restoration alternatives

The geomorphic Science Panel included:

Jeff Mount, UC Davis, geomorphology, Science Panel Chair
Joan Florsheim, UC Davis, geomorphology
Geoff Schladow, UC Davis, hydrology/hydraulic modeling
Bill Fleenor, UC Davis, hydrology/hydraulic modeling

They recommended clarifying project goals, indicated uncertainty on the need to decrease elevations to make the floodplain accessible to frequent floods, and developing an adaptive management program to address uncertainties.

An ecological Science Review meeting was held January 27, 2005. The goals of the meeting were:

1) An update of geomorphic assumptions used to develop conceptual restoration alternatives for the Grizzly Slough Tract

2) A briefing of ecological considerations

The panelists were:

Jeff Mount, UC Davis, geomorphology, Science Panel Chair
Joan Florsheim, UC Davis, geomorphology, coordinator
Peter Moyle, UC Davis, fisheries and wildlife biology
Wendy Trowbridge, Univ. of Nevada, Reno, botany
Sharon Lawler, UC Davis, entomology-mosquito issues

Three fundamental questions were raised during the meeting:

- Could the proposed project restore tidal freshwater marsh environment?
- Could the proposed project potentially restore floodplain processes?
- Could the proposed project potentially sustain floodplain ecology?

The panel suggested that the Grizzly Slough Tract is appropriate for fluvial process and riparian restoration; even though the lower part of the site is tidally influenced. Winter and spring conditions would bring native fishes to the site. There was concern over long-term management that requires mowing. This may not be allowed due to endangered species concerns. Full summary of the Grizzly Slough science panel comments is available as an Appendix to the North Delta EIR.

Through science panel input, the alternatives were narrowed to two basic alternatives. The first alternative, shown as Concept 2 in Figure 97 below, has a breach allowing flood flows onto the floodplain, but does not involve any grading of the floodplain. The second alternative, shown as Concept 3 in Figure 98, will lower the breach and floodplain elevation and involve sculpting a channel. Both alternatives include reconnecting the tidal wetland channels of the DWR mitigation project in the north end of Grizzly to the adjacent channels.

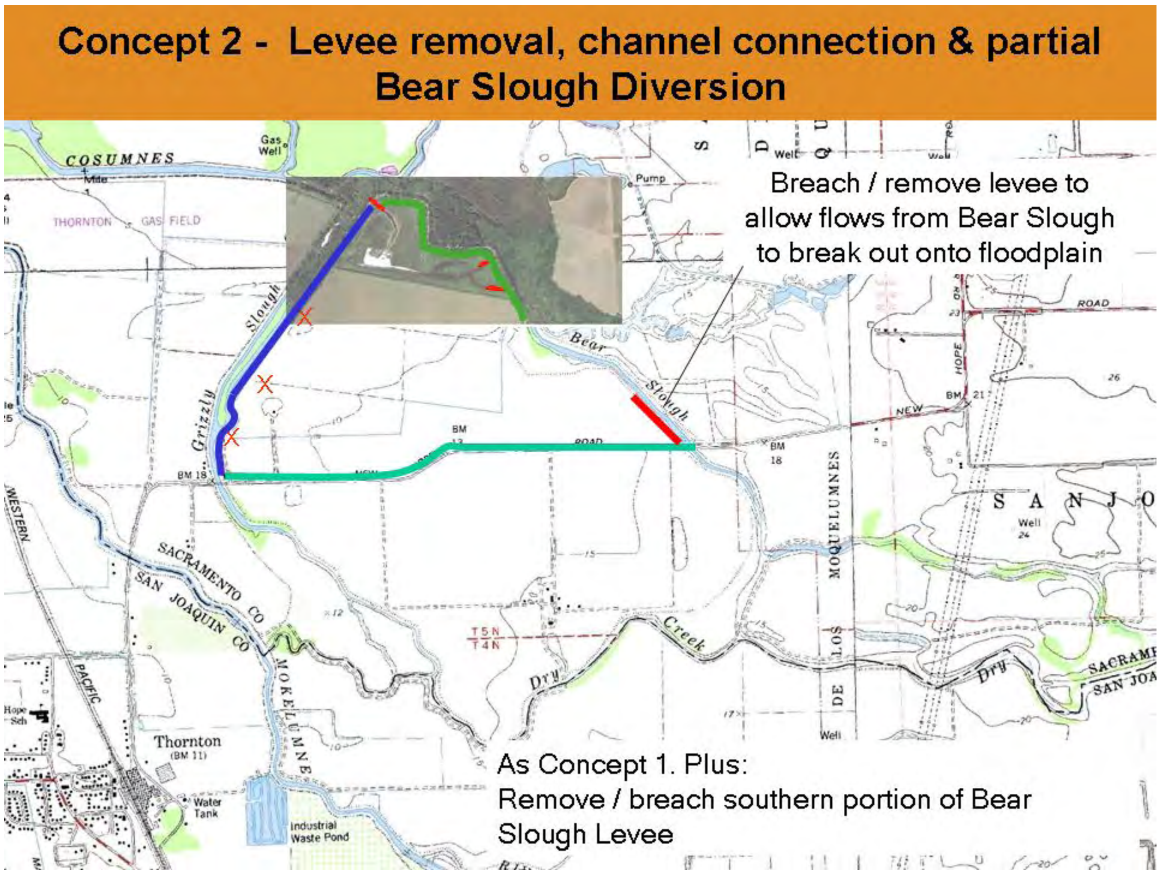


Figure 97: Concept 2 Revised - Levee removal, channel connection and partial Bear Slough diversion

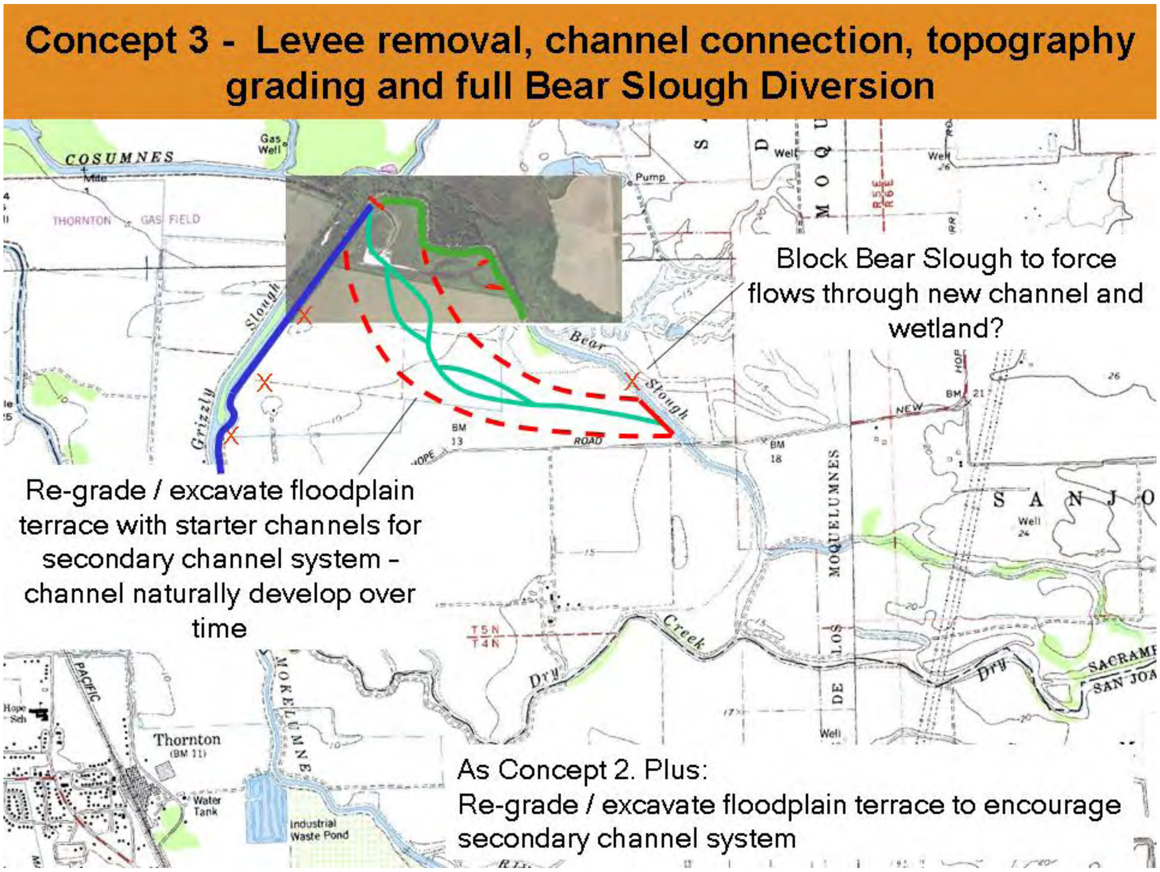


Figure 98: Concept 3 Revised - Levee removal, channel connection and full Bear Slough Diversion

Subsequent modeling verified that either of the above scenarios will result in a flooding frequency at least every 1.5 years.

The multiple objectives (ecosystem restoration, borrow needs, mitigation bank) of the Grizzly Slough Project, in combination with the simulation results predicting identical inundation frequencies for multiple restoration scenarios, necessitated expanding the number of alternatives from the initial two to four. Each of these four alternatives in turn contains permutations, resulting in a broad spectrum of restoration scenarios. This "bookend" approach will increase the available pool of alternatives to select from when making a final determination.

Post-Scoping Development of Recreation Components

Recreation components of North Delta alternatives were developed through NDIG stakeholder input as well as individual discussions with County and State Department of Parks and Recreation (DPR) staff. DWR planning staff also coordinated with members of the Recreation Citizens Advisory Committee, an Ad Hoc group under the Delta Protection Commission concerned with Delta Recreation issues, and Delta Protection Commission staff. Early concepts for recreation elements that were presented to the NDIG include wildlife viewing, informational kiosks, non-motorized boating, restrooms, and parking facilities on Staten Island and non-motorized boating and hiking trails on McCormack-Williamson Tract.

Several key considerations for developing North Delta recreation components emerged through stakeholder discussions: It was noted that any recreation on Staten Island must not interfere with the agricultural operations. As well, stakeholders and Agency staff stressed that any planned enhancements need to include funding for operations and maintenance, provision for long-term ownership and maintenance, liability concerns, and safety patrols. For example, Parks and Recreation agency staff stressed that they would not be willing to accept responsibility for maintaining any new facilities without identified maintenance funds in perpetuity because they don't have enough funds to maintain what they are currently responsible for maintaining. Given this consideration, many stakeholders indicated that the best area improvements might entail enhancing existing area facilities that are currently under-funded such as the Delta Meadows State Park.

Another stakeholder suggestion for recreation improvements was to focus on underutilized opportunities such as non-motorized boating and hiking. The alternatives presented in the EIR include non-motorized boating on McCormack-Williamson Tract and some trails on Staten for wildlife viewing. Hiking trails on McCormack-Williamson accessed by means of the road that runs from Thornton Road west to McCormack-Williamson Tract parallel to and just north of the Mokelumne River were also considered but were taken out of consideration because of liability issues as well as safety concerns; McCormack-Williamson tenants frequently drive large trucks down the access road which could endanger foot travelers and it would be cost prohibitive to built an isolated pedestrian path in this area. Impacts to tenants of McCormack-Williamson, particularly KCRA, from increased public access must also be considered.

Recreation components that are being taken forward in the EIR include non-motorized boating on the southern tip of McCormack-Williamson Tract and improvement of the Delta Meadows Property. Delta Meadows improvements may include upgrading boat launch facilities, parking improvements, and providing signage and public restrooms. DPR staff indicated that prior to the development of any permanent improvements at Delta Meadows, a General Plan for the property must be prepared by DPR and funding for the preparation of the General Plan for Delta Meadows has not yet been identified. Therefore, DWR commits to working cooperatively with DPR to assist in preparation of the general plan, development of funding strategy and implementation. For the Delta Meadows Property, it is anticipated that passive recreation activities would be developed including hiking, nature viewing, non-motorized boating, and fishing. Physical improvement may include boat launch facilities, parking improvements, trails, interpretive signage, and public restrooms.

Another recreation improvement being taken forward in the EIR includes a proposed wildlife viewing area on Staten Island. The viewing area would be on the Staten detention basin levee, with supporting infrastructure near the base of the levee. Access to the wildlife viewing area would be via Staten Road with a new parking facility and restroom located adjacent to the road.

In light of the uncertainty of funding for recreational provisions, they are characterized as "optional" elements in the project description so that other elements such as incremental flood control benefits can still go forward if funding cannot be found for the recreation elements. Recreation components are identified for each group of actions presented in the EIR. The concept of groups of actions is discussed below.

Incorporating "Groups of Actions" Within Project Description

As project alternatives were being refined, the project planning team continued to seek project implementation funding sources. In the fall of 2005, the project team was asked to revisit the project in terms of funding feasibility. This included looking at ways that the project could be phased to allow implementation flexibility depending on availability of implementation funding and so that incremental benefits could be achieved while full project funding was attained. As well, implementing the project incrementally was consistent with the adaptive management approach promoted by the CALFED science community, because components implemented earlier, as incremental funding became available, could provide valuable feedback for the implementation of future phases. This adaptive management approach could benefit ecosystem restoration as well as flood control components. The Alternatives taken forward in the EIR include Group 1 and Group 2 project actions that can be implemented independently. The incorporation of groups of actions into the project alternatives is described below.

Organizing the project in terms of two groups of actions was first widely shared with the stakeholders at the 4/6/05 NDIG meeting although the concept of incremental project implementation had been discussed for some time in the NDIG. The concept was originally discussed in terms of "phases;" However, because the "groups" are essentially independent and self-contained in terms of mitigation, the consensus was that the term "groups" was more appropriate. Group 1 actions are on and in the vicinity of McCormack-Williamson Tract. Group 2 actions consist of either detention on Staten or dredging and levee-raising along the Mokelumne River. In general, the Group 1 alternatives are much less expensive than the Group 2 alternatives according to preliminary cost estimates and are therefore more likely to receive incremental funding in the near-term. However, it is important to note that the way project Groups are presented in the EIR does not preclude simultaneous implementation of the Groups or implementation of a Group 2 action only.

Summary of Project Alternatives for Analysis in the EIR

Group 1 alternatives include one of the ecosystem restoration options on McCormack-Williamson Tract, degraded levees on McCormack-Williamson Tract to improve area flood dynamics, and downstream levee modifications. Group 2 alternatives include either one of three different detention scenarios on Staten Island or dredging in combination with levee modifications. As discussed in this document, recreation and dredging actions are optional. A more detailed description of the components of these alternatives is provided in Chapter 2 of the Administrative DRAFT EIR for North Delta Flood Control and Ecosystem Restoration project.

Alternatives/Components Considered and Set Aside

Setbacks on Bouldin Island

In response to stakeholder and Agency recommendation, the potential for setback levees on Bouldin Island to achieve flood control and ecosystem restoration objective was assessed. Bouldin Island is currently planned to provide mitigation for the Delta Wetlands project. Because the area is so deeply subsided, setback levees would provide little ecosystem benefits and would create deep pools which may encourage exotics. This deep subsidence as well as poor soil conditions would also pose greater costs in constructing setback levees. As well, because of the presence of State Highway 12, the setbacks would have to meet exceptionally rigorous design standards, which may not be financially feasible. Bouldin farm headquarters and several houses are located north of State Highway 12 and adjacent to the levee (with some houses on the levee) and would be impacted by setback construction. As well, construction of setbacks on Bouldin would necessitate a purchase of currently-farmed agricultural lands from Delta Wetlands and the Delta Wetlands project would have to look elsewhere to meet its mitigation requirements (most likely to other Delta agricultural areas) which would make agricultural land impacts a significant issue. In addition, setback levees on Bouldin would not help achieve flood control goals because of how far south in the system (and well within the area of tidal influence) they are.

Georgiana Slough Outlet Modifications

In response to stakeholder recommendation, the potential for a Georgiana Slough outlet modification to achieve flood control objectives was assessed. The key issue raised is that when the hydraulic head is high enough in Georgiana Slough where it empties into the Mokelumne River south of Staten Island, a backwater effect is caused that raises stages on the upstream forks of the Mokelumne adding stress to the system. Potential solutions include modifications to the outlet configuration, instream flow controls, or other flow barriers. Because there is a sizeable marina as well as significant State infrastructure in the vicinity of the outlet, and no willing landowner participation, Georgiana Slough outlet modifications are not financially or politically feasible. Instream flow control or other barriers (such as tide gates included in the Draft 1990 North Delta EIR/EIR) have proven to not be acceptable to navigation and wildlife interests.

Setbacks on New Hope Tract

In response to stakeholder and Agency recommendation, the potential for setback levees on New Hope Tract to meet ecosystem restoration and flood control goals was assessed. Recent efforts to construct setback levees on New Hope Tract through the Subventions and Special Projects Program have indicated that the landowner is not willing to consider setbacks along the Mokelumne. As well, hydraulic modeling has shown that setbacks along the Mokelumne River adjacent to New Hope Tract do not achieve significant upstream stage reductions and flow through McCormack-Williamson is required to achieve sizable upstream stage reductions. Also, stakeholders have clearly indicated that improvements should be focused on lands in non-private ownership. For these reasons, setbacks on New Hope Tract have not been pursued.

Upstream Dam on Cosumnes River

Stakeholder comments at the public scoping sessions included that an upstream dam on the Cosumnes should be considered for achieving flood control goals. The Cosumnes River is widely recognized as a rare and valuable ecosystem resource because it is the only remaining Sierra river without a significant dam facility. The overwhelming ecosystem impacts as well as the extreme political sensitivity of damming this river alone could render this concept infeasibility. As well, construction of a major dam facility would likely be cost-prohibitive and impact significant portions of non-public lands.

Staten Full Island Detention

Some stakeholders requested consideration of Staten Full Island detention. Because of the need to balance ecosystem, agricultural, and flood control uses, it is desirable to minimize the acreage inundated while achieving flood benefits. Preliminary modeling and stage volume estimates showed that, because Staten Island is significantly subsided, a half island or potentially smaller scenario can take off the order of volume necessary to achieve significant flood control benefits. This would result in a deeper basin, but would require less land recovery after a flood event and cause less agricultural and ecosystem impacts. Because the topography of Staten is such that soil elevations range from roughly -5' to -20' as shown in Figure 37, some pumping will be required to remove flood waters after an event. Locating a detention basin as far North as possible, such as in the half island versus full island scenario, may allow for some gravity drainage and will minimize the pumping head. This would reduce fish impacts and costs of pumping. Another reason it is desirable to locate detention basins as far north as possible and avoid full island detention is that soil conditions become highly organic and compressible as you move further south on Staten, which could cause structural problems and seepage issues. Modeling results indicated that full island detention achieves minimal additional flood control benefits when compared with other detention scenarios. As well, because of agricultural and ecosystem impacts as well as fish stranding, pumping issues, and the cost of farmland reclamation after flooding, it is desirable to minimize the amount of acreage used for detaining flood waters on Staten. The topography of Staten is such that the land surface becomes increasingly more subsided towards the south, lessening the ability for any gravity drainage of floodwaters and complicating fish-stranding and pumping issues. Therefore, it is desirable to keep detention area as far north as possible and minimize the required volume and acreage for detention.

Grizzly Slough Area Floodwater Attenuation

In response to stakeholder and Agency recommendation, the potential for Grizzly Slough area to provide additional upstream flood attenuation to help achieve North Delta flood control goals was assessed. Research showed that the area currently floods and that flood water flow patterns are such that additional and/or significant floodwater attenuation cannot be feasibly achieved. However, the Grizzly Slough area is being considered as an additional ecosystem restoration component and as a borrow source for the project.

New Hope Marina Modification

In response to stakeholder and Agency recommendation, the potential for achieving significant flood water conveyance benefits from removal and/or relocation of the New Hope Marina was addressed. HEC-RAS modeling of the channel with and without the cross sectional area taken up by the marina as performed and revealed that there is a marginal benefit from removing the marina cross-section out of the channel.

Alternative Means to Accommodate McCormack-Williamson Tract Access Provisions

There is an existing lease agreement on McCormack-Williamson Tract requiring that access be maintained to the northwest corner of the Tract, where a transmission tower is located, for any project alternatives. In order to meet the agreement terms, several options for satisfying access provisions were considered in addition to the 8.5' East levee with a paved road that is included in the current project alternatives description. These included providing access by barge from another area property and constructing a bridge across Lost Slough. These options were eliminated because of cost, environmental concerns, and impacts to private landowners.

Lining Staten Detention Basins with Clay

Lining the Staten detention basins with clay to minimize potential seepage impacts to adjacent properties was considered, but is not cost effective.

Inflatable Dam on East Levee of McCormack-Williamson Tract

In order to maximize sediment capture on McCormack-Williamson Tract, use of an inflatable dam on the East levee of McCormack-Williamson for the "Fluvial Maximum" restoration option, or Alternative 1-A in the EIR, was considered. It was hypothesized that an inflatable dam could be used to force a greater percentage of flow through the Mokelumne River breach instead of over the East levee in low and intermediate flow events. Greater flow through the breach could maximize sediment capture from the Mokelumne River. The dam would be deflated for high flow events. It was determined, however, that use of an inflatable dam would only marginally increase sediment capture, would have significant maintenance concerns, and would generally not be cost-effective for augmenting sediment capture.

Sediment Siphons on McCormack-Williamson Tract

In order to maximize sediment capture on McCormack-Williamson Tract, staff considered the use of sediment siphons to pump sediment-laden waters from the bottom of Mokelumne River to the southeast portion of McCormack-Williamson Tract. However, scientists advised that his method of sediment capture would not likely be successful since the diversion would need to be screened because of fish concerns which would slow velocities and minimize potential sediment capture.

Dead Horse Island Ecosystem Restoration

Dead Horse Island was considered as a potential site for ecosystem restoration. However, because the ground elevation within Dead Horse Island lends itself mostly to shallow water habitat creation, Dead Horse Island restoration alternatives were dropped from consideration for this planning effort. The consensus was that with the exotic species concerns regarding shallow-water habitat, the project should limit shallow-water habitat creation to McCormack-Williamson Tract and Staten Island setback levees initially. If exotic species concerns are not significant, restoration on Dead Horse Island could be pursued as later project, or different restoration techniques could be pursued at Dead Horse Island as an adaptive management strategy. As well, Dead Horse Island is in private ownership and this planning process focuses on opportunities involving non-privately held lands first.

Selling Floodwaters Collected on Staten Island to Offset Project Costs

Some stakeholders suggested that floodwaters detained on Staten Island during flood events could be stored for sale at a later date, similar to the in-delta storage envisioned on Bacon Island and Webb Tract in the Delta Wetlands Project. Sale of stored flow could then be used to offset the sizable cost of building a flood flow detention basin on Staten Island. This concept was set aside because the feasibility of the similar Delta Wetlands Project is currently questionable, the scope is too big for the resources of the current North Delta planning effort, and long-term flow storage on Staten would likely not be compatible with agricultural and habitat uses of Staten Island.

Appendix A- Chronology of Key Alternatives Development Events and Discussions

NOTE: This listing includes all of the North Delta Improvements Group (NDIG) meetings as alternatives status was discussed regularly at the meetings. It only includes North Delta Agency Team (NDAT) or Action Specific Implementation Plan (ASIP) meetings if pertinent discussion on the formation of the alternatives was involved in those meetings.

November 1990- Release of Draft North Delta Improvements EIR/EIS.

July 2000- Release of "White Paper on North Delta Improvements"- conceptual ideas based largely on 1990 Draft EIR/EIS formulated by early NDIG.

August 1, 2001 NDAT- DWR/J&S provided NDAT with overview of the North Delta Flood Control and Ecosystem Restoration Project, highlighting potential project components.

Summer 2001- Ongoing- DWR/J&S works with Delta Wide Ecosystem Restoration Steering Committee (DWERSC) to identify specific ecosystem restoration actions. In spring 2002 DRERIP scope projected to be conceptual level. Key concepts review meeting July, 2002 with ERP staff and DWERSC. Continue to coordinate with DRERIP.

September 5, 2001 NDAT- DWR/J&S informed group that DWR was working with DWERSC to help develop ecosystem actions for the North Delta Flood Control and Ecosystem Restoration Project. DWERSC anticipated having Project goals/actions available February 2002.

April 2, 2002, ASIP- DWR/J&S presented overview of the North Delta Flood Control and Ecosystem Restoration Project, including a review of alternatives outlined in white paper.

May 2002 - Refinement of White Paper configurations by DWR and J&S (largely based on emphasizing use of properties not in public ownership). Conceptual ideas remained largely the same including dredging, setbacks, etc.

June, 2002 NDIG- Presentation of Conceptual Components

June 4, 2002 ASIP- DWR/J&S presented a list of potential impact mechanisms (ie., physical disturbance, river flow) indicating which of the potential project components could trigger a given impact mechanism.

September 10, 2002 NDAT- DWR/J&S presented slides outlining the alternative components under development (same as June, 2002 NDIG) and stated that hydraulic model would help refine/eliminate some alternative components and/or result in the combination of components.

November 5, 2002 Joint NDAT/NDIG Meeting- MBK presented HEC-RAS calibration and verification and noted that model was ready to model individual components.

January, 2003 NDIG- HEC-RAS results of individual components presented.

February, 2003 NDIG- Results for combinations of conceptual components to characterize potential range of stage changes at key index points presented.

February, 2003- Public Scoping Sessions presented broad concepts for public input.

March, 2003- Summer 2003- Alternatives refinement and continued coordination through DRERIP, NDIG, NDAT, MCWA and other groups.

April 1, 2003- DWR convened Agency Ecological Restoration Coordination Team (ERCT) to kick-off brainstorm sessions on ecosystem restoration concepts.

April 22, 2003- ERCT met on refining project ecosystem goals, reviewing draft screening criteria, and developing ecosystem restoration ideas for the Project.

May 1, 2003 – Joint NDAT/NDIG meeting. Developed draft screening criteria. Refined flood goals.

May 13, 2003- ERCT met to further refine ecosystem restoration concepts for the project (later submitted to Science panel review in fall 2003).

July 31, 2003- Local landowner meeting to review most current flood control concepts and to provide feedback on how flood control concepts perform in terms of local knowledge and screening criteria.

September 17, 2003- NDIG. Presented ERCT restoration concepts to all stakeholders including Dixon, McCormack-Williamson Tract, and North and South Forks of the Mokelumne scenarios.

November 5, 2003- ERCT reviewed ecological restoration concepts to be presented to science panel.

November 13, 2003- First Science Panel Meeting.

February 10, 2004- ERCT reviewed ecological conceptual alternatives refined by input from the November Science panel meeting.

March 3, 2004- NDIG meeting. Stakeholders voted on trade-offs to clarify most important project objectives, DRAFT Alternatives Evaluation Process document released. DWR recommended to move forward with four main flood control and three ecosystem alternatives. Draft Alternatives Evaluation Process document released.

April 7, 2004- Science Panel meeting.

April 28, 2004- NDAT.

May 5, 2004- NDIG. Jeff Mount presented Science panel summary, Bill Fleenor presented Mike11 model results, DWR presented narrowing to three ecosystem alternatives on McCormack Williamson Tract.

June 23, 2004- ERCT met to review ecosystem concepts refined with input from the April 7, 2004 science panel meeting and new ideas including Dead Horse ecosystem restoration scenarios.

July 15, 2004- ASIP review of ecosystem restoration concepts.

August 19, 2004- DRERIP coordination and review of ecosystem restoration concepts.

September 14, 2004- DFG coordination and review of ecosystem restoration concepts.

September 22, 2004- NDIG. Conceptual design for detention basin cross-levee per Hultgren-Tillis report presented. Conceptual models for McCormack-Williamson Tract ecosystem restoration scenarios presented.

November 22, 2004- Meeting to brief SAFCA on Project status and relationship to a regional solution.

December 1, 2004- Mike11 modeling update on low-flow performance of McCormack-Williamson Tract scenarios presented. Sacramento County request to broaden scope to include options to provide flood protection to south Sacramento County areas.

December 15, 2004- Grizzly Slough Geomorphology Science Panel held.

January 12, 2005- NDIG. Mike11 modeling results for 1997 high flow scenarios presented. Results presented that showed stage change effects from opening Dead Horse marginal. Recreation improvements ideas presented. Discuss Sacramento County intent to fund supplemental analysis of options for EIR.

January 26, 2005- ERCT met to review Grizzly Slough restoration concepts.

January 27, 2005- Grizzly Slough Ecological review science panel held.

February 16, 2005- NDIG. Mike11 results for 1986 high flow scenarios presented. Notification that DWR management requested re-assessment of project scope, economic feasibility, and potential for phasing.

March 17, 2005- Meeting between project staff and KCRA representatives to discuss meeting lease provisions on McCormack-Williamson Tract.

April 6, 2005- NDIG. Mike11 modeling results presented including 1997 and revised 1986 events. Discussion that project alternatives be revised to include potential for project phasing in the environmental document for implementation flexibility.

May 18, 2005- NDIG. Discussion on incorporating new technologies, such as erodible-crest weir in detention components. Project grouping strategy outlined. Presentation on Staten island storage indicates diminishing return on volumes versus upstream stage decreases., discuss access issues, and other technical challenges.

July 13, 2005- Hydraulic modeling coordination team meeting to review Mike11 hydraulic modeling appendix and discuss modeling issues of concern.

July 20, 2005- Mike11 technical issues review and discussion with stakeholders.

September 23, 2005- Sacramento County and DR upper management. Confirmed decision that Sacramento County alternatives are not within the scope of the EIR. DWR agreed to convene a group to look at possibilities for solutions in the Beach Stone Lakes (BSL) and Point Pleasant area.

October 19, 2005- BSL Coordination Meeting kick-off (Subsequent meetings on November 15, 2005 and December 6, 2005 and continuing).

October 19, 2005- NDIG. Presentation of alternatives phasing and acknowledgement that phases are independent although the word implies time-sequence (later terminology changed to groups). Rough benefit-cost analysis presented by group and discussion of how to refine approaches to refined benefit-cost discussed. Stakeholders agreed to complete surveys. Acknowledgement that any alternatives will likely need to satisfy benefit-cost needs to be funded.

December 6, 2005- NDAT. Review of project description with "groups" incorporated.

December 14, 2005- NDIG- Outline of project alternatives description for EIR including project groups distributed for stakeholder comment. Review of Group 1 and Group 2 elements. Review of Grizzly Slough actions. Discussion that marina relocation not to be included in project.

Appendix B- DRAFT Proposed Alternatives Development Process (Screening Criteria)

NORTH DELTA FLOOD CONTROL AND ECOSYSTEM RESTORATION

PROPOSED ALTERNATIVES DEVELOPMENT PROCESS

July 9, 2003

INTRODUCTION

The following outline presents a proposed method for developing North Delta flood control and ecosystem restoration alternatives. Most large and/or complex planning projects use two or more levels of screening to refine project alternatives. This is also consistent with required procedures for the 404(b)(1) analysis process.

This method proposes three primary levels of screening. The first screen would be used to determine if project alternatives meet the purpose and need of the North Delta Improvements Project (NDIP), which was developed with input and review by the agencies and stakeholders participating in the NDAT, NDIG, and MCWA groups. Objectives to achieve the project purpose are being developed by the Project Team and are presented in draft below as part of the first level screen. It should be noted that development of the purpose and need statement for the NDIP was based, in large part, on achievement of the applicable goals in the CALFED programmatic EIR/EIS, as well as compliance with the CALFED solution principles. Therefore, although the CALFED solution principles are not specifically spelled out in the described alternatives development process, each alternative carried forward into the EIR/EIS must satisfy those criteria.

The second screen would be used to determine if a project alternative is viable given financial, logistical and technical feasibility parameters. As described below, the second level screen would ensure that only implementable alternatives are carried forward into the environmental document for additional analysis.

The third screen would be used to further refine alternative selection by emphasizing project outcomes that are desirable, but that can be incorporated into the project to varying degrees. For example, third level screening criteria, which are described in greater detail below, could include optimization of recreational opportunities, minimization of agricultural impacts, and minimization of impacts to privately owned land.

SCREENING CRITERIA

First Level Screening: Does the project alternative meet the stated purpose and need of the NDIP?

The purpose of the NDIP is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes.

To practicably achieve the project purpose, the project alternative should achieve the following ecosystem and flood control objectives.

Ecosystem Objectives

1. Restore ecological processes, including hydrologic, geomorphic and biologic processes in the North Delta Improvements Project area. Restoration of ecological processes could be achieved by:
   a. Promoting natural flooding processes, tidal action and appropriate salinity regimes.
   b. Improving river floodplain connectivity.
   c. Allowing channel migration, where practicable.
   d. Promoting sediment deposition, especially to increase elevations in areas of subsidence.
   e. Promoting foodweb productivity and water exchange with adjacent channels.

2. Restore self-sustaining habitats, including freshwater tidal marsh, seasonal floodplain, and riparian, in the North Delta Improvements Project area.

3. Support special status species in the North Delta Improvements Project area.

4. Limit exotic species establishment in the North Delta Improvements Project area, to the extent practicable.

Flood control Objectives

6. Provide flood control benefits to I-5 and the North Delta area by achieving a stage reduction, targeted at a water surface elevation below approximately to 16.5 feet at Benson's Ferry and below approximately 12 feet at New Hope Landing, based on the '97 event for stage and '86 event for volume.

7. Convey flood flows to the SJ River without unmitigable stage impacts.

8. Reduce risk of catastrophic levee failures during the '97 storm event for stage and '86 event for volume.

9. Control flood waters coming through McCormack-Williamson Tract in a way that avoids the historical condition where a large surge or pulse of water from McCormack-Williamson Tract adversely affected adjacent island levees (e.g., Tyler and Staten Islands) and downstream flows, and knocked boats loose from local marina moorings in flood events.

Second Level Screening: Is the project alternative viable given financial, logistical, and technical feasibility parameters?

1. Is the project alternative financially feasible?

This criterion would be used to determine whether cost would create an insurmountable barrier for implementation of a given project alternative. To determine if a project would be financially feasible, the following factors would be considered:

A. Capitol, maintenance, monitoring, and mitigation costs.

B. Net beneficial effect, based on the National Economic Development (NED) criteria.

C. Cost-effectiveness of the project alternative, relative to other project alternatives, in alleviating the identified problems and realizing the specified opportunities.

2. Is the project alternative logistically feasible?

This criterion would be used to evaluate whether any insurmountable logistical barriers associated with construction, operation, or maintenance of a project alternative could exist. The following questions could be used in this evaluation:

A. Would constructing, operating, and/or maintaining this project alternative violate federal, state, or local laws and codes? (e.g., KCRA lease agreement)

B. Would the alternative require a permit that could not reasonably be obtained?

C. Is this alternative available to the project proponent?

D. Is this alternative compatible with CALFED plans?

3. Is the project technically feasible?

This criterion would be used to identify any insurmountable technical barriers that would make it infeasible to construct, operate, or maintain the components proposed under each alternative and to determine if each alternative would function as expected. The hydraulic model would play a key role in answering the questions used during this evaluation, which could include:

A. Are there significant or unreasonable hydraulic, geotechnical, or engineering problems associated with this alternative?

B. Does this alternative rely on untested technology?

C. Is the project alternative compatible with existing sediment dynamics processes? (i.e., do existing sediment processes affect long-term viability of the project or can existing processes be used to enhance project effectiveness?)

D. Does the project alternative incorporate subsidence reversal strategies for long-term viability?

E. Does this alternative require that any unreliable sites or resources be available?

F. Does the project alternative incorporate adaptive management processes into its evolution? For example, does it involve irreversible actions? Does it include studies to address major uncertainties, such as mercury methylation and organic carbon production?

G. Does the project provide for long-term operations and maintenance and long-term monitoring?

Third Level Screening: To what extent does the project alternative meet the following desirable outcomes?

1. Does the project alternative minimize establishment of exotic fish predators? For example, does it minimize areas of slow-moving, warm water, or minimize ponds that would have water after late spring?

2. Does the project alternative maximize environmental benefits and minimize environmental damage?

   This criterion would be used to evaluate the type and relative magnitude of environmental damage caused by construction and operation of project alternatives, as well as the environmental benefits expected as a result. The following questions could be used in this evaluation, and are specifically designed to meet the alternatives analysis criteria required under Section 404(b)(1) of the CWA.

   A. Would the project alternative have adverse impacts on species listed under ESA and CESA?

   B. Would this alternative damage wetlands or other waters of the United States?

   C. Could the benefits of the alternative be achieved by implementing another alternative that would be less environmentally damaging?

D. Would the project alternative cause or contribute to violations of any applicable state water quality standard or cause or contribute to the significant degradation of waters of the U.S.?

E. Would the project increase organic carbon levels (specifically disinfection byproduct precursors) in Delta channels, degrading source water quality for municipal water systems?

F. Would the project result in environmental effects from mercury methylation and bioaccumulation?

3. Does the project alternative have a minimal impact (or mitigable impacts) on agriculture? If agricultural impacts are unavoidable, does the project alternative primarily affect agriculture that is suboptimal (subject to flooding, low arable land to levee ratio, greatly subsided)?

4. Is the project alternative compatible with the DWR Levee Program?

5. Does the project alternative maximize use of lands not in private ownership?

6. Does the project alternative maximize recreational opportunities?

7. Does the project alternative avoid negative effects on local access routes?

8. Does the project alternative maximize benefits across CALFED program elements, such as conveyance, ecosystem restoration, levees, science program, and recreation? (Reflects Prop 50 language)

9. Does the project alternative address any potential seepage concerns?

Optimization of Project Alternatives and Application of Screening Criteria

Preliminary hydraulic analyses show that McCormack-Williamson Tract (McCormack) and areas south of McCormack, such as Staten Island and the New Hope marina area, need to work as a system to meet the stated project purpose and need. Modifications at McCormack alone will not achieve the project purpose and any flood control or ecosystem restoration improvements on McCormack-Williamson Tract will result in hydraulic changes downstream (e.g., stage increase). Accordingly, improvements downstream (south) of McCormack-Williamson would be needed to mitigate for those hydraulic changes and help meet the project purpose.

The project alternatives would be developed to emphasize the following priorities:

1. Optimization of McCormack-Williamson flood control and ecosystem restoration alternatives.

2. Optimization of operation of the headworks at McCormack-Williamson through stage and damage function (e.g., will determine how much we want to open the “bottleneck”).

3. Optimization of Staten Island and area south of McCormack-Williamson through levee setbacks, detention, and other scenarios

4. Optimization of components that, when combined, meet the majority of the screening criteria.

The project screening criteria would be systematically applied to evaluate proposed project components (1) on or in the vicinity of McCormack-Williamson Tract (McCormack), and (2) areas south of McCormack, such as Staten Island

Appendix C

Science Panel Executive Summary

State of California **The Resources Agency**

M e m o r a n d u m

Date: April 14, 2006

To: Dave Mraz, Acting Principal Engineer
Delta-Suisun Marsh Office
Division of Flood Management

From: Gwen Knittweis, Senior Engineer
North Delta Program
Division of Flood Management

Subject: North Delta Science Panel

Attached are documents summarizing the four North Delta Science Panel (NDSP) meetings held in November, 2003; April, 2004; December, 2004; and January, 2005. The NDSP is comprised of scientific experts in a diversity of fields including hydraulics/hydrology, water quality, and terrestrial and aquatic ecology. The NDSP was convened to provide recommendations to DWR staff on the scientific efficacy of proposed alternatives to enhance ecosystems for the North Delta. The advisory role of the science panel is not intended to influence planning or policy decisions made in future DWR North Delta ecosystem restoration efforts.

The first two science panel meetings focused on providing feedback on McCormack-Williamson Tract (M-W Tract) project elements on or adjacent to Staten Island. The latter two meetings focused on providing feedback on Grizzly Slough elements. The NDSP feedback from the first two meetings, which focused largely on the M-W Tract and environs, was positive and the panel acknowledged DWR staff's difficult task in implementing a complex restoration project. Panel members also recognized the "enormous potential to implement a cutting edge science based restoration project without negatively affecting existing local or regional ecosystem values". However, the NDSP commented that DWR staff need to develop different approaches to meet the goal of ecosystem restoration and flood control. The development of alternatives should be hypothesis based and these hypotheses should be testable and form part of the Adaptive Management program. Subsequently, three ecological models and an alternative covering setback levees were developed by DWR staff.

The second NDSP was organized into three different subgroups at the beginning of the panel meeting; (1) Hydraulics/Hydrology and Geomorphology, (2) Mercury, Carbon, Water Quality, and (3) Terrestrial and Aquatic Ecology, Exotic Vegetation, and Mosquitoes. Each of these breakout groups summarized their key findings to the larger panel and a quick synopsis of each of the three is described below:

1.) Hydraulics/Hydrology and Geomorphology
Sediment is the limiting resource in the M-W Tract and restoration efforts should focus on maximizing flood flows that capture sediment in order to raise the elevation of the subsided portion of the M-W Tract. In addition, the restoration program should recognize the dynamic nature of fluvial and tidal contributions to the sedimentation

processes. The ultimate goal is the development of a self-sustaining ecosystem which maximizes sediment deposition on the island.

2.) Mercury, Carbon, Water Quality
The absence of information on Mercury (Hg), dissolved organic carbon (DOC), pesticides, and other water quality concerns precludes the implementation of any mitigation efforts. Additional data must be collected to evaluate the impacts of environmental factors such as physical transport processes, pollutant cycling, tidal cycles, seasonable variability, etc., on DOC concentrations and mercury methylation. The panel recommends that a water quality monitoring study focusing on mercury methylation and dissolved organic carbon be conducted to gain a better understanding of how each contaminant functions in a variety of habitats.

3.) Terrestrial and Aquatic Ecology
This subgroup stated that the overall restoration goal for the M-W Tract is to maximize development of habitat that favors native fish and bird species, and discourages exotic species and mosquitoes. Tidal and fluvial scenarios were evaluated for their impacts in achieving the restoration goal. In the case of the fluvial scenario, the sub panel recommended the M-W Tract: 1) "create habitat that is dry in summer and connected to the river and adjacent sloughs during the winter, 2) create patches of terrestrial habitat with successional riparian forests managed through plantings (reinforced levees around M-W Tract would be good for birds), and 3) discourage exotics." The sub panel commented that the tidal scenario would be much more difficult to implement because creation of a freshwater tidal marsh would likely require extensive maintenance and this type of habitat would promote establishment of exotic species.

There were multiple issues identified by the panel subgroups that may be addressed through adaptive monitoring and management programs. However the goals of (1) converting the M-W Tract to a self-sustaining freshwater tidal wetland and (2) improving sedimentation of the M-W Tract may conflict with the goal of discouraging exotics and mosquitoes. The panel recommended these issues be addressed by clarifying the goals and priorities of the M-W Tract restoration project.

The third and fourth meetings of the NDSP (January, 2005) focused on Grizzly Slough. The panel recommended that a sustainable ecosystem restoration of Grizzly Slough Tract is most suited to fluvial-riparian habitat. Tidal freshwater habitat was considered but was determined to be impractical without significant physical modification to the site. The NDSP concluded the distance from the site to the Delta was too far to have much of a tidal influence.

A more detailed description of the all above listed panel subgroup recommendations is available in Attachments 1 and 2. Attachment 1 "North Delta Science Panel II, April 2004" includes a summary of the first two meetings provided by the NDSP chair. Attachment 2, "North Delta Science Panel IV" provides a summary of the third and fourth panel meetings. Attachment 3 provides a listing of the NDSD government and university scientists.

Attachment 1

NORTH DELTA SCIENCE PANEL MEETING II, APRIL 2004
Science Panel Summary

Introduction

This document summarizes discussion at the second North Delta Science Panel meeting held in April, 2004 at the University of California, Davis. The goals of the second North Delta Science Panel meeting were to: 1) review new alternatives of the North Delta Improvement Project that optimized alternatives that consider ecosystem restoration separately from flood control; 2) review results of modeling efforts by UC Davis that evaluated alternatives; and 3) to identify overarching questions and remaining uncertainties, and to propose adaptive assessment and management actions.

During the morning session, the panel heard presentations from DWR staff regarding a new set of alternatives to consider and from Dr. Geoffrey Schladow, UC Davis evaluating the results of modeling restoration alternatives using the MIKE 11 model. During the afternoon session, the panel scientists and DWR staff broke into three groups for discipline-focused discussion (subgroup summaries are included as Appendix I, II, and III). Panel members of the breakout groups included:

Hydraulics/Hydrology and Geomorphology:

Jon Burau, Hydrologist, USGS--Hydrology/Hydraulic Modeling*
Bill Fleenor, Research Scientist, UCD--Hydrology/Hydraulic Modeling*
Joan Florsheim, Research Scientist, UCD—Geomorphology, Panel Coordinator*
Jeff Mount, Professor, UCD—Geomorphology, Science Panel Chair*
Denise Reed, Professor, UNO—Geomorphology*
Geoff Schladow, Professor, UCD--Hydrology/Hydraulic Modeling*

Mercury, Carbon, Water Quality:

Randy Dahlgren, Professor, UCD--Water Quality*
Roger Fujii, Research Chemist, USGS--Water Quality*
Mark Marvin-DiPasquale, Microbial Ecologist, USGS—Mercury*

Terrestrial and Aquatic Ecology, Exotic Vegetation, and Mosquitoes:

Lars Anderson, Research Scientist, UCD—Exotics*
Bill Bennett, Research Scientist, UCD--Fish/Aquatic Biology*
Sharon Lawler, Professor, UCD—Mosquitoes*
Peter Moyle, Professor, UCD--Fish/Aquatic Biology*
Dennis Murphy, Research Scientist, UNR--Ecology

*members in attendance for April 7th meeting

At the end of the day, each panel sub-group summarized their key findings to the whole group. A summary of the presentations and breakout group discussion follows. Finally this document identifies conflicting recommendations needing resolution.

Attachment 1

Summary of MIKE-11 Modeling Presentation

Presentation by G. Schladow

MIKE 11 is a one-dimensional unsteady model that simulates stage in rivers and the rate at which water flows into off-channel areas. MIKE 11 does not model sediment or sand deposition on floodplains. The model for the North Delta and Cosumnes River has been developed through three Masters theses (Blake, 2001; Hammersmark, 2002; and Moughamian, in progress) and validated using hydrologic records of peak discharges during 1986 (41,285 cfs; ~25 yr RI), 1998 (32,773 cfs; ~10 yr RI), and 2000 (11,791 cfs, ~2.5+ yr RI) at the Michigan Bar gaging station.

Stage gages on the Mokelumne River at Benson's Ferry (upstream) and New Hope Landing (downstream) bracket flow elevations at McCormack-Williamson Tract. Five tracts were flooded during 1986 as a result of levee breaches: Glanville Tract, McCormack-Williamson Tract (Bean Ranch), Dead Horse Island, Tyler Island, and New Hope Tract. The timing of the breaches is evident in the shape of the hydrographs with both Benson's Ferry and New Hope showing a lowering of water surface elevation in the Mokelumne River as a result of the levee breaches. Model simulations show the metering effect of a levee breach at McCormack-Williamson Tract on both the peak discharge and duration of flood flows in the Mokelumne River at both Bensons Ferry and New Hope Landing.

Nine restoration scenarios were modeled as part of Hammersmark's thesis (2002). These scenarios include levee failures upstream and downstream and with a range of options including no action, four breaches, a setback levee, and levee removal. MIKE-11 model results suggest that in all scenarios at the highest flow modeled, there is reduction in stage at Benson's Ferry. In all but two of the scenarios (#6 and #7; Hammersmark, 2002) model results also suggest that there is a reduction in stage or that stage does not vary significantly at New Hope Landing. Interannual variation in tidal datums affects the extent of subtidal, intertidal, and supratidal habitat zones.

These results suggest that it is possible to increase habitat at the McCormack-Williamson Tract without increasing flooding in upstream or downstream reaches—for example, the model predicts no negative impacts of opening McCormack-Williamson Tract to tidal and fluvial flow in an effort to restore ecosystem values. There would be a substantial benefit, however, resulting from filling McCormack-Williamson Tract early during a flood, by eliminating flood hazards associated with the "domino effect," whereby uncontrolled breaching at the upstream end of the tract during a high flow stage releases a flood wave that breaches the downstream end of the tract, and subsequently levees surrounding adjacent Islands and tracts.

Seven new scenarios based on new alternatives developed by DWR were modeled and presented to the Science Panel. These new scenarios model a range of options including levee breaching, secondary channel creation with fluvial and or tidal elements. Additionally, all scenarios share in common one design element – lowering of the eastern levee at McCormack-Williamson Tract to an elevation of 8.5 ft. MIKE 11 model results suggest that at the highest flow modeled, there is a reduction in flow stage in upstream reaches. During this high flow, the model predicts an increase in stage in downstream reaches, due to increased flood conveyance across McCormack-Williamson Tract associated with the lowering of the eastern levee.

Conclusions for old scenarios (modeled as part of Hammersmark's thesis):

- All scenarios reduce water levels at Benson's Ferry, and most scenarios reduce water levels at New Hope;
- Results suggest potential for subtidal, intertidal, and supratidal habitat types – with large variations between scenarios;
- Habitat restoration and flood peak stage reduction at both Benson's Ferry and at New Hope Landing are compatible.

Conclusions for new scenarios (modeled as part of the Science Panel processes to evaluate new alternatives developed by DWR):

- All scenarios reduce water levels at Benson's Ferry (by double the old scenarios), and 10 and 25 yr events increase water levels at New Hope;
- For 10 and 25 yr events, all scenarios yield identical model results;
- Results suggest potential for subtidal, intertidal, and supratidal habitat types – but small variations between scenarios;
- Habitat restoration and flood peak reduction are compatible at Benson's Ferry only;
- The new scenarios all increase peak flood stage at New Hope Landing.

Summary of Hydraulics/Hydrology and Geomorphology Panel Sub-Group

Sediment is currently a fundamental limiting resource in the Delta compounded with subsidence of leveed Delta Islands. Thus, restoration alternatives at MWT should attempt to maximize flood flows that capture sediment in order to raise the elevation of the subsided portion of MWT to the extent possible, and to facilitate the interaction between sedimentation and ecological processes. Sedimentation processes could be enhanced through either fluvial or tidal processes. From a physical processes viewpoint, it is not necessary to separate tidal or fluvial options—both may (and are likely to) coexist from a physical perspective. Recognition of the transitional nature of MWT between fluvial and tidal processes, and accommodating the dynamic nature of both would maximize effectiveness and minimize future maintenance.

Attachment 1

Fluvial Processes (DWR Alternative A: "Secondary Channel"

- Rename DWR Alternative A: a "secondary channel" rather than an "avulsion," because avulsion implies dynamic switching of channel location, rather than a sand splay and channel complex illustrated in the alternative.

- Restoration strategies should allow for dynamic processes, such as flooding, erosion, and deposition that create and maintain the physical structure of floodplain habitat, rather than simply allowing vegetation growth without the dynamic processes that sustain riparian forest ecology.

The goal of the MWT restoration program should be to initiate a change of trajectory toward a self-sustaining state and capture the maximum amount of sediment on the island. Experience from Cosumnes floodplain restoration efforts suggest that secondary channels will develop as part of sand splay complex formation without excavation of a starter channel. Adaptive management may be needed if flows are insufficient to keep a secondary channel open or if the secondary channel becomes blocked by sand during a flood. If monitoring shows that it is warranted, an excavated secondary channel could be constructed to convey streamflow, sediment and momentum to downstream portions of MWT during increased stages that are still below bankfull. Sand (crevasse) splay development at higher overbank stages would enhance floodplain topography as flow is routed from the Mokelumne River into the Tract through an intentional levee breach. Lowering the east levee to 8 ft, would reduce the efficiency of such a breach in focusing flood flow from the Mokelumne River onto McCormack-Williamson Tract.

Tidal Processes

The daily tidal flow may not convey a sufficient volume of sediment to raise the elevation of subsided portions of MWT through deposition of sediment from suspension, although adjacent Snodgrass Slough is apparently accumulating sediment. If tidal flow is introduced to MWT through Snodgrass Slough, and monitoring shows that deposition within the Tract does not occur, an adaptive management option to consider would be a one time only dredging of Snodgrass Slough where material excavated from the slough would be placed in the subtidal portion of MWT to raise elevations to tule colonization elevation (MLLW). Determination of the cause of aggradation in Snodgrass Slough would need to be taken into account along with other environmental factors such as water quality that limit dredging in the Delta.

Attachment 1

Summary of Terrestrial and Aquatic Ecology, Exotic Vegetation, and Mosquitoes Panel Sub-Group

<u>Fluvial Scenario</u>

The goal of restoration alternatives that focus on fluvial processes at MWT is to maximize habitat that optimizes birds, native fishes (splittail and salmonids) and discourages mosquitoes and exotics. This approach should seek to create a self-sustaining floodplain mosaic of riparian habitats. Components of this scenario should include the following:

- Minimize standing water in order to avoid mosquitoes and exotic aquatic plants.
- Monitor and manage exotics, particularly invasive aquatic plants and animals.
- Promote habitat adapts to and keeps up with sea level rise.
- Seek simplicity in design (e.g do not over-engineer) in order to allow systems to self-organize.
- DWR options #3 and #6b have some direct benefits for ecology, but the sub-group expressed concerns over excavating a channel through MWT because it could lead to standing water on site all year (e.g. problems with mosquitoes).
- An optimal management strategy would be to encourage flooding from January through late April – early May, and then drain the restoration area, keeping it dry through the summer. This would discourage exotic aquatic plants and animals and minimize mosquito problems.

To promote native fishes species such as salmon and splittail and an array of other species, the MWT should: 1) create habitat that is dry in summer and connected to the river and adjacent sloughs during the winter; 2) create patches of terrestrial habitat with successional riparian forests managed through plantings (reinforced levees around MWT would be good for birds); 3) discourage exotics.

In the fluvial scenario, water should inundate MWT for short periods of time and then drain. Alternatively, this scenario could include a wetland in lower MWT that is disconnected from the river and sloughs during the summer and fall. This wetland could receive deposition of sediment, with a pond or lake at the downstream end of the island. The subgroup felt that the wetland would not provide significant ecological benefits, but that it also would not be likely to support exotics or mosquitoes.

Attachment 1

Tidal Scenario

The sub-group concluded that the negative and positive aspects of tidal wetland restoration at MWT self-cancel. Although establishment of freshwater tidal marsh is a CALFED goal, creation of this habitat on MWT may require extensive maintenance. Major invasions of exotic plants and animals would be expected within this habitat, because of the presence of exotic species proximal to the site. Moreover, the sub-group felt that managing tides to create floodplain habitat doesn't make sense. However, should MWT be restored as a tidally-influenced system, the impacts of ponding in the downstream end of MWT will need to be addressed and may require installation of nekton gates similar to those used in Suisun Marsh. The gates which would be used to mute an intertidal range on MWT, may impact the movement of native fish on and off of the island during the winter.

Avoiding problems with standing water, stagnation, mosquitoes, and exotics in the tidal scenario would require drainage and intensive management (management at postage stamp level when problems really are really regional in scope). For example, tides will vary in magnitude and stage and interact with the uneven topography of the island, and may form standing water that is not flushed out during subsequent lower tides. These ponded areas will produce mosquitoes unless they are ditched or leveled, requiring continual monitoring and maintenance. A managed tidal system could reduce mosquitoes and egeria. This would involve limiting tidal exchange between the island and surrounding sloughs and river to the December-early May period. After early May, the island would be drained in order to eliminate any standing water. In the tidal scenario, MWT would be a wet island during the winter when exotics do less damage, and when there are fewer mosquitoes. This system would not function as a tidal marsh after this scenario. It should be noted that mosquito season is likely to lengthen due to predicted climate changes, which may modify the future flood regime.

Summary of Mercury, Dissolved Organic Carbon, and Water Quality Panel Sub-Group

There is a deficit of information on Mercury (Hg), dissolved organic carbon, and other water quality issues in the North Delta; however, within a few years there will be a series of good data sets produced as a result of current research projects. There are numerous critical uncertainties with respect to mercury methylation; however, nothing in present in the current body of knowledge is a “show stopper” with respect to restoration of fluvial or tidal systems. The panel sub-group suggested that the focus of questions that need to be answered change with each alternative for restoration-flood control that DWR proposes.

Specific uncertainties arise from the lack of knowledge about the effects of factors on mercury methylation and dissolved organic carbon. Such factors include: effects of seasonal variability, physical transport processes; pollutant cycling; pollutant functions in various sub-habitats; effects of floods, tidal cycles, temperature, wetting and drying, and submerged aquatic vegetation; interactions with phytoplankton blooms, fish or other aquatic organism's life cycles. Moreover, there is uncertainty about hydrodynamic transport of dissolved organic carbon to water intake pumps in the South Delta, potential for soil absorption, and if there is a difference between what is derived from channels vs. islands. Sediment and pesticides were also identified as pollutants: restoration of McCormack-Williamson Tract would be likely to improve water clarity downstream under most scenarios; and pesticides would be taken up by biota, or degraded on-site.

Monitoring of mercury methylation and dissolved organic carbon should be conducted to help answer questions as to how each pollutant functions within various habitats and sub-habitats is needed. This will help resolve uncertainties with respect to different habitat systems' microbial and nutrient cycles, transport processes, hydrologic and sediment regimes, and grain size distributions. Monitoring over a year/s will allow for identification of intersections by overlaying fish life cycle, floods, erosion and sedimentation, phytoplankton blooms, temperature with rate of mercury methylation, etc. These data could be used as a comparison to other nearby wetlands such as at the Cosumnes River Preserve and provide the basis for a linked sediment transport, hydrologic, mercury methylation, dissolved organic carbon model recommended by the panel.

Issues Needing Resolution

During the course of their discussions, the panel sub-groups identified several critical uncertainties that may be addressed through adaptive monitoring and management programs (see Appendix I-III). However, two issues were identified that result in incompatibilities that need resolution. These are:

1. The goal of initiating a change toward a self-sustaining freshwater tidal wetland relying on both fluvial and tidal processes and interactions conflicts with draining the restoration area and keeping it dry through the summer, in an attempt to minimize standing water, and exotics during the warmer months.

2. Capturing the maximum amount of sediment on MWT requires option such as an intentional levee breach and development of secondary channels in order to maximize sedimentation within the tract. However, the Aquatic Ecology/Exotic Vegetation/ Mosquitoes panel subgroup suggests that excavating a channel through MWT would be a problem if it allowed water to remain on site all year (e.g. problems with mosquitoes).

These issues should be addressed through clarification of goals and priorities for restoration at MWT. Additional issues related to the MWT project's goals and priorities requiring definition are detailed in the: *Summary of Issues Raised by the Science Panel at the November 13, 2003 Meeting* (Appendix IV).

Attachment 1

APPENDIX I

North Delta Science Panel Meeting II April 7, 2004

HYDRAULICS/HYDROLOGY AND GEOMORPHOLOGY

Group Summary:

Sediment is a fundamental limiting resource in delta because of subsidence and reduced supply from upstream. Restoration alternatives should try to maximize flood flows and capture sediment within MWT, and allow for dynamic processes on the floodplain, not simply riparian vegetation.

Recommend calling Alternative A: "secondary channel" rather than an "avulsion."

Experience from Cosumnes floodplain suggests that secondary channel will develop as part of sand splay complex without excavation of a starter channel. Alternatively, an excavated secondary channel could convey streamflow, sediment and momentum to downstream portions of MWT during increased stages that are still below bankfull—and sand crevasses at higher overbank stages. Lowering the east levee to 8 ft, would reduce the efficiency of an intentional levee breach in focusing flood flow from the Mokelumne River onto McCormack-Williamson Tract. Adaptive management may be needed if flows are insufficient to keep a secondary channel open or if the secondary channel becomes blocked by sand during a flood. The goal is to initiate a change of trajectory toward a self-sustaining state and capture the maximum amount of sediment on the island.

It is not necessary to separate tidal or fluvial options—both are possible from a physical perspective.

Daily tide doesn't bring in a lot of sediment. Snodgrass Slough is accumulating sediment—so an option is a one time only dredging of Snodgrass slough where material excavated from the slough would be placed in the subtidal portion of MWT to raise elevations to tule colonization elevation (MLLW).

Questions to Address in Group Discussion

1. How can existing sedimentation processes be modified to enhance ecosystem restoration and flood control? What additional efforts can be undertaken to further enhance our understanding of the sedimentation processes.

Attachment 1

Critical uncertainties:

- Sediment supply (mean annual ~440 tons/day – highly pulsed) and rates of sedimentation within MWT;
- Sediment quality (type or grain size);
- How sensitive is flood conveyance to the elevation of the eastern levee? Higher increases sediment input to island.

Adaptive Management/Experiments Needed to Address this:

Regional examination of sedimentation patterns (long-term sediment budget) – identify tradeoffs.

Concerns or recommended modifications to design:

- Use vegetation to enhance sedimentation, OM will enhance aggregation and sediment;
- Dredging Snodgrass may increase flood control, and use sediment for subtidal;
- Sand splay complex near upstream levee breach enhances topographic variation;
- Raise 8.5 ft eastern levee to get more water and sediment directly into MWT via the secondary channel.

2. What adaptive management measures might be important to incorporate into the project regarding hydraulics/hydrology, and geomorphology?

- Narrowest possible acceptable breach width (tidal or riverine), enlarge as necessary (OK if it enlarges by itself);
- Adaptive management controlled releases from upstream dams – to assist channel incision, sediment effects are likely to be marginal but should be tried;
- Try controlled breaches on tidal channels;
- Construct and maintain a 3-d model (water, sediment, and WQ) to test CM and apply results in AM framework;
- Monitoring geomorphic changes;
- Monitor this project as an experiment for future work.

3. What local geomorphic process might occur within McCormack-Williamson Tract under the different scenarios

Riverine/floodplain

- Degrading levee – sedimentation;
- Focused breaches – new channels, deposition, crevasse splays;
- Interior channel – would meander, deposit point bars, evolve to complex forms;

Tidal

- Tidal channels – low order dendritic channels;
- Ponds within vegetated marsh;
- Sedimentation within vegetated areas.

4. Can McCormack-Williamson Tract support dendritic tidal channels?

Critical uncertainties:

Will they wash out? (especially with the east levee degraded)

- Depends on time scales for development of channels vs frequency/magnitude of floods.

Tidal range locally is lower than in other parts of delta – is it enough?

- There will be channels within the marsh on the intertidal but they may not be very complex given small size of area and tidal range.

Adaptive Management/Experiments Needed to Address this:

- Could plug/re-grade drainage ditches in one area, and not in another;
- Could re-grade/till surfaces to make erosion of channels more likely in one area vs. another;
- Staged implementation – let tules develop first, then degrade the levees.

Concerns or recommended modifications to design:

- Removal of material from intertidal/subtidal is counterproductive to the development of tidal channels. No need to dig starter channels;
- Protection of interior levees from wave action may only be a concern until marshes develop (tules absorb wave energy);
- Tule planting could really kick-start sediment deposition.

5. How would opening McCormack-Williamson Tract to increased flood conveyance affect upstream and downstream areas geomorphologically?

Critical uncertainties:

- No data but CMs cover this issue.

Adaptive Management/Experiments Needed to Address this:

- Monitoring.

Concerns or recommended modifications to design:

- Alongside MWT rate of incision will decrease;
- Nothing happens upstream and downstream.

6. How would a (natural or manmade) avulsed channel through McCormack-Williamson Tract affect flooding and sediment deposition on the Tract as well as upstream and downstream from a geomorphic viewpoint? *refer to info on #7 Upstream and downstream effects*

Critical uncertainties:

- Where does the sediment we want to capture on MWT go now?

Adaptive Management/Experiments Needed to Address this:

- Monitor changes in sediment deposition in South Fork.

Concerns or recommended modifications to design:

- Cosumnes experience is scour on upstream side, deposition on downstream side.

7. What are the tradeoffs with either letting the channel naturally avulse through McCormack-Williamson Tract, constructing a channel (or a portion of a channel) through the Tract?

Critical uncertainties:

- Crevasses vs. channel avulsion uncertain? Natural avulsion usually produced by blockage/inefficiency of main channel.
- Will new channel cut into the existing substrate? Is starter channel needed?

Adaptive Management/Experiments Needed to Address this:

- Try experiment of cutting channel and seeing if natural flows can keep it open.

Concerns or recommended modifications to design:

- "Avulsion" means actually moving the channel – this may not be feasible in near term.
- What we really should call this scenario is creation of a "secondary channel" as part of an anastomosing (multiple channel) system.
- Experience from Cosumnes floodplain suggests that secondary channel will develop as part of sand splay complex without excavation of a starter channel;
- Alternatively, an excavated secondary channel could convey streamflow, sediment and momentum to downstream portions of MWT during increased stages that are still below bankfull—and sand crevasses at higher overbank stages;
- If a pilot channel is excavated, material should be used to fill lower parts of MWT (e.g. make some subtidal areas intertidal);
- Breach levee at the highest elevation part of island to increase channel cutting efficiency;
- In order to encourage more flow into the new channel increase elevation of east levee above 8.5;
- Do not armor the breach or the channel; let natural levees develop along channel.

8. Would it be ecologically feasible to construct a tidal marsh plain with imported material in the southern subtidal McCormack-Williamson Tract upon which intertidal channels might form? Would these channel systems be sustainable?

Critical uncertainties:

- Same uncertainties as #4 re. tidal channel formation;

Adaptive Management/Experiments Needed to Address this:

- Try opening first and letting tides move sediments around to produce land forms;
- Work with DCC to maximize sediment inputs.

Concerns or recommended modifications to design:

- Natural process solutions are preferred;
- One time only - dredge Snodgrass Slough and use material to fill downstream subtidal end of MWT to tule colonization elevation (MLLW).

Attachment 1

APPENDIX II

North Delta Science Panel Meeting II April 7, 2004

TERRESTRIAL AND AQUATIC ECOLOGY, EXOTIC VEGETATION AND MOSQUITOES

Group Summary:

Fluvial Scenario

Maximize habitat that optimizes birds, native fishes (splittail and salmonids) and discourages mosquitoes and exotics: floodplain mosaic of riparian habitats.

- Minimize standing water.
- Monitor and manage exotics.
- Design should promote habitat that keeps up with sea level rise.
- In this scenario, the goal is simplicity (e.g simple topography and flood regime).
- Options #3 and #6b have some benefits for ecology – but group had problems with excavating a channel through MWT because it would be a problem to have water on site all year (e.g. problems with mosquitoes).
- An optimal as management strategy would be to have flooding from January from April - May and then drain the restoration area, keeping it dry through the summer.

To promote native fishes species, e.g. salmon and splittail and an array of other species; 1) create habitat that is dry in summer and wet in winter; 2) create patches of terrestrial habitat with succession of riparian forest managed through plantings (reinforced levees around mw tract would be good for birds); 3) discourage exotics.

In the fluvial scenario, water would inundate MWT for short periods of time and then drain—or this scenario could include a wetland in lower MW. This could get some deposition of sediment, with a pond or lake at downstream end of the island that would hold water that wouldn't go through gate. May have no benefits, but wouldn't have hazards-exotics, mosquitoes.

Tidal Scenario

The negative and positive aspects of tidal wetland restoration at MWT cancel each other out, as there is a risk of not being able to create habitat that wouldn't require a lot of maintenance. Major invasions of exotics would be expected. Moreover, managing tides to create floodplain habitat doesn't make sense**.** Some problems could occur, e.g. how would fish get into island in muted regime at gates? It makes more sense to create a floodplain system instead of a tidal system and not use nekton gates.

However, a strategy for a tidal scenario would need to recognize that there would be ponding in the downstream end of MWT. To address the standing water, a nekton gate could be installed (e.g. at Suisun Marsh, a nekton gate allows muted tidal range and control mechanisms to full drain and then partial fill). This could create a muted intertidal range. .

Avoiding problems with standing water, stagnation, mosquitoes, and exotics in the tidal scenario would require drainage and intensive management (management at postage stamp level when problems are really regional), e.g. if tidal action creates berms that pools water. Tides also vary in height and the landscape is uneven, so it is likely that other pools will form in low areas during higher tides. These will not flush out on subsequent lower tide cycles. These ponded areas will produce mosquitoes unless they are ditched or leveled. The ditches will require maintenance.

In tidal scenario managed for mosquitoes and egeria:

- Tides and floods would be allowed all winter long (December to ~May), but close off after late April – May time frame.

- Tidal system would be opened to floods and tidal flow during cold part of year

- System wouldn't function as a marsh since it would be kept dry part of year.

In the tidal scenario, MWT would be a wet island during the winter when exotics do less damage, and when there are fewer mosquitoes. Mosquito season is likely to lengthen due to global warming.

Questions to Address in Group Discussion

1. Can McCormack-Williamson Tract support dendritic intertidal channels?

Critical uncertainties:

a) Do dendritic intertidal channels improve conditions for invasive species?
b) Can dendritic intertidal channels deep out egeria and other marsh exotics?
c) How do flow rates influence mosquito populations?
d) Could a managed marsh be a major exporter of carbon to the rest of the system?
e) Will a "ditched" dendritic system work from draining marshes and not create habitat for exotic fishes?

a-d above may not be essential for restoration – if draining standing water is important for mosquito control, then dendritic ditches (no standing water) may be needed).

Adaptive Management/Experiments Needed to Address this:
Create region that is dry in the summer and wet in January – April (low risk-high benefit)
Have gates that could operate experimentally to see affect on Hg, exotics, natives
Nekton gates to keep water flowing out of system (no standing water)
Artificial channel creation

Concerns or recommended modifications to design:

a) Must keep water moving through the system
b) Can control (management) at "postage stamp" (e.g. MWT in relation to the Delta) level make a difference? Issues are Delta-wide; is this an "experimental" island?
c) Can the designs keep up with sea level rise?

2. How might increasing the flood frequency on McCormack-Williamson Tract affect exotic species in the different proposed restoration alternatives?

Frequency is not as important as other variables!

Critical uncertainties:

1) What do different intensities of flooding do to exotic plants and other biota?
2) Flood frequency is not as important as duration of flooding and timing.
3) How much duration of subtidal habitat is needed to promote native fishes?
4) How much flooding before exotic plants establish? How do you keep unwanted organisms out when breaches are opened in January and February? Is it possible?

3. Which of the proposed restoration alternatives are most beneficial to native fish in the North Delta region? Other species?

Critical uncertainties:

1. How much variability in flooding is needed?
2. What kind of aquatic habitat, if any, is maintained through dry season without harming native fish?
3. What kind of terrestrial habitat can/should be created to benefit terrestrial species of concern?
4. Can excavation create diversity (or just more uncertainty)?
5. Is channel excavation even a good idea? Would it capture the Mokelumne? Probably not) What are groundwater table effects?

Assumption is that all (wildlife friendly) levees must be re-sloped on inside (8 miles) of site to support riparian forest. Will the material required be brought in from off-site or will it be excavated from on-site?

Adaptive Management/Experiments Needed to Address this:
a) Need to set goals! What do we need to maximize?

1) Splittail spawning and rearing, chinook rearing.
2) Riparian forest in multiple successional stages (make patches).
3) Discourage exotics.

Concerns or recommended modifications to design:
For splittail and chinook (and to minimize for mosquitoes and exotic plants):
#3 Breaches and Nekton gate
#6b Breaches and Nekton gate + subsidence recovery (eliminates open water habitat)

For other species:
#1 secondary channel scenario
#7ab good for birds (channel dugout for levees)
could channel be seasonal?
Would you hit groundwater and get stagnant pools?

Simpler topography an flooding regime is probably better (more manageable) – let processes create their own heterogeneity.

4. Can the proposed restoration alternatives be modified to discourage exotic species' establishment (such as submerged aquatic vegetation, exotic fish) in McCormack-Williamson Tract? What control measures should be adopted as part of the project?

Critical uncertainties:
Will short duration flooding keep out exotics?
Can public education reduce spread of exotics?

Adaptive Management/Experiments Needed to Address this:
Flooding during winter, dry during summer.
Re-vegetate with native plants, monitor for exotics.

5. Which of the proposed restoration alternatives present the greatest risk of harmful mosquito production? Can the alternatives be modified to reduce the risk of mosquito problems?

Critical uncertainties:
Mosquito season expanding with global warming;

Concerns or recommended modifications to design:
Be sure marshes drain;
Limit standing water;
Winter flood/summer dry good;

Access needed for abatement people.

6. What mosquito control measures should be adopted as part of the project?

Critical uncertainties:
Can access be created if needed?

Concerns or recommended modifications to design:
If water off early—not much of a problem.

7. What adaptive management measures might be important to incorporate into the project regarding terrestrial and aquatic ecology, exotic vegetation, and mosquitoes?

Monitor and control as needed, reconfigure habitat to discourage these species if needed.

Critical uncertainties:
Unintentional natural habitats will form.

Attachment 1

APPENDIX III

North Delta Science Panel Meeting II April 7, 2004

MERCURY, DISSOLVED ORGANIC CARBON, AND WATER QUALITY

I. Mercury (Hg)

Many critical uncertainties related to Hg cycling and dynamics were identified that make it difficult to assess which proposed restoration alternatives for MWT have the greatest risk for Hg methylation and uptake by the foodweb.

General Critical Uncertainties With Respect to Hg

1. Methylation of Hg depends on several factors such as the presence of sulfate and redox conditions conducive to microbial reduction of sulfate (sulfate reducing bacteria also methylate Hg), quantity and quality of dissolved organic carbon (DOC can bind Hg and increase total Hg in solution thereby affecting potential availability of Hg for methylation), and DOC quantity and quality, in addition to other factors (e.g., temperature), also may influence the rate and extent of Hg methylation. Therefore, understanding the relative contribution of these types of multiple controls on Hg-methylation under the biogeochemical conditions at various anticipated sub-habitats (SAV, marsh, open-water, sloughs, vs river channel) are key critical unknowns that cause large uncertainties when trying to assess which restoration alternatives will likely have the greatest risk for Hg methylation.
2. The size and configuration of levee breaches will affect the tidal prism, which will determine the relative and absolute amounts of subtidal, intertidal, and supertidal zones. The resulting habitats (big unknown) will have a significant effect on Hg cycling because of the very different biogeochemical environments associated with these habitats.
3. The variations in hydrology (big unknown), as a result of various restoration scenarios, will influence suspended sediment particle size distribution within MWT, which will impact a) Hg distribution, b) redox gradients, c) Hg/MeHg diffusion rates across the sediment water interface.
4. We currently have a very poor understanding of the physical and chemical processes that transport Hg from the sediment to the water column.
5. Transfer of Hg(II)/MeHg from the water column into the base of the food web (i.e. phytoplankton and benthic fauna) also is unknown.
6. The effects of seasonal variability Hg cycling and transport processes currently are very poorly understood.
7. Under the various proposed restoration scenarios for MWT, we need to gain an understanding of the temporal interaction between macro-biological cycles (e.g. algae, fish, etc.) and MeHg production and degradation and transport.

8. We need to determine the influence that SAV (e.g., eugaria) and emergent marsh plants (e.g., tule), have on a) sediment trapping, b) *in-situ* organic matter production, and c) rhizosphere – redox chemistry, all of which ultimately affect Hg-cycling.

II. DOC (and other Water Quality Concerns)

Dissolved organic carbon (DOC) plays two important roles of concern for restoration of MWT: DOC can be important in Hg cycling (discussed above) - as an energy source for microbial methylators and as a ligand that complexes Hg and increases total Hg in solution; and as a precursor to disinfection byproducts (DBPs) (e.g., trihalomethanes) that form when water containing certain forms of DOC is chlorinated for drinking water. The primary drinking water quality concern is whether and how much the proposed restoration scenarios will increase the loads of DOC, and more particularly DBP precursors, in water discharged from the restoration site that eventually reach any of the drinking water intakes in the Delta.

General Critical Uncertainties With Respect to DOC

1. The quality and quantity of DOC (DBP precursors) derived from different land uses (e.g., floodplain, agriculture, wetland) and discharged to the channel water need to be assessed to determine whether restoration activities that alter the land use patterns will result in increased discharge of DBP precursors.
2. The hydrodynamic transport of DOC to the drinking water intakes.
3. The (photo) and biological degradation and bioavailability of DOC transported to the drinking water intakes.
4. Combination of #1, 2, and 3, determine the forms of DOC produced by restoration activities, the residence time in channel waters before reaching the intake pumps, and the potential for degradation and consumption for DOC precursors. These (unknowns) together will determine whether the DOC produced from restoration activities will pose a significant drinking water problem.
5. Will pesticides be degraded or taken up as a result of restoration?
6. Will the MWT restoration improve water clarity downstream as a result of particle trapping, thereby increasing potential for primary productivity?

III. Adaptive Management / Experiments Needed to Address Hg and DOC Uncertainties:

1. Review and synthesize all existing scientific studies regarding Hg and DOC currently taking place around the MWT, in the Delta, and in other analog environments.
2. Plan to develop a Hg-DOC model for the system, linked to the hydrology and sediment transport model.
3. Paired floodplain studies with the MWT and the Cosumnes, focusing on Hg and DOC.
4. Baseline studies of Hg/MeHg concentrations and DOC quantity and quality in soils and sediments.
5. Linked Hg-MeHg-DOC net flux experiments from the MWT as a function of sub-habitats.

6. Mesocosm studies in and nearby the MWT to investigate Hg-cycling dynamics and effects of DOC quantity and quality.
7. Develop annual cycle conceptual models for key processes (Hg-transformation dynamics, phytoplankton blooms, hydrology, nutrient cycles, primary consumer and fish life cycles, etc…).
8. Laboratory-based photo and microbial DOC degradation studies on waters collected from habitats representative of those expected to exist in the MWT restoration. Assess changes in DOC quality due to degradation studies, especially with respect to changes in DBP precursor content and changes in DOC-Hg interactions.
9. Compare and contrast DOC quantity and quality from currently existing wetlands: both seasonally flooded areas and diurnally flushed wetlands.
10. Particular attention needs to be focused in areas that are subject to fairly long periods of drying followed by an intense precipitation or irrigation event. Under these conditions, significant "flushing events" for both Hg methylation and DOC production from soils have been observed in the Delta.

Attachment 1

APPENDIX IV

Summary of Issues Raised by the Science Panel at the November 13, 2003 Meeting

Introduction

The University of California, Davis Watershed Center, under contract with The California Nature Conservancy, convened a panel of scientific experts to assist and assess the California Department of Water Resources' North Delta Flood Control and Ecosystem Restoration project (formerly called the North Delta Improvements Project, NDIP). The project seeks to "implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species and ecological processes." A summary of the NDIP and related documentation can be found at http://baydeltaoffice.water.ca.gov/ndelta/northdelta/. The project's Science Panel is charged with evaluating proposed efforts to enhance ecosystems of the North Delta and to recommend alternatives where appropriate.

The goals of the first meeting were to review the status of the North Delta Improvement Project and to evaluate DWR's efforts to meet the project's ecosystem objectives. During the morning the panel heard presentations from DWR staff on the project. The afternoon was spent interacting with staff on critical hydrologic and ecologic uncertainties and components of the project's design. The final hour of the meeting consisted of panel members only, with no DWR staff in attendance.

The Science Panel is composed of 13 government and university scientists with expertise in a broad range of disciplines. Current members include:

Lars Anderson, Research Scientist, UCD—Exotics*
Bill Bennett, Research Scientist, UCD--Fish/Aquatic Biology*
Jon Burau, Hydrologist, USGS--Hydrology/Hydraulic Modeling*
Randy Dahlgren, Professor, UCD--Water Quality*
Mark Marvin-DiPasquale, Microbial Ecologist, USGS--Mercury
Bill Fleenor, Research Scientist, UCD--Hydrology/Hydraulic Modeling*
Joan Florsheim, Research Scientist, UCD—Geomorphology*
Roger Fujii, Research Chemist, USGS--Water Quality*
Jeff Mount, Professor, UCD—Geomorphology*
Peter Moyle, Professor, UCD--Fish/Aquatic Biology
Dennis Murphy, Research Scientist, UNR--Ecology
Denise Reed, Professor, UNO—Geomorphology*
Geoff Shladow, Professor, UCD--Hydrology/Hydraulic Modeling*

*members in attendance for November 13th meeting
The Panel Chair is Jeff Mount and Panel Coordinator is Joan Florsheim

The following is a summary of comments, conclusions or recommendations made by panel members:

Attachment 1

General Observations

- The panel sees enormous potential to implement a cutting-edge science-based restoration project experiment without negatively affecting existing local or regional ecosystem values. Combinations of the ecosystem restoration and flood hazard reduction goals can, with further exploration, provide a pragmatic approach toward managing the North Delta. The panel looks forward to working with DWR staff to achieve these goals.

- Given the potential of the NDIP, and the expressed intent on the part of DWR to attempt to optimize flood control and ecosystem restoration, the panel felt that it is important that a greater range of alternatives be considered and their relative flood/ecosystem benefits be explicitly stated. This will allow an assessment of trade-offs in project design.

- The panel felt that the overall project is still relatively unformed and there is a lack of specificity about what the project hopes to accomplish. It was difficult for the panel to assess constraints, including political, financial, hydrologic and ecologic, and their rationales. These need to be developed better by DWR staff.

- To date there has been limited reliance on ecosystem science in merging goals, objectives, and alternatives for the project. It is anticipated that the Science Panel will assist in incorporating this into the project. However, design considerations and objectives appear to be driven principally by flood control issues, with ecosystem restoration goals a secondary objective. Rather than driving design, ecological objectives are adjusted to fit into the overall flood control objectives. The panel recognizes that tradeoffs come with making decisions in ecosystem enhancement—e.g. cost effectiveness, flood impacts, etc. DWR needs to explicitly define priorities, however. If DWR is trying to optimize ecosystem restoration and flood control goals it needs to define alternatives that support ecosystem restoration without constrains imposed by flood control.

- One of the stated goals of the project is sustainability. DWR needs to more explicitly define this and to demonstrate relative differences in sustainability of project alternatives. If a goal is to be sustainable, DWR should demonstrate what can be achieved without engineering manipulation and without alternatives that require long-term maintenance.

- If the stakeholder scoping process drove flood control constraints, then other stakeholders with environmental restoration goals besides TNC should be recruited into the scoping process; e.g. resource agencies and other environmental groups. These stakeholders need to be included in an integral way into the modeling and planning process rather than in the currently separate efforts of the agency ecosystem group.

Attachment 1

Panel Recommendations

- Merge principles, goals, objectives and alternatives so that they are evaluated in a consistent manner. For example, the goal of being sustainable is not consistent with elements of some alternatives, such as dredging; the goal of promoting natural disturbances may not be consistent with flood control; the goal of creating dendritic channels may not be appropriate at MWT—because of the potential dominance of fluvial processes. Cross correlate every principle, goal, and objective with each alternative to see if it meets the criteria. This will allow a systematic evaluation and comparison of alternatives.

- Develop alternatives that create sustainable function rather than a particular habitat. In a dynamic fluvial-tidal system like the North Delta, habitat mosaics will evolve with time and may ultimately lead to the disappearance of some habitat types. For example, a design for dendritic channels may not persist due to fluvial disturbances.

- Develop separate alternatives to meet the goal of ecosystem restoration at MWT. For example develop restoration alternatives for MWT that do not significantly change stage in the North Delta system. This will aid in identification of elements that are critical to restoration, without first negating them.

- In order to evaluate alternatives distilled out of this first meeting, a systematic approach needs to be developed to assess ecosystem benefits separate from flood control benefits. Once completed, then the two assessments can be blended to evaluate optimization approaches. This would involve defining projects that maximize each of the following:

  1. Restore sustainable ecosystem function at MWT
     a. without regard to flood control
     b. without increasing flood hazards

  2. Reduce flood hazard upstream of MWT

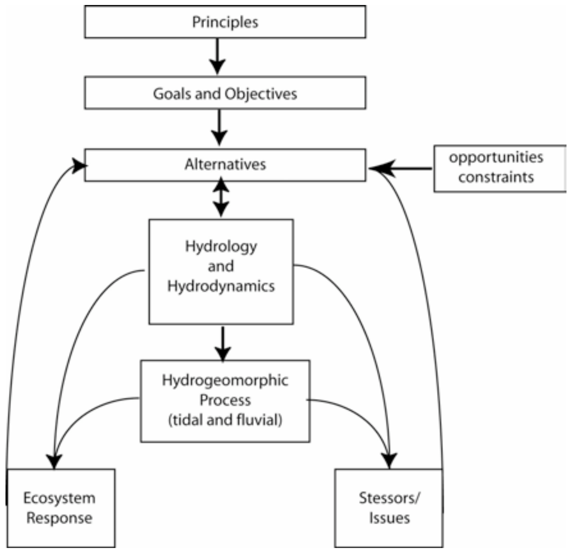
  3. Reduce flood hazard downstream of MWT

  4. Combinations of 1 with 2 and 3

- Use these (new) defined alternatives to develop an adaptive management strategy as the elements of adaptive management must be based on predicted ecosystem response and both science-based ecological and flood metrics.

- Predict ecosystem-response and stressors to each alternative using science-based ecological metrics. The panel recommends developing relationships that can be applied across the alternatives to use as an evaluation tool. The following figure provides an illustration of the recommended process.

Attachment 1



- Develop a matrix to show relative benefit of alternatives—e.g. high, minimum low. Such a matrix may look like this:

Alternative I	Metric	High	Medium	Low
	Metric 1			
	Metric 2			

- In order to achieve the best possible result, the project alternatives need more scientific analysis that addresses the way the project is likely to work, based on analogue and professional literature. In order to accomplish this, the panel recommends analyzing IEP datasets, data from the Yolo Bypass work, and the Cosumnes floodplain work to define and quantify relationships that identify potential physical drivers, trends (not statistical relationships), and pathways leading to ecological response. Uncertainties identified through this process should drive the adaptive management process—where specific hypotheses are posed and tested. In this way, the project may be implemented as an experiment that furthers restoration science. Some of this analysis needs to be iterative, for example to address water quality, food web dynamics, etc., the modeling scenarios need to be defined and output provided.

- It is important that the ecosystem science portion of the project be hypothesis-based. These hypotheses should be testable and form part of the Adaptive Management program. For example: Hypotheses (1) a restored MWT will be dominated by fluvial processes that will, through time, eliminate dendritic channels formed in tidal areas. Alternatively, Hypothesis (2) a restored MWT will develop dendritic tidal channels that will remain tidal.

Attachment 1

- The panel recommended that anticipated ecosystem responses and metrics should be developed by DWR. Many of these will rely on modeling output and field surveys to illustrate specific conditions and further analyze ecosystem response. Multiple models will need to be developed that are not currently available. A selection of these include:

  Links between MWT hydraulics and anticipated geomorphic response;
  Links between hydrogeomorphic processes and riparian forest establishment and growth;
  Links between spring snowmelt flows and native fish use of MWT;
  Biological models that describe predator-prey relationships, presence-absence relationships of particular species

- Example: The approach developed in upstream sand splay complexes at CRP levee breaches can be used to predict the evolution of splay complexes at MWT. If splay complexes are a defined element of the restoration then use a hydrogeomorphic model to predict sand splay evolution, assess available information to define expected relationships and to develop experimental design. If elements are totally unknown, or there are critical uncertainties, then define targeted research.

- Example: project design is currently based on one or two floods. New modeling will be needed evaluate how various (new) restoration alternatives perform under a range of flood and tidal flow conditions. Rather than using one or two "design" flows, modeling should address intra and interannual variation, since ecological responses will be tied to processes at this time scale. This hydrologic modeling should form the foundation for assessment of anticipated ecosystem responses.

- While the development of two independent hydraulic models provides a range of information on the physical components of the North Delta system, the panel has some concerns about the separation of modeling efforts where the HEC-RAS model is developed to address flood control analysis and a MIKE-11 model is developed to address ecological restoration analysis. Now that both models are up and running, the panel recommends running the models side by side, using the same input parameters and boundary conditions to address modeling uncertainty in all of the alternatives. Of particular concern are some of the key hydraulic unknowns in the system that have not been addressed (e.g. the lack of small to moderate flood magnitudes in the flood control analyses and impacts of alternatives on Dead Horse Island).

- In fluvially-dominated tidal systems, elevations become critical for planning ecosystem restoration. DWR needs to identify geometric and elevation relationships between:1) interior of subsided and non-subsided portions of MWT, Staten, Dead Horse, and adjacent Islands, Tracts; 2) river and slough channel bathymetry; 3) levee top elevations; 4) local tidal datum range; 5) modeled flood stages at a range of recurrence intervals. Quantification of these relationships is needed to help assess what processes are likely to occur and resulting ecosystem function, as well as the feasibility of various alternatives.

- In order to assess the potential for ecosystem restoration, high quality information is needed on special status species in the North Delta. These surveys need to be assembled and analyzed. Where information is lacking, surveys need to be conducted.

- Exotic plants and animals are a significant concern for the North Delta. To date, there has been no comprehensive analysis of the state of invasives in the North Delta. Additionally, strategies need to be developed to encourage natives and discourage exotics.

- If dendritic tidal channels are a goal of the MWT restoration, then the panel recommends that DWR utilize the tidal gradient at MWT and full tidal exchange to allow tidal channels to self-organize, without engineering intervention—tidal channels will be oriented toward the lower breach, not toward Mokelumne River. Because the transition between intertidal and supratidal/ fluvial depend on interactions between the Mokelumne River and Camanche dam flows, the Cosumnes River, and flows through the Delta Cross Channel, a combination of modeling and geomorphic analysis is needed to investigate the process-function relationships possible under different restoration scenarios.

- Mercury methylation and bioaccumulation was not discussed during the panel meeting, but will be taken up at a future meeting. However, several panel members suggested investigating the role of coarse sediment deposition as a possible mechanism to minimize meHg.

SUMMARY

The panel was generally positive about the potential ecosystem restoration benefits of the NDIP, and was supportive of DWR staff's efforts on this complex project. Most panel members felt that rather than optimizing flood control and ecosystem restoration, the flood control objectives appear to be driving the project at this point. The project would benefit from a systematic evaluation of the flood control and ecosystem benefits of a greater range of alternatives. This evaluation would test all project alternatives equally against project objectives.

The panel identified a range of critical uncertainties that will need to be addressed through targeted research, development of process-response models, and adaptive management. These uncertainties will be addressed more specifically in the next panel meeting to be scheduled in the new year.

Attachment 1

Panel Next Steps

It was recommended that the Panel reconvene in January or February for a second meeting. The one-day meeting would be structured to address key uncertainties identified in the first meeting. The first two hours of the meeting would be spent reviewing "global" issues that have arisen, including answers from DWR to our criticisms or suggestions. Then, from 10-3, specific groups would break out and work with DWR staff to discuss critical specific issues and how they might address them through experiment and analysis. The subgroups would refine the questions that need to be addressed, identify what output is needed from existing models, define metrics to measure or predict ecosystem response, and develop recommendations on how to tackle larger scientific issues. At the end of the day the whole group will reconvene, with each break-out group summarizing their recommendations, answering questions from the rest of the panel and integrating the conclusions of the subgroups. Subgroups (with some overlap) would include:

- Water Quality—addressing DOC, Hg, food web support
- Ecology—fish, exotics, riparian forests, ecosystem responses
- Hydrology--hydraulics, hydrology, geomorphology

The third and final meeting of the science panel would include evaluation of the outcome of DWR's incorporation of recommendations into planning process.

The following is a list of questions provided to the Science Panel prior to the November 13th meeting. These questions will help guide the second meeting.

Panel Questions

General Questions

- How can the model of "what would the system it revert to without constraints" be incorporated into the project planning process so the project can restore natural processes?
- How will conceptual models be assessed?
- Why can't do ecosystem rest at MW with no change in flood control?
- Why are there 4 alternatives for Staten and only one for MW—what are viable ecosystem restoration alternatives besides variance in levee breach width?
- Are these the right alternatives to optimize both flood control and ecosystems restoration?
- Is the Benson ferry target driving the need to use aggressive flood control measures in MW instead of looking at the criteria needed for ecosystem restoration?
- Is there time to do proposed demonstration projects before EIR process begins?
- Are previous ecosystem alternatives modeled by UCD being considered? If not, why not?
- Why is 2-ft reduction at Benson's Ferry target?

- What is the ecological, economic benefit of the proposed Dixon channel? Why do Dixon channel at all?
- Why lower stage upstream of MW if it is potentially growth inducing?

Hydraulics-Hydrology-Modeling-Design

- How much control does anyone have over Camanche releases—and how could that uncertainty affect the project?
- How long do floods last (duration, stage)?
- What is the duration of flood reversals?
- What is the minimum threshold for floods—e.g. what is minimum threshold (magnitude, timing, duration, etc) to show have met ecosystem restoration goals?
- How much does future development potential affect hydrology, e.g potential Morrison creek urbanization will increase stage?
- How much has storage capacity been reduced by new levees around urbanizing areas south of Sacramento?
- Do flood targets consider duration of flow at high and low magnitudes?
- What is flood recurrence interval that would overtop east levee?
- What is conveyance of the Mokelumne River channels without flow through at MW?
- Are there are other ways to get flood flows through MW?
- Does dredging increase conveyance and if so, how much does it reduce flow stages?
- How does dredging below sea level increase flood conveyance?
- If lower MW is open and MW is full of water, is degradation of east levee needed to eliminate surge?
- Are new levees required for flood storage on Staten a new threat to downstream areas on the island—if new Staten levee overtops e.g. would there be the same surge as there currently is on MW when the east levee fails accidentally?
- At what stage will detention basins start being filled?
- How long would water be stored?
- Are setback levees being considered?
- Why maintain levees around MW at all if the downstream end will be open anyway?
- What are the trade-offs between setback levees and detention basins for flood stage reduction?
- Why excavate the channel through Dixon instead of simply letting flood water over flow onto this floodplain area and re-create a riparian forest?
- Is flood energy enough to scour out interior of MW without excavation of channels?
- If diverted water into MW through the Mokelumne River instead of the Dixon channel what would happen?
- How far could levees be degraded and still dampen fetch?
- What alternatives are there for the kind of feature that could modify fetch related erosion at New Hope Levee?

- Does water get through proposed Dixon channel any faster than it already does by way of Middle Slough?

Ecology-Fish-Exotics

- What are the fish stranding issues associated with the detention basins?
- How does flow duration govern what vegetation survives there?
- How would exotics like arundo donax and pepperweed be kept out of the proposed Dixon channel? How will the project mitigate for new exotic plants?
- Can get fish out of the proposed Dixon channel through culverts?
- How does the project support special species habitat? Will be predators from deep
- subtidal zone enter into the intertidal and fluvial zones?
- How can self sustaining habitat be restored at MW and Dixon?
- If lower MW becomes full of exotics, why keep production there? Why produce for exotic species?
- Are "natural" relationships between natives and water depth affected by the presence of predators in this currently disturbed system? What are the implications for restoration?
- What is the best way to minimized mosquitoes problems?
- How will ecological responses to physical structural system built be assessed?
- What hydrologic residence time is important to get the maximum productivity, are there negative effects of increasing residence time at MW?

Water quality

- What are the water quality issues associated with the detention basins?
- If demonstration projects that are already 4 years old haven't reached steady state—how can predict long-term DOC and carbon cycling at restored MW through demonstration projects?
- Are water quality effects and exotics issues that will prevent implementation of the project, or do food web or other benefits outweigh these issues?
- How will increased residence time of sediment, water in a restored MW affect DOC?
- How does groundwater flow affect DOC?
- Will the meHg problem reduce over time as the system traps coarse sediment and reverts to floodplain?
- What is needed to promote salinity regime required by North Delta habitat?

Geomorphology-Sediment

- Would Dixon channel help get sediment into Dixon floodplain and MW?
- Does excavating sediment from MW deplete sediment in storage at the expense of new channel formation (formed by splay channel aggradation and progradation)?
- Is system sediment limited?

Attachment 1

- What is the volume of material needed in the various alternatives (for individual elements) and what are alternative sources of that sediment? e.g. how much sediment would not building islands save from the need for excavation?
- What would hybrid tidal-fluvial channel look like?
- Is a hybrid tidal-fluvial channel possible and would it persist?
- What recurrence interval of flood would “blow-out” tidal morphology in MW?
- Can the system get both functional tidal and fluvial processes or is it a trade-off? What is the optimal plan for floodplain and optimal plan for tidal habitat? What is the desired function/habitat as MW fills in, e.g. in 30, 50 years?
- What processes would dominate the system in the absence of intervention?
- Why remove lower levee down to grade if that would just allow sediment to be flushed from site?
- Can tules help retain sediment? How much?
- Under what scenarios could channel migration in the Mokelumne occur; e.g. would the levee have to be removed, or would there have to be a true avulsion event with new channel formation?
- Could Middle Slough be integrated into the alternatives to re-create multiple channels that once dominated morphology?
- How many breaches optimize habitat potential?
- Where should breaches be placed—what criteria are applied to select breach openings?
- What is hydrologic (tidal and flood) and hydraulic difference between placing breaches in the Mokelumne River, vs. in Snodgrass Slough?
- What are the potential effects of a fully tidal vs. modified tidal range on restoration of sustainable physical processes and habitat at MW?

Attachment 2

NORTH DELTA SCIENCE PANEL MEETING IV
GRIZZLY SLOUGH ECOLOGY
JANUARY 2005
Science Panel Summary

Introduction

This document summarizes discussion at the forth North Delta Science Panel meeting held on January 27, 2005 at the University of California, Davis (UCD). The goals of the forth North Delta Science Panel meeting were focused specifically on Grizzly Slough, and included: 1) an update of geomorphic assumptions used order to develop conceptual restoration alternatives for the Grizzly Slough Tract; and 2) a briefing of ecological considerations.

During the January meeting, project background information revised conceptual alternatives were presented by Department of Water Resources (DWR) staff and Philip Williams Associates (PWA), and Environmental Sciences Associates (ESA) consultants to DWR. The science panel present included:

Peter Moyle, Professor, UCD—Fisheries and Wildlife Biology
Sharon Lawler, Professor, UCD—Entomology
Wendy Trowbridge, Post-doc, University of Nevada, Reno
Jeff Mount, Professor, UCD—Geomorphology, Science Panel Chair
Joan Florsheim, Research Scientist, UCD—Geomorphology, Science Panel Coordinator

This document provides a summary of key panel recommendations and considerations to aid DWR in their planning efforts. The recommendations are based on the panel's research experience in the North Delta including the Cosumnes, Mokelumne, and Dry Creek Rivers, the area including Grizzly Slough, and on issues raised previously by the 13 member North Delta Science Panel during the first two North Delta Science Panel Meetings and the Hydrology and Geomorphology Panel subset during the third meeting focused on Grizzly Slough.

Attachment 2

Summary of Panel Ecology (and Hydrology and Geomorphology) Findings and Recommendations

During the January meeting, the science panel questioned assumptions related to Grizzly slough ecology, hydrology and geomorphology and posed three fundamental questions in order to help focus restoration options:

- Could the proposed project restore tidal freshwater marsh environment?
- Could the proposed project potentially restore floodplain processes?
- Could the proposed project potentially sustain floodplain ecology?

The panel suggests that the Grizzly Slough Tract is appropriate for fluvial process and riparian restoration; even through the lower part of the site is tidally influenced.

Potential Restoration of Tidal Freshwater Marsh

The Grizzly Slough Tract is within the zone of tidal influence, where water in low elevation sloughs adjacent to the site is subject to tidal stage fluctuation. However, fluvial processes near the confluence of Dry Creek and the Cosumnes River are likely to dominate geomorphic processes such as flooding, erosion, and deposition.

The panel considered the feasibility of creating tidal freshwater marsh habitat at the site and suggested that because of the distance of the site upstream of the Delta, tidal freshwater habitat could not be achieved without significant grading. Instead, the tidal influence at the Grizzly Slough site is likely to be manifested as variation in low flow water levels (over an approximately 2-foot tidal range) similar to the stage variation in the Cosumnes River channel adjacent to the Cosumnes River Preserve. However, this tidal fluctuation would not drive processes in this fluvial-tidal transition zone. Thus, the panel recommends that sustainable ecosystem restoration is most suited to fluvial-riparian habitat.

Questions arose related to the effect of tidal influence at lower end of site with respect to mosquitoes and exotic fish. The panel suggested that mosquitoes are not likely to be a big problem as the upper part of the site will dry out during the warm summer months. However, if ponded areas persist into late spring (April-May), *Anopheles freeborni* mosquitoes may begin to breed appreciable numbers. Tidal exchange in the lower part should minimize mosquito problems. Some maintenance may be required to encourage tidal flushing or to reduce dense stands of emergent vegetation where mosquitoes can thrive. Areas with tidal influence would be dominated by non-natives in summer as it is everywhere in the Delta; however, winter and spring conditions would bring native fishes to the site.

Attachment 2

Restoration of Floodplain Processes

Modification to the conceptual restoration designs based on recommendations from the December 15 Science Panel meeting show a branch of Dry Creek routed across the Grizzly Slough tract from east to west with various options for levee removal utilize the existing gradient and provide opportunity for restoration of floodplain processes. The panel felt that this configuration addressed issues raised at the December meeting. Questions remaining (e.g. would a channel form without excavation?; would an excavated channel fill in with sediment?; would breaches promote sand splay development? Would an excavated swale adjacent to the new channel promote riparian establishment? How does the timing of flooding in the Cosumnes and Dry Creek influence fluvial processes?) could be addressed through adaptive assessment and monitoring and potential phasing of the project. A suggestion from the panel was to assume Dry Creek as the source of sediment form splays instead of expecting uncertain transport regime from Grizzly slough to create a splay.

Restoration of Floodplain Ecology

The site contains an appropriate range of elevations to promote restoration of floodplain riparian species. The panel suggested that vegetation management may be required if conditions for establishment of cottonwood and willow are not met during the first year of the restoration project, e.g. if the ground is not flooded at the right time of year, and if the rate of drawdown is so rapid that it isolates roots of seedlings. If riparian species are not established during the first year, bare ground is likely to be overrun with exotics. Disking could be an option to renew "disturbance" required for establishment, however, suitable methods for exotics removal would need to be reviewed with relevant agencies. Questions related to succession potential that depend on disturbance regime or recruitment from upstream areas could be addressed through adaptive assessment and monitoring. The lowest portion of the site within the tidal range is likely to be dominated by Scirpus and slightly higher areas by annual grasses. The range of tidal inundation and associated plants is likely to shift during the next several decades due to global warming and sea level rise.

Key Habitats and Species
Key habitats that could be promoted through restoration of the Grizzly slough site include seasonal floodplain with primary successional riparian vegetation. Native species that would benefit most from the proposed conceptual restoration design would be chinook salmon, splittail, minnows, sandhill cranes, and Swainson's Hawk.

Regulatory Issues
The proposed conceptual designs would not be a detriment to any species of concern.

Mowing is generally not an option due to potential harm to giant garter snake. Note that if the site was maintained as an agricultural area, disking and harvesting would be allowed.

Attachment 3

North Delta Science Panel Members

Topic	Scientist	Affiliation	Expertise
Geomorphology	Jeff Mount	UC Davis	fluvial processes, restoration
	Joan Florsheim	UC Davis	fluvial and tidal processes, restoration
	Denise Reed	Louisiana State University and Ecosystem Restoration Program Independent Science Board	tidal processes, restoration
Hydrology and Hydraulic Modeling	Geoff Schladow	UC Davis	
	Bill Fleenor	UC Davis	
	Jon Burau	U.S. Geological Survey (USGS)	
Fish/Aquatic Biology	Peter Moyle	UC Davis and Ecosystem Restoration Program Independent Science Board	Bay-Delta fish biology
	Bill Bennett	UC Davis	Delta smelt
Ecology and Exotics	Dennis Murphy	University of Nevada and Ecosystem Restoration Program Independent Science Board	terrestrial ecology
	Lars Anderson	UC Davis	aquatic ecology
Water Quality	Randy Dahlgren	UC Davis	nutrients
	Roger Fujii	US Geological Survey	organic carbon
Mercury	Mark Marvin DiPasquale	US Geological Survey	
Mosquitoes	Sharon Lawler	UC Davis	vector research

Appendix D
Overview of Ecological Conceptual Models

Appendix D
Overview of Ecological Conceptual Models

DWR staff, in coordination with Agency and other scientists, developed the following conceptual models to illustrate the scientific principles and hypotheses underlying ecosystem restoration alternatives for McCormack-Williamson Tract (M-W Tract). These conceptual models were developed in response to recommendations from science panel review of early North Delta Flood Control and Ecosystem Restoration Project ecosystem restoration concepts. The science panel recommendations recognized 1) the necessity for a greater range of alternatives to meet the goal of ecosystem restoration at M-W Tract and 2) the need to focus on creating sustainable function rather than a particular habitat due to the dynamic nature of the Delta. Therefore, the ecological conceptual models cover a variety of process-oriented goals as follows:

- Ecological Option 1 Conceptual Model (Attachment 1)

The main objective of this alternative is to promote sedimentation through fluvial and to a lesser extent tidal processes. The M-W Tract represents the transition from wetlands to riverine habitat in the Delta. A starter channel would be cut off of the Mokelumne River into the M-W Tract to promote the riverine processes. A secondary channel should then form within M-W Tract. To promote tidal processes, the southwest levee would be degraded to land surface elevation, -2.5' msl. This would allow the formation of tidal channels at appropriate elevations, near sea level.

- Ecological Option 2 Conceptual Model (Attachment 2)

The main objectives of this alternative are to benefit floodplain spawning fish and to discourage exotics. By lowering the east M-W Tract levee to 8.5' msl, the M-W Tract would flood every year during the January to May period. The M-W Tract would drain through the use of self-regulating tidal gates and would be dry during the summer, thereby reducing exotic aquatic species issues. Self-regulating tidal gates, placed in the lowest elevations in the south, would allow some tidal action during the winter-spring (January-May). These gates would partially fill during incoming tide, and fully drain during outgoing tide. The southwest M-W Tract levee would be lowered to 5.5' msl to enhance flow-through during flood events. Existing agricultural pumps would be used to pump the area after floods.

- Ecological Option 3 Conceptual Model (Attachment 3)

This alternative is similar to II in benefiting floodplain spawning for fish, but also provides a subsidence reversal demonstration project area in the south. The subsidence reversal demonstration project area would be created by building a cross-levee at 5.5’ msl to isolate the southern tip of M-W Tract. The southwest levee would be degraded to 5.5’ msl to enhance flow-through during flooding events. The subsidence reversal demonstration project would be effectively isolated from the channels and the rest of the M-W Tract except for in flood events. Water would be siphoned onto the subsidence reversal demonstration project area to grow tules and enhance accretion rates; thereby building up elevation in this area. Alternative subsidence reversal techniques, such as thin-layer sediment addition could be part of this demonstration project. During flood events the tule marsh may also enhance sedimentation in this area. The subsidence reversal project area could also serve as a rearing area for Sacramento perch. Existing agricultural pumps would be used to pump the area after floods.

- Staten Island Setback Levee Conceptual Model (Attachment 4)

The Staten Island Setback Levee Conceptual Model was developed with the technical assistance and oversight of the Ecological Restoration Coordination Team (ERCT). The ERCT consisted of representatives from the State Department of Fish and Game, U.S. Fish and Wildlife Service, NOAA Fisheries, The Nature Conservancy, and the California Bay-Delta Authority. The goal of the ERCT was to come up with innovative ideas in developing alternatives with the dual purpose of ecological restoration and flood control. Each of these alternatives was then submitted to the science panel for comment and revision. DWR incorporated the recommendations of both the ERCT and the science panel into the final conceptual model discussed below:

The Setback Levee model proposes creating additional shallow water, shaded riverine aquatic and riparian habitat on Staten Island. This will be accomplished by constructing a setback levee on the island, and degrading and or breaching the existing levee. Two different setback levee arrangements are proposed in the conceptual model to facilitate establishment of riparian habitat and emergent marshlands. The abandoned existing levees and will support special status species and increase food web productivity.

Attachment 1

North Delta Flood Control and Ecosystem Restoration Project
Ecological Option 1 (Fluvial Max-Minimal Control)
Conceptual Model

Objectives

- Promote natural flooding processes
- Improve river floodplain connectivity
- Promote foodweb productivity and water exchange with adjacent channels
- Restore freshwater tidal marsh, seasonal floodplain, and riparian habitats
- Promote bioaccretion and sedimentation through flooding, riverine and tidal processes
- Allow channel migration
- Support special status species
- Limit exotic species establishment

Hydrology

Mokelumne River stage

The average stage in the Mokelumne River for the typical growing season (March-September) is 2’ NGVD. Stages throughout the year typically range from less than a foot below sea level to about 5’ NGVD, although stages can reach 10-12’ NGVD in some years due to high water events. Mokelumne River flows are affected by Camanche Dam releases, Delta Cross Channel operation and other factors.

Tidal range in the Mokelumne River is about 3 feet. The following tidal elevations were published by NOAA for the Mokelumne River at New Hope.

English Units (feet)

	Tidal Datum (MLLW=0)	NGVD 29
MHHW	3.08	**3.31**
MHW	2.69	**2.92**
MTL	1.54	**1.77**
MLW	0.36	**0.59**
MLLW	0.00	**0.23**

NGVD 29.
National Oceanic and Atmospheric Administration (NOAA) from the New Hope gage data for the period of November 1978 to October 1979.

The tidal elevations would be somewhat muted on McCormack Williamson Tract (M-W Tract) due to the size and location of the breach. High tide levels within the Tract will be less than stages in the River except for perhaps during flood periods.

Text below uses the following definitions:
Subtidal indicates area remains inundated at MLLW.
Intertidal indicates inundation at MHHW but not MLLW
Supratidal indicates inundation by above average tidal levels and flood pulse flows but not MHHW.

Hydraulic modeling of previous restoration options (one with 4 breaches about 160' wide) performed by UC Davis staff showed subtidal habitat as great as 1200 acres (about 3/4s of the M-W Tract) although much of the subtidal habitat was less than 1.6 feet deep. Intertidal habitat ranged from about 5-20% of the area. Supratidal habitat was about 100 acres. Formation of subtidal, intertidal and supratidal habitat is very sensitive to water year type (interannual variation), Mokelumne River stages and Camanche Dam releases, and Delta Cross Channel operation. It is not clear how the current alternative would result in formation of subtidal, intertidal and supratidal habitat (currently being modeled).

Natural Flooding Processes
The M-W Tract was historically riverine (Florsheim, Mount). A breach in the Mokelumne River levee and excavation of a channel into the interior of the M-W Tract would facilitate flooding areas historically associated with a riverine system. This channel would overbank flood at relatively low stages (allowing flooding perhaps 10 times each winter). The overbank flood events may result in deposition of suspended sediment.

In addition, larger flooding events would be facilitated by degrading the east levee (currently at about 17-18.5' NGVD) to 8.5' NGVD. These larger flood events (estimated to occur 2-3 times per year) will occur over the entire east levee.

Riparian vegetation will colonize the higher areas of M-W Tract. Flooding events will import propagules such that willows and cottonwoods will naturally colonize. Once established, young willow and cottonwoods should be able to access the relatively shallow groundwater.

Wetter areas should develop into tule marsh. Because the southwest levee is degraded to land surface elevation, tidal waters will enter the Tract from the South as well as to a lesser degree through the Mokelumne River breach. Tidal exchange should occur over much of the Tract.

Fish stranding should be unlikely since much of the M-W Tract will be subject to tidal waters and therefore hydrologically connected to the exterior channels at least on a daily basis.

Hypotheses:

\Many flooding events (perhaps 10x per year) will occur through the Mokelumne River breach.

Annual flood events (perhaps 1-3x per year or more in wet years) will occur over the entire east levee and shown in Figures 1-3 which shows stages over 8.5 NGVD (the height of the proposed East levee at nearby Benson's Ferry gage for a representative dry, wet, and average water year).

Suspended sediment may be deposited in the Tract from flooding and tidal processes.

Native riparian trees such as willows and cottonwoods will establish on the higher areas of the floodplain.

Vegetation may increase sediment capture.

There will not be significant fish stranding on the floodplain because much of the Tract will be hydologically connected to the outer channels at least on a daily basis.

Riverine Processes

A breach in the M-W Tract Mokelumne River levee will allow a secondary channel of the Mokelumne River to flow through the Tract. The Mokelumne River historically meandered onto the M-W Tract (Florsheim, Mount). The breach will be placed towards the northern end of M-W Tract and the resulting secondary channel would be perennial, allowing maximum river flow through the Tract. The breach would be 300' in width, with a central 100' width that degraded to 0' NGVD, allowing flow onto the M-W Tract most of the time. Maintaining this hydraulic connection would allow any fish in the secondary channel the ability to exit the Tract and reenter the Mokelumne River. 100' of either side of the central 100' would be degraded to 3.5' NGVD. The rationale for the higher shoulder breach would be to increase the breach width to 300' during higher Mokelumne River stages. The average stage in the Mokelumne River for the typical growing season (March-September) is 2' NGVD. Stages throughout the year typically range from less than a foot NGVD to about 5' NGVD, though they are as high as 10-12' NGVD during flood events.

A starter channel may be excavated to increase the effectiveness of the breach in facilitating Mokelumne River flow onto the M-W Tract. The starter channel would be dug approximately 1200' feet into the M-W Tract. The channel would be dug to -3' NGVD. With at least three feet of water in the channel, it is likely that the channel would remain open water (as opposed to supporting emergent vegetation which might eventually clog the channel). Also, -3' NGVD is probably the deepest one would want to excavate the channel as the groundwater table is very shallow and digging deeper might not be feasible. The channel, including the starter channel, would have the ability to migrate over time.

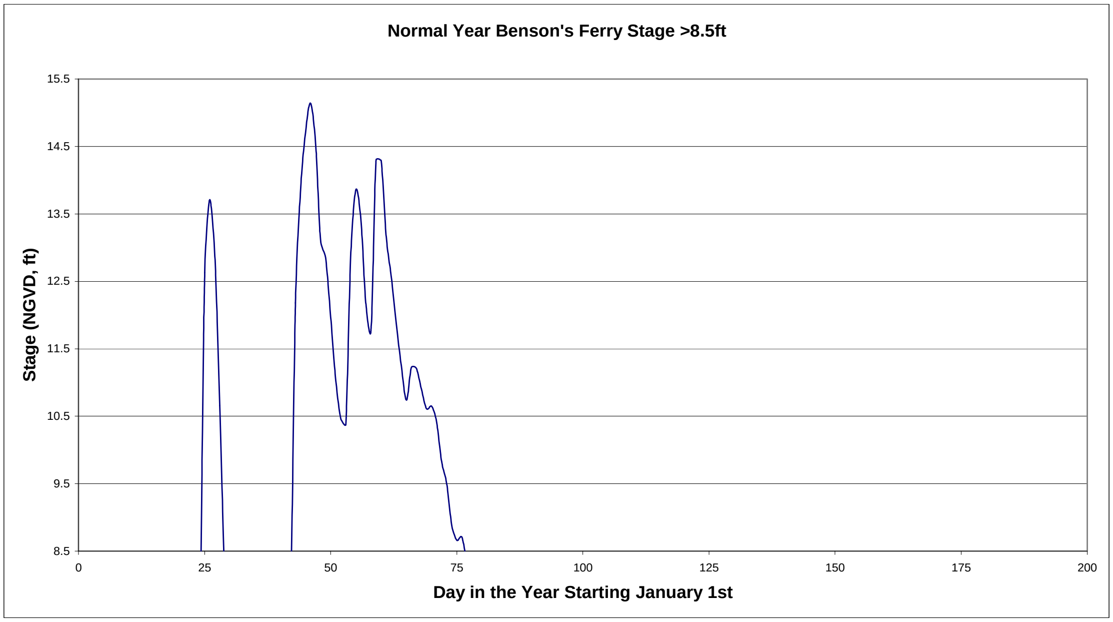


Figure 1. Water stages exceeding height of M-W Tract east levee for average rainfall year (2000), based on Benson's Ferry gage data provided by the Department of Water Resources California Data Exchange Center (CDEC).

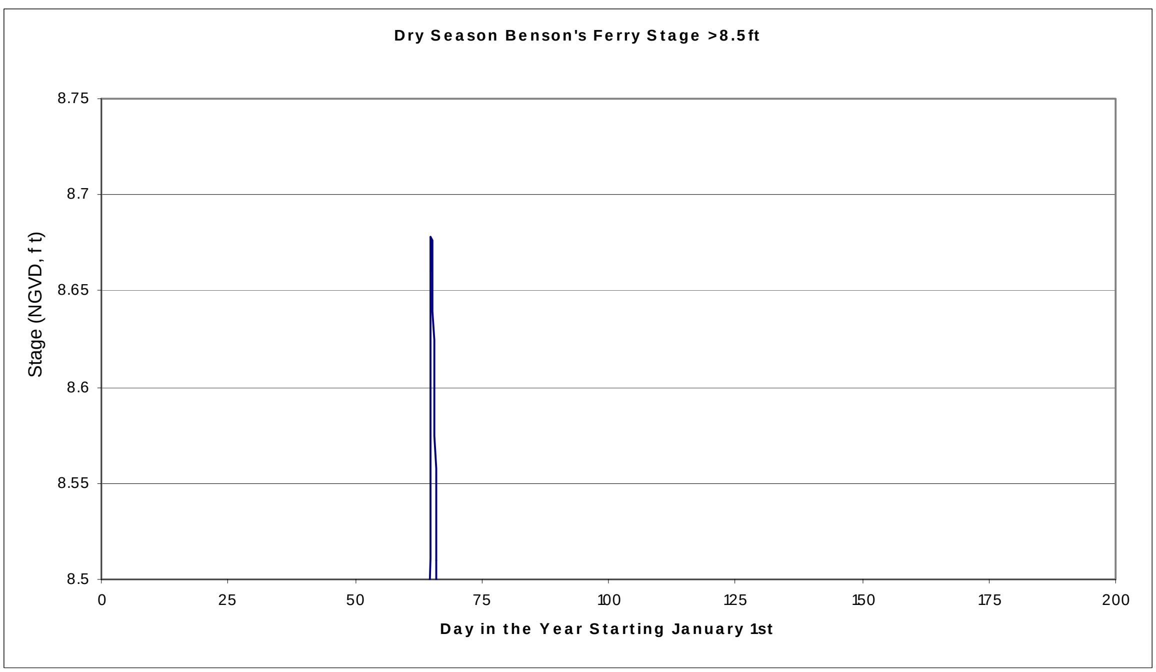


Figure 2. Water stages exceeding height of M-W Tract east levee for lower than average rainfall year (2001) based on Benson's Ferry gage data provided by the CDEC.

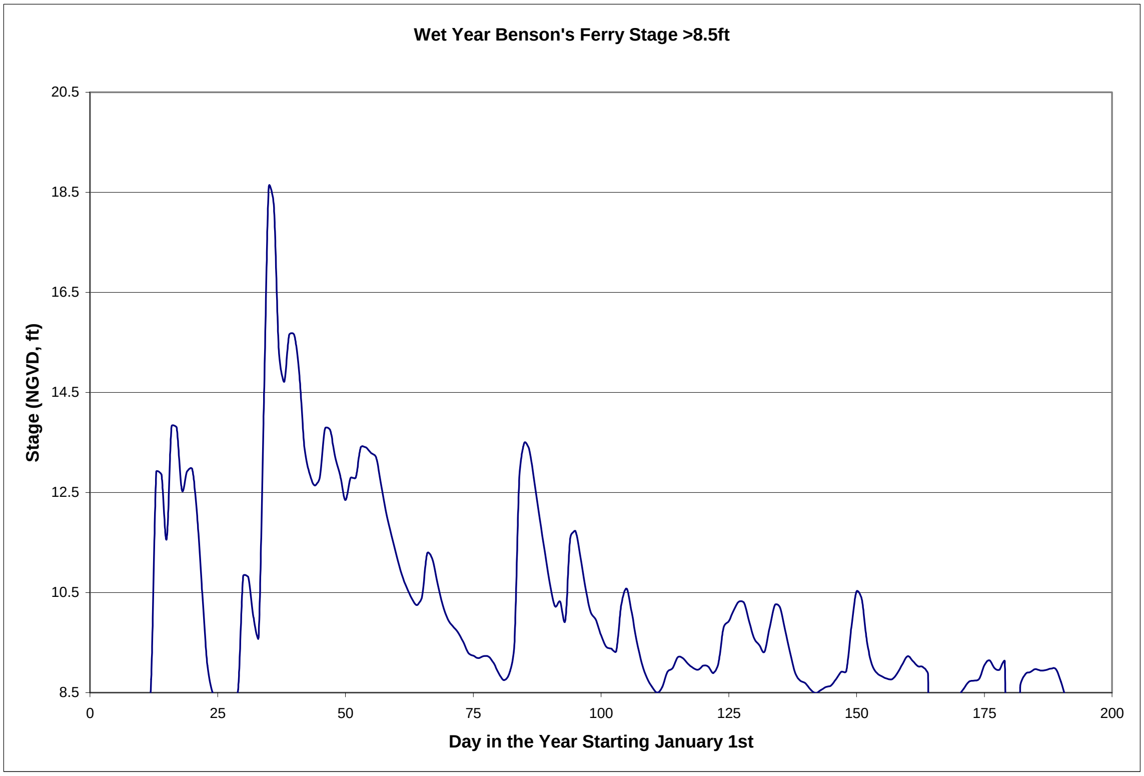


Figure 3. Water stages exceeding height of M-W Tract east levee for higher than average rainfall year (1998), based on Benson's Ferry gage data provided by the CDEC.

Hypotheses:

A breach in the M-W Tract levee will allow Mokelumne River water to flow onto the Tract.
Excavation of a starter channel will facilitate flow onto the M-W Tract.
Nonnative vegetation and fish will not dominate the channels.
The starter channel will remain open water and not clog due to emergent vegetation or deposited sediment.

Dendritic Intertidal Channels

Dendritic intertidal channels in M-W Tract may achieve ecosystem restoration goals of restoring habitats, processes and species given current conditions. In geologic time (late Quaternary), the M-W Tract area alternated between an area that was more riverine to an area where tidal influence (and tidal wetlands) predominated (Atwater 1982, Mount). The Atwater maps show that tidal wetlands likely extended to the eastern boundary of M-W Tract. Mokelumne River flows are now moderated by detention upstream. Also, exotic species now dominate the Delta biological system. However, as discussed below, there may be competitive advantages for native species in a dendritic intertidal system.

A dendritic intertidal wetland system can benefit native fish species by providing a maximum amount of edge habitat (due to the extensive channel network and associated vegetation) while having the majority of channels shallow enough so that there is daily drying of the channels, preventing the establishment of exotic submerged aquatic vegetation (Kimmerer and Reed, Adaptive Management Workshop). Nonnative SAV establishes in deeper stagnant water and nonnative fish have been found to be associated with this habitat (Grimaldo et al.). Native fish should benefit from the food resources of the edge habitat.

The backwater sloughs, such as the current Delta Meadows area, are reminiscent of what many people conceive as historic delta wetland habitat. However, the channels are relatively deep (5-10 feet deep), slow-moving stagnant water and support exotic vegetation (Egeria densa). Fish monitoring has found primarily exotic fish associated with this exotic vegetation (Whitener, Crain). Native fish are now more likely to be found in fast-moving water, riprapped banks, channel habitat. However, native fish species continue to decline; therefore, it is possible that riprapped channel habitat may not provide the necessary food resources for native fish.

The dendritic intertidal habitat would be created by fully degrading the southwest levee down to land surface elevation allowing full tidal access to the Tract. The lower part of the Tract (elevations -3’ NGVD to 0’ NGVD) would probably not support channel formation but would be areas of open-water habitat. Dendritic intertidal channels would be expected to form where the elevation is at least 0.5’ greater than sea level (the central portion of the Tract). It is assumed that enough tidal energy would be retained as water passes through the southern portion of the Tract to form dendritic intertidal channels in the central portion of the Tract. Another possible outcome is the formation of emergent marsh without defined tidal channels.

Hypotheses:
Dendritic intertidal channels will form over time in areas greater than 0.5’ NGVD.
There will not be permanent water in fingers of the intertidal dendritic channels.
Enough tidal energy will be retained from water moving through the southern breach to form tidal channels in the central portion of the Tract.
Dendritic intertidal channel habitat will contribute to the Delta foodweb.

Open Water/Tule Marsh
The southern portion of the M-W Tract will likely be open water. As stated above, elevations are -3’ NGVD to 0’ NGVD and given tidal ranges of approximately 3’ NGVD, average water depths would be about 3’. This would likely be an area of relatively warm, slow-moving water. It is possible that submerged aquatic vegetation and warmwater fish would colonize, mainly exotic species. Although establishment of these likely exotic species is not desired, it is a necessary byproduct of opening the M-W Tract to tidal action.

[One possible strategy to lessen the likelihood of colonization by exotic species in the southern open-water area of M-W Tract is to establish tules in the southern area before degradation of the southwest levee. Areas of dense tule growth may prevent the establishment of submerged aquatic vegetation because there would be no open water for exotic plants to colonize. However, it is uncertain whether tules could survive 3' inundation. Also dense tule growth might lessen tidal energy such that dendritic intertidal channels are not formed at higher elevations further inside the M-W Tract.]

Hypotheses:
The southern portion of the M-W Tract will be open-water with gradual transition to tules as elevations are increased.
Sedimentation will occur as the result of tidal action.
Sedimentation will be enhanced when the Delta Cross Channel is open and Sacramento River water is in the area.
Warmwater fish and submerged aquatic vegetation will colonize the open-water area.
[Dense tule growth in the southern portion of the M-W Tract may prevent establishment of submerged aquatic vegetation.
Tules will persist in the southern portion of the M-W Tract after inundation.]
Adding dredged material before opening the M-W Tract will increase elevations and may lessen likelihood of submerged aquatic vegetation establishment.

Riparian
Low-slope wildlife-friendly levees will be built on the interior of levees surrounding the M-W Tract. These levees will add geotechnical stability to the levees, especially when the interior is subjected to water during the annual flooding events. In addition, they allow for gradation of habitats, from upland, to riparian/scrub-shrub, and emergent marsh and mudflat (when the interior is inundated).

Hypotheses:
Wildlife-friendly levees will add stability to the land-side of the perimeter levees.
Wildlife-friendly levees will provide upland, riparian, scrub/shrub, emergent marsh and mudflat (when interior flooded) habitats.

Overall
Riverine and flooding processes will be restored to M-W Tract by breaching the Mokelumne River levee and degrading the entire southwest levee. By opening the system to riverine, flooding and tidal processes, natural processes may be restored. Channel and floodplain habitats, dendritic intertidal channels, emergent marsh, and open-water should exist. Flooding may affect any dendritic intertidal channel development, perhaps filling in any channels that form. Over time, with enhanced flooding and tidal processes, bioaccretion and sedimentation may result in increased elevation.

Hypotheses:
Natural processes (flooding, riverine, and tidal) can be restored by opening the M-W Tract to adjacent channels.

Channel and floodplain habitats, dendritic intertidal channels, emergent marsh and open-water habitats should exist.
Dendritic intertidal channels may be disturbed due to flooding events, but should reform during the summer months.
Elevations should increase over time due to bioaccretion and enhanced sedimentation.

References

Atwater et. al., History, Landforms and Vegetation of the Estuary's Tidal Marshes. pp. 347-385 in AAAS. 1979.

Bennett, W.A. and P.B. Moyle. 1996. Where have All the Fishes Gone: Interactive Factors Producing Fish Declines in the Sacramento-San Joaquin Estuary. In JT Hollibaugh ed. *San Francisco Bay: the Ecosystem.* San Francisco AAAS, Pacific Division.

Crain, P. Personal Communication.

Florsheim, J.L and J.F. Mount. 2002. Restoration of floodplain topography by sand-splay complex formation in response to intentional levee breaches, Lower Cosumnes River, California. *Geomorphology*. 44. pp. 67-94.

Grimaldo et al. Personal Communication.

Kimmerer and Reed, March 2002. CALFED Adaptive Management Workshop.

Reed, D. Understanding Tidal Marsh Sedimentation in the Sacramento-San Joaquin Delta, California. Journal of Coastal Research, Special Issue 36, 2002.

Reed, Denise. Coastal Biogeomorphology. An Integrated Approach to Understanding the Evolution, Morphology, and Sustainability of Temperate Coastal Marshes. pp. 347-362. In Estuarine Science. Edited by John Hobbie. 2000.

Rozas, Lawrence P. and T.J. Minello.   Marsh Terracing as a Wetland Restoration Tool for Creating Fishery Habitat. pp. 327-341.

Whitener, K. Personal Communication.

Williams, P.B., M.K. Orr and N.J. Garrity. September 2002. Hydraulic Geometry: A Geomorphic Design Tool for Tidal Marsh Channel Evolution in Wetland Restoration Projects. *Restoration Ecology*. Vol 10. No. 3, pp. 577-590.

Williams, G.D. and J.B. Zedler. Fish Assemblage Composition in Constructed and Natural Tidal Marshes of San Diego Bay: Relative Influence of Channel Morphology and Restoration History. Estuaries. Vol. 22, No. 3A. pp. 702-716. Sept. 1999.

Zedler, Joy. Ed. Handbook for Restoring Tidal Wetlands. 2001.

Zedler, J.B. and J.C. Callaway. Tracking Wetland Restoration: Do Mitigation Sites Follow Desired Trajectories? Restoration Ecology Vol. 7 No. 1 pp. 69-73.

Zedler, J.B. G.D. Williamson, and J.S. Desmond. Wetland Mitigation: Can Fishes Distinguish between Natural and Constructed Wetlands? Fisheries. Vol. 22, No. 3. pp. 26-28.

Attachment 2

North Delta Flood Control and Ecosystem Restoration Project
Ecological Option 2 (Fish Ecological Maximum-Maximum Control)
Conceptual Model

Objectives

- Provide annual floodplain spawning habitat
- Limit aquatic exotic species establishment by drying Tract during summer months (July-December)
- Promote annual flooding and associated sedimentation
- Reconnect Mokelumne river and associated McCormack-Williamson Tract floodplain
- Promote foodweb productivity on floodplain and water exchange with adjacent channels with annual flooding events
- Restore seasonal floodplain and riparian habitats
- Support special status species
- Limit terrestrial exotic species establishment with weed control

Hydrology

Mokelumne River stage

The average stage in the Mokelumne River for the typical growing season (March-September) is 2' msl. Stages throughout the year typically range from less than a foot below sea level to about 5' msl, although stages can reach 10-12' msl in some years due to high water events. Mokelumne River flows are affected by Camanche Dam releases, Delta Cross Channel operation and other factors.

Tidal range in the Mokelumne River is about 3 feet. The following tidal elevations were published by NOAA for the Mokelumne River at New Hope.

English Units (feet)

	Tidal Datum (MLLW=0)	NGVD 29
MHHW	3.08	**3.31**
MHW	2.69	**2.92**
MTL	1.54	**1.77**
MLW	0.36	**0.59**
MLLW	0.00	**0.23**

NGVD 29.
National Oceanic and Atmospheric Administration (NOAA) from the New Hope gage data for the period of November 1978 to October 1979.

Tidal action on McCormack Williamson Tract (M-W Tract) would be limited to flow through self-regulating tidal gates.

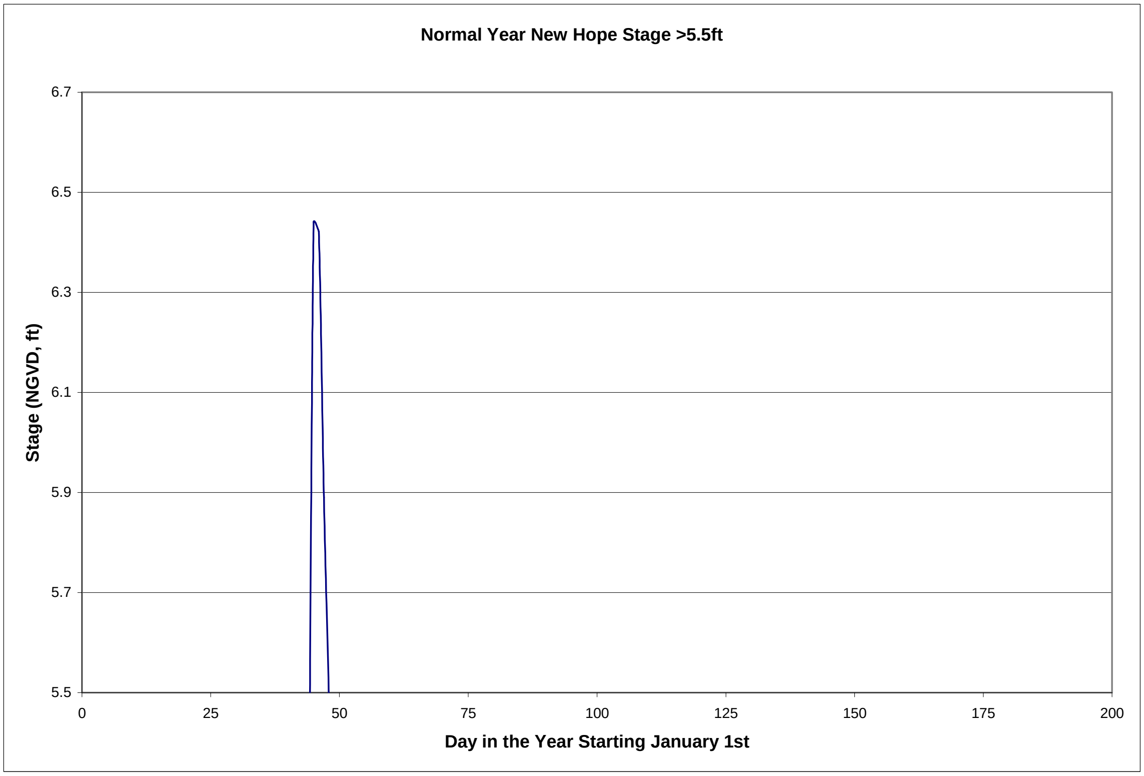


Figure 1. Water stages exceeding height of M-W Tract southwest levee for average rainfall year (2000), based on New Hope Tract gage data provided by the Department of Water Resource's (DWR) California Data Exchange Center (CDEC).

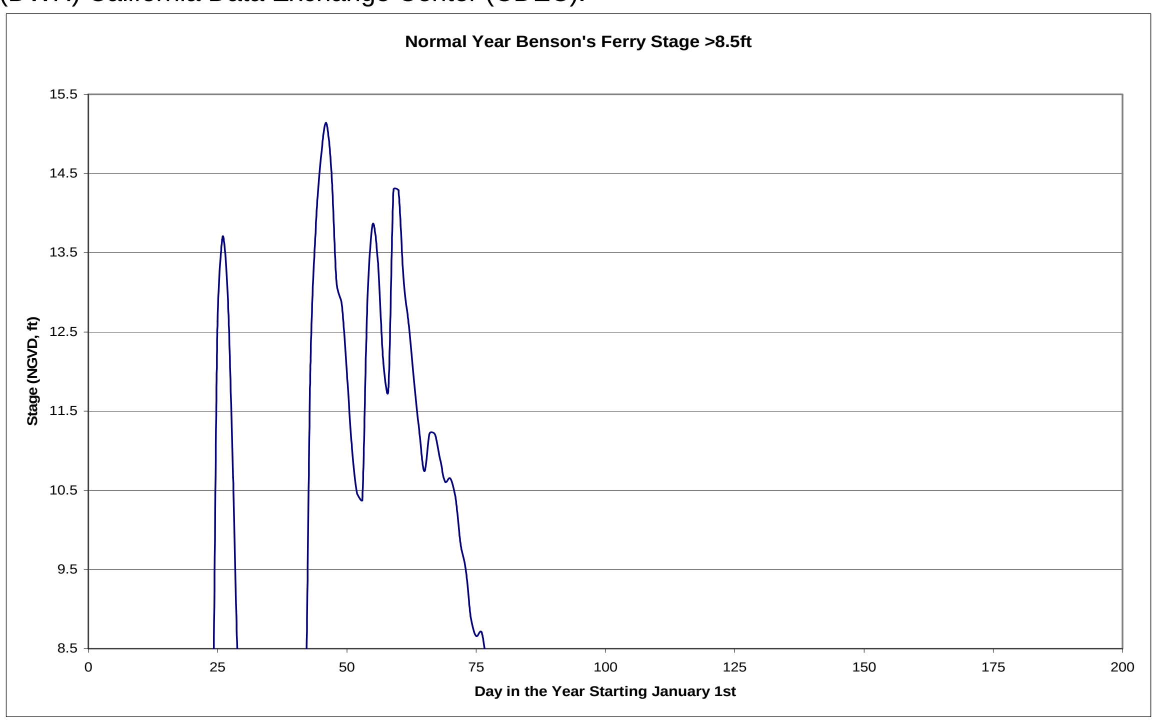


Figure 2. Water stages exceeding height of M-W Tract east levee for average rainfall year (2000), based on Benson's Ferry gage data provided by CDEC.

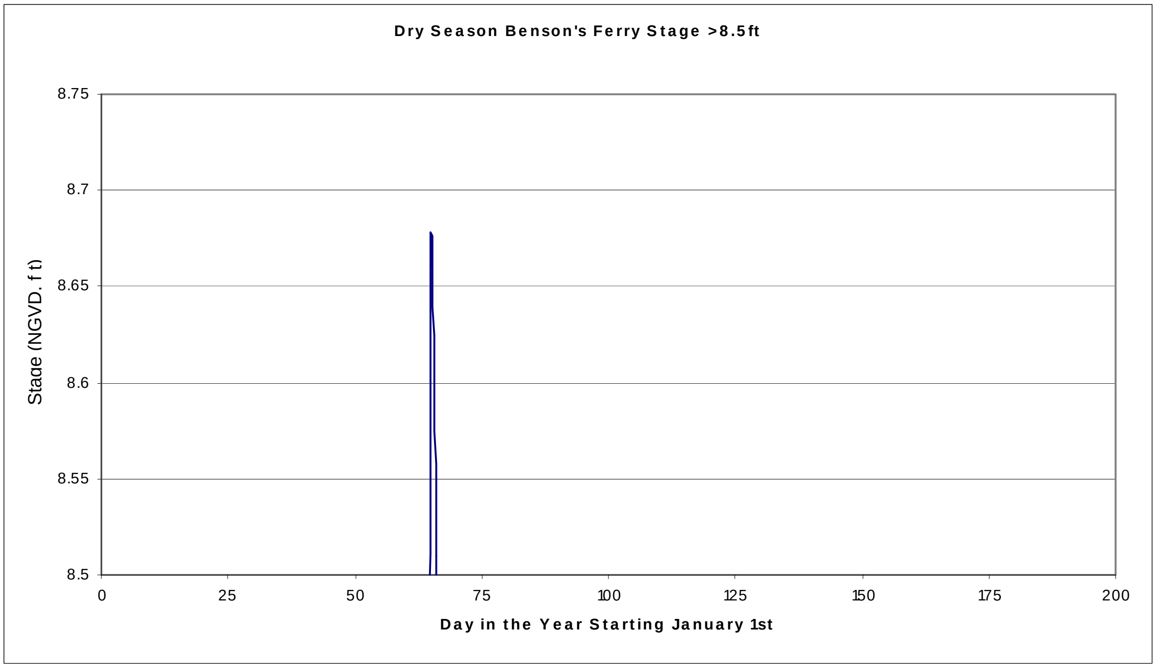


Figure 3. Water stages exceeding height of M-W Tract east levee for lower than average rainfall year (2001) based on Benson's Ferry gage data provided by the CDEC.

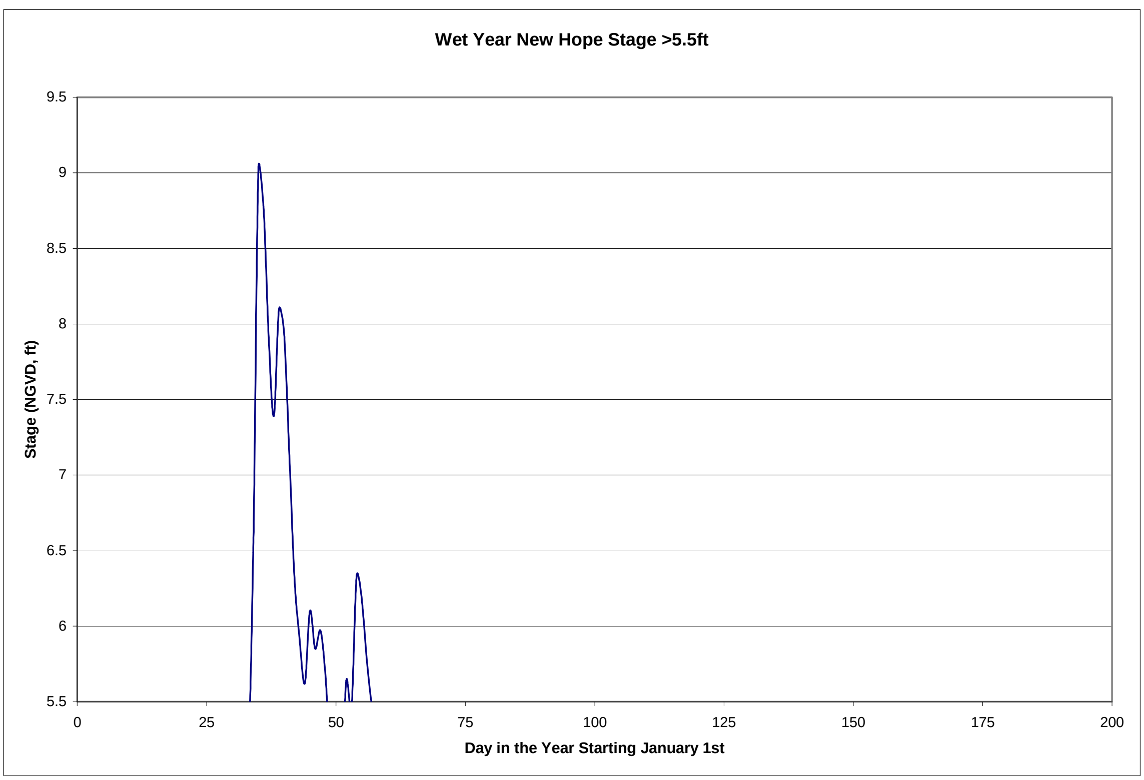


Figure 4. Water stages exceeding height of M-W Tract southwest levee for higher than average rainfall year (1998) based on New Hope Tract gage data provided by the CDEC.

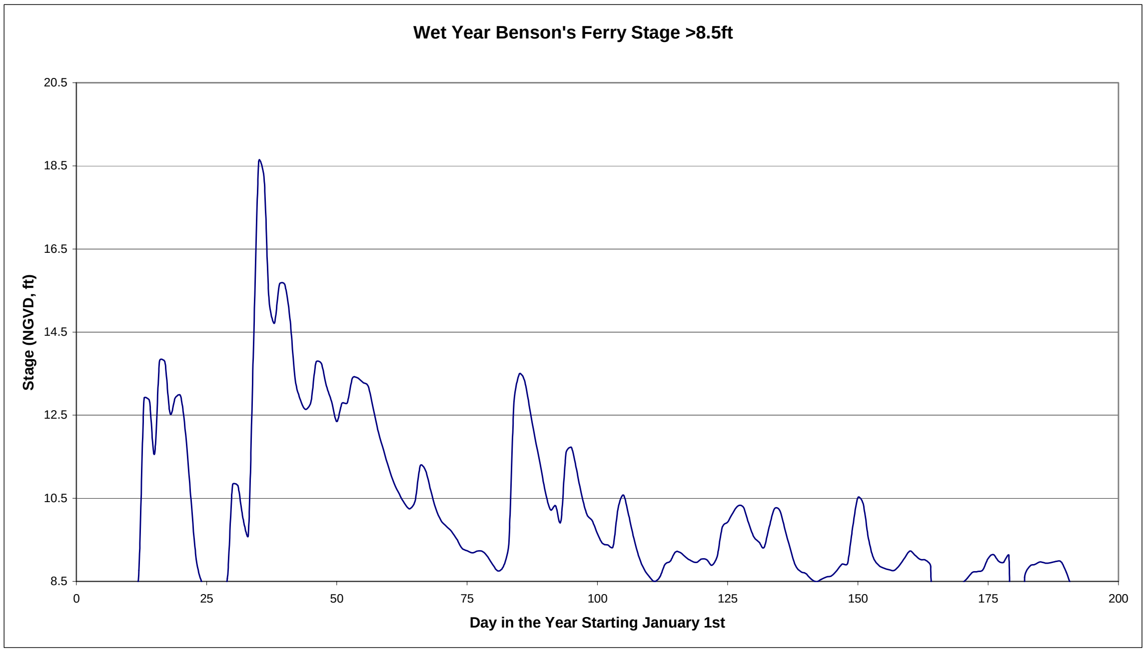


Figure 5. Water stages exceeding height of M-W Tract east levee for higher than average rainfall year (1998), based on Benson's Ferry gage data provided by the CDEC.

Topography

The M-W Tract elevation ranges from a low of -3' msl in the extreme southern tip to +3' msl in the northeast section. Much of the M-W Tract is between -2' msl and 1' msl. The northern half of the M-W Tract is more mineral soils and the southern half is more peat soils.

Floodplain Habitat

The M-W Tract was historically riverine with a meandering channel and floodplain habitat (Florsheim, Mount). The M-W Tract was separated from surrounding channels by levees after a reclamation project conducted in the late 1890s. As one of the last islands to be reclaimed and with levee heights restricted by the Reclamation Board to elevations lower than adjacent islands, the M-W Tract continued to flood more frequently than surrounding islands, though less frequently than prior to reclamation. The M-W Tract was farmed over several decades, resulting in appreciable subsidence of the peat soils in the southern half of the Tract.

Due to the subsided elevations, connecting the existing M-W Tract to adjacent channels would result in areas of shallow open water. Warmwater mostly exotic fish and vegetation are associated with shallow open water in the Sacramento-San Joaquin Delta (Whitener, Grimaldo). Exotic warmwater fish and vegetation are probably now more prevalent in the Delta than historically. Floodplain habitat has been postulated to give a competitive advantage to native species compared to permanent shallow-water habitat because floodplain habitat dries up during the summer months. Native floodplain spawning fish such as Sacramento splittail are adapted to spawning during the spring months, when California rivers and streams historically inundated the floodplain. Exotic fish such as striped bass spawn later in the summer.

The goal is to recreate floodplain on the M-W Tract. Elevations on the Tract range from about -3' msl to 3' msl. Because of the subsided elevations especially in the southern portion, water will need to be pumped off the Tract to avoid having standing water. Floodplain inundation is proposed for every January-June, and the Tract will be dry every July-December. Annual floodplain inundation will provide the most possible floodplain habitat. The east levee will be lowered from an existing height of 17' to 18.5' msl to 8.5' msl to achieve desired flood control and ecosystem enhancements, and to maintain the current level of access to the transmission tower. The southwest levee will be lowered to 5.5' msl to allow flood waters to flow offsite yet still be high enough to prevent tidal flooding during low flow seasons. Self-regulating tidal gates in the southern portion of the M-W Tract will assist in draining and can provide some circulation of the water in the Tract when it is flooded.

Figures 1 – 5 illustrate water stages that would flood M-W Tract for low, average, and greater than average rainfall years (3 years total) for the New Hope Tract and Benson's Ferry stage gage locations. Figures 2, 3, and 5, used 8.5' msl as the baseline for flooding because the Benson's Ferry gage is located in the vicinity of the M-W Tract's 8.5' msl east levee, and any water elevations greater than 8.5' msl would top the levee and cause flooding of the M-W Tract. The same methodology would apply to Figures 1 and 4 for the New Hope Tract gage in which 5.5' msl is used as the baseline for flooding. The New Hope gage is located in the vicinity of the M-W Tract's 5.5' msl southwest levee and any tidal flows greater than 5.5' msl would top the levee and flood the Tract. An inundation graph for the New Hope Tract for a low rainfall year was not included because tidal flow did not exceed 5.5' msl in 2001 and subsequently there was no overtopping of the southwest levee of the M-W Tract.

Depending upon hydrology and water management decisions, the M-W Tract may be flooded continuously January-June or could be managed to have separate flooding and draining events throughout the winter. First, any flooding is dependent upon having high water events, though the east levee will be lowered such that it should flood annually. The first flooding event may not occur in January, but could happen in later months, if at all. It is also possible that high-water flooding events could occur in the July-December period, but then the floodplain would be actively drained to avoid providing habitat for exotic species. Rather than allowing the floodplain to be continuously flooded all winter, it could potentially be desirable to drain the floodplain and have separate flooding events. Drainage (after 20-30 days) and allowing new flood events for example, could avoid stagnant water on the M-W Tract and may mimic nature more closely by having multiple flood events. However, this must be weighed against lost opportunity for floodplain growth and spawning.

Water quality (dissolved oxygen, temperature, etc.) may be impacted with extended periods of inundation (30 to 45 days) at the M-W Tract. One approach to mitigating this issue would be to develop minimum water quality and flooding duration criteria to facilitate water management decisions regarding flooding frequency at the site.

Annual flooding should result in deposition of suspended sediment on the Tract. Over time elevations should increase. As studies on the Cosumnes Preserve floodplain have shown, sediment deposition should result in development of riparian forest. Over time, grassland on the floodplain should be replaced with riparian forest.

Hypotheses:
Lowering the east levee to 8.5' msl will provide annual flooding of the Tract from 1 to greater than 3 events.

Annual flooding will benefit native floodplain spawning fish such as Sacramento splittail.
Approximately 80% of the about 1600-acre Tract will be inundated.
Fish will not be stranded during the draining of McCormack-Williamson Tract.
Exotic fish will not disproportionately benefit from annual flooding of the Tract January-June.
The Tract can be drained through the use of self-regulating tidal gates and pumps. There won't be appreciable standing water on the Tract July-December (e.g., from seepage, scour ponds developed from flooding events).
Annual flooding will result in sediment deposition on the Tract, increasing elevations over time.
Riparian forest will replace grassland over time on the floodplain, given annual flooding events and associated sediment deposition.

Riparian
Low-slope wildlife-friendly levees will be built on the interior of levees surrounding the Tract. These levees will add geotechnical stability to the levees, especially when the interior is subjected to water during the annual flooding events. In addition, they will allow for gradation of habitats, from upland, to riparian/scrub-shrub, and emergent marsh and mudflat (when the interior is inundated).

Hypotheses:
Wildlife-friendly levees will add stability to the land-side of the perimeter levees.
Wildlife-friendly levees will provide upland, riparian, scrub/shrub, emergent marsh and mudflat (when interior flooded) habitats.

Overall
The main objectives of this alternative are to benefit floodplain spawning fish and to discourage exotics. The MWT would flood every year during the January to

June period by lowering the east levee to 8.5’ msl. The M-W Tract would drain through the use of self-regulating tidal gates with supplemental pumping as needed and would be dry during the summer, thereby reducing exotic aquatic species issues. Self-regulating tidal gates, placed in the lowest elevations in the south, would allow some tidal action during the winter-spring (January-June). These gates would partially fill during incoming tide, and fully drain during outgoing tide. The southwest M-W Tract levee would be lowered to 5.5’ msl to enhance flow-through during flood events.

Hypotheses:
The M-W Tract will flood annually.
The M-W Tract can be drained through the use of self-regulating tidal gates
Self-regulating tidal gates will provide some tidal circulation in the southern area.

References

Bennett, W.A. and P.B. Moyle. 1996. Where have All the Fishes Gone: Interactive Factors Producing Fish Declines in the Sacramento-San Joaquin Estuary. In JT Hollibaugh ed. *San Francisco Bay: the Ecosystem.* San Francisco AAAS, Pacific Division.

Florsheim, J.L and J.F. Mount. 2002. Restoration of floodplain topography by sand-splay complex formation in response to intentional levee breaches, Lower Cosumnes River, California. *Geomorphology*. 44. pp. 67-94.

Grimaldo, L. Personal Communication.

Whitener, K. Personal Communication.

Attachment 3

North Delta Flood Control and Ecosystem Restoration Project
Ecological Option 3 (Hybrid Floodplain/Subsidence Reversal)
Conceptual Model

Objectives

- Provide annual floodplain spawning habitat
- Limit aquatic exotic species establishment by drying Tract during summer months (July-December)
- Promote annual flooding and associated sedimentation
- Reconnect Mokelumne river and associated McCormack-Williamson Tract floodplain
- Promote foodweb productivity on floodplain and water exchange with adjacent channels with annual flooding events
- Restore seasonal floodplain and riparian habitats
- Support special status species
- Limit terrestrial exotic species establishment with weed control
- Advance application and understanding of subsidence reversal techniques
- Increase elevations on southern McCormack-Williamson Tract to intertidal elevations elevations (near sea level) that would support native species but discourage colonization by warmwater exotic species
- Determine whether *S. californicus* or *S. acutus* persists in an annually flooded environment, which species captures the most sediment during flooding events, and which species is associated with the most bioaccretion
- Capture Mokelumne suspended sediment through siphon in southern MWT
- Research dissolved organic carbon and THMFP production in wetland
- Beneficial reuse of dredged material in subsidence reversal demonstration project
- Potential for mercury mesocosm experiment in subsidence reversal demonstration wetland

Hydrology

Mokelumne River stage

The average stage in the Mokelumne River for the typical growing season (March-September) is 2’ msl. Stages throughout the year typically range from less than a foot below sea level to about 5’ msl, although stages can reach 10-12’ msl in some years due to high water events. Mokelumne River flows are affected by Camanche Dam releases, Delta Cross Channel operation and other factors.

Tidal range in the Mokelumne River is about 3 feet. The following tidal elevations were published by NOAA for the Mokelumne River at New Hope.

English Units (feet)

	Tidal Datum (MLLW=0)	NGVD 29
MHHW	3.08	**3.31**
MHW	2.69	**2.92**
MTL	1.54	**1.77**
MLW	0.36	**0.59**
MLLW	0.00	**0.23**

NGVD 29.
National Oceanic and Atmospheric Administration (NOAA) from the New Hope gage data for the period of November 1978 to October 1979.

Tidal action on Tract would be limited to flow through self-regulating tidal gates.

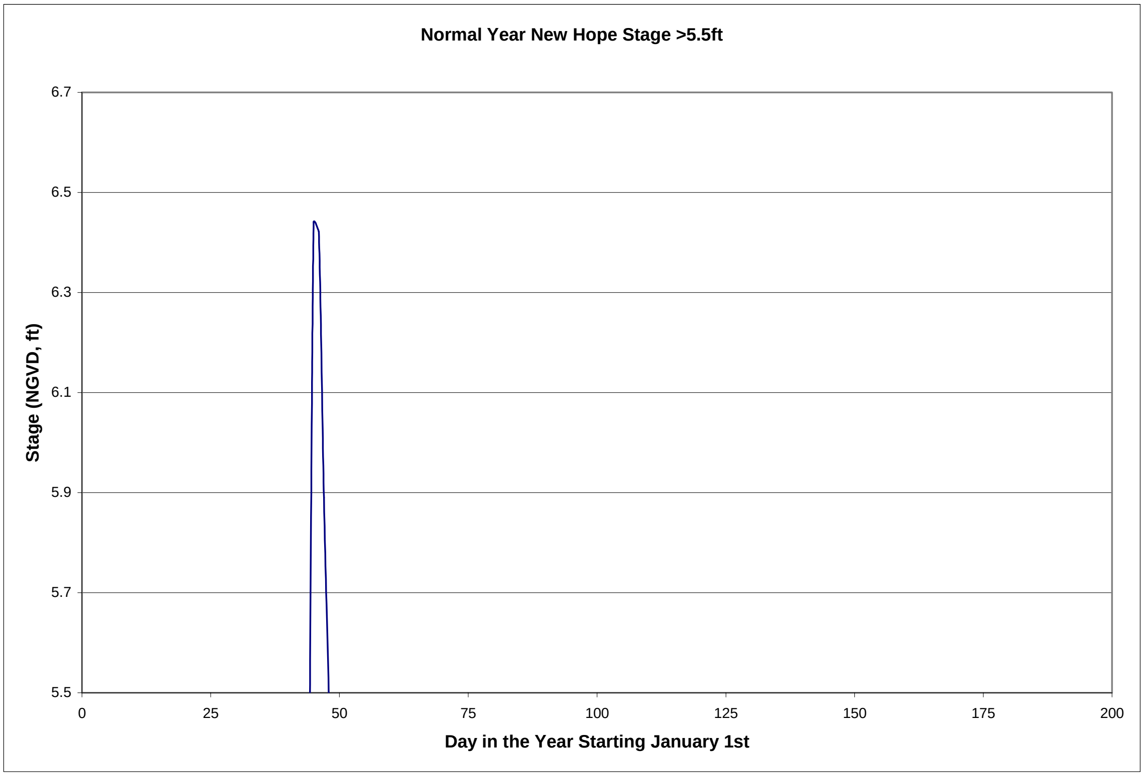


Figure 1. Water stages exceeding height of M-W Tract southwest levee for average rainfall year (2000), based on New Hope Tract gage data provided by the Department of Water Resource's (DWR) California Data Exchange Center (CDEC).

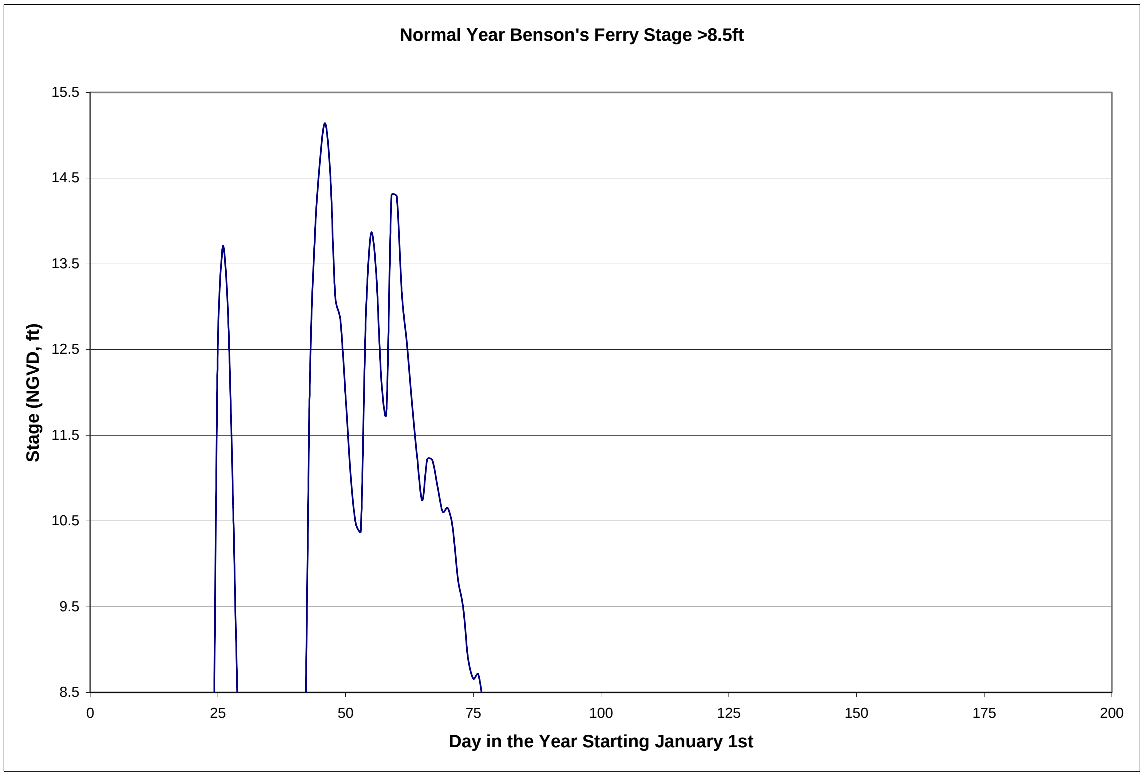


Figure 2. Water stages exceeding height of M-W Tract east levee for average rainfall year (2000), based on Benson's Ferry gage data provided by CDEC.

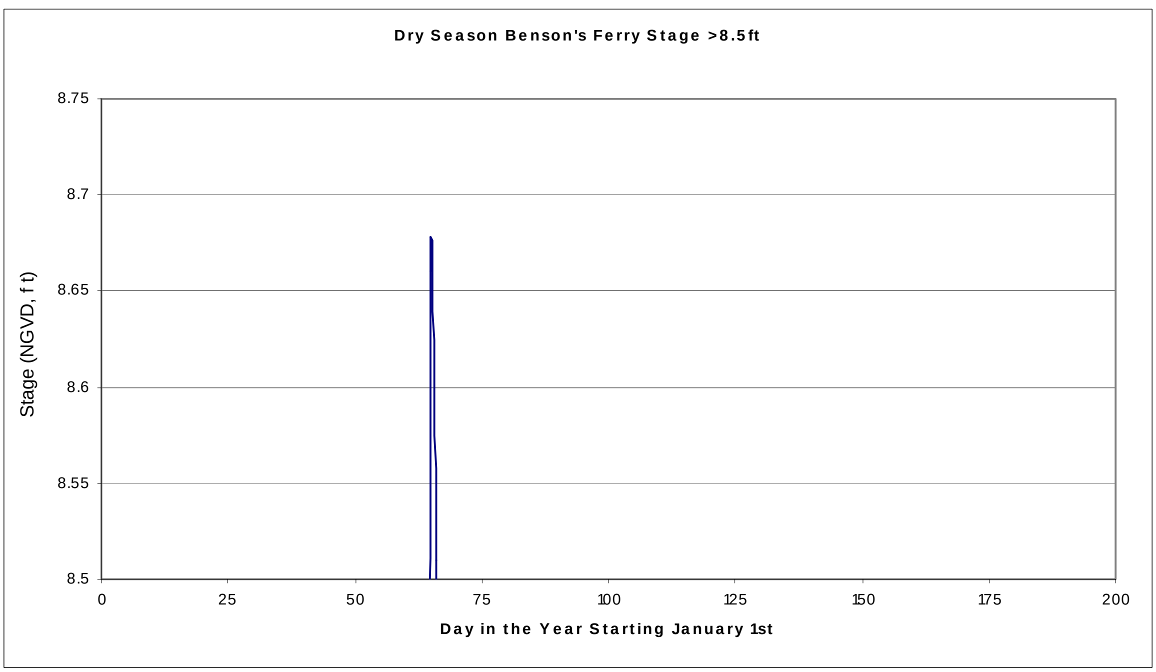


Figure 3. Water stages exceeding height of M-W Tract east levee for lower than average rainfall year (2001) based on Benson's Ferry gage data provided by the CDEC.

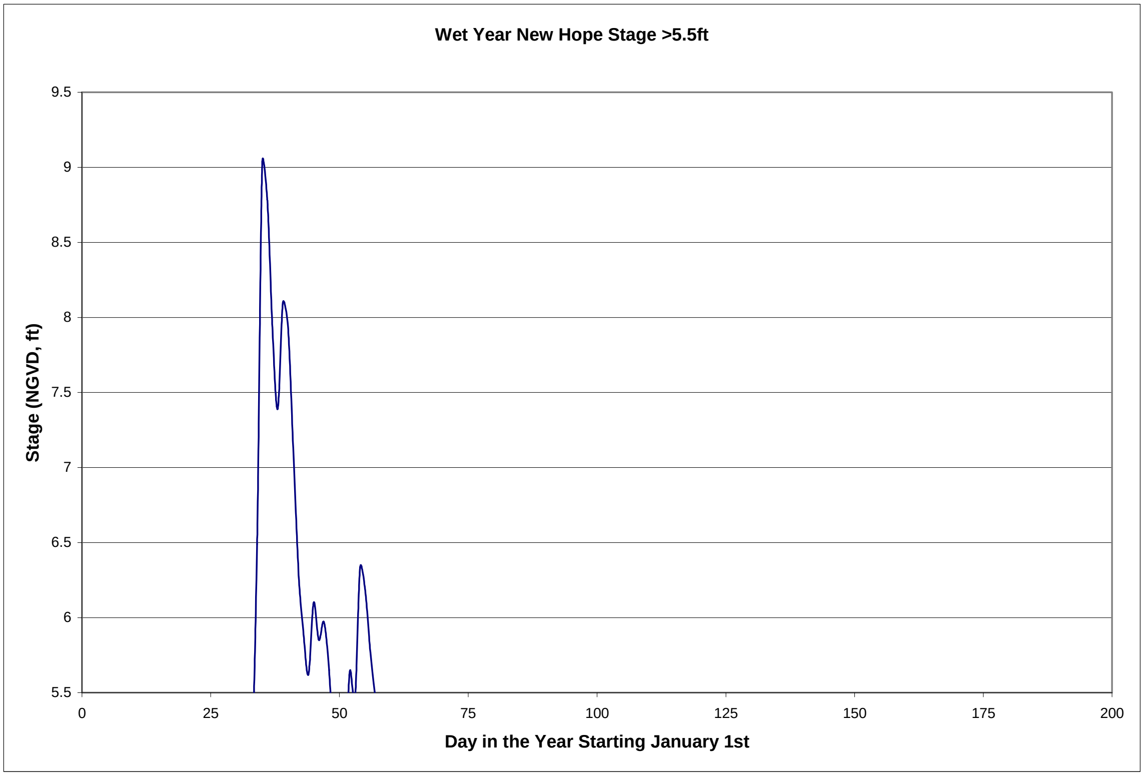


Figure 4. Water stages exceeding height of M-W Tract southwest levee for higher than average rainfall year (1998) based on New Hope Tract gage data provided by the CDEC.

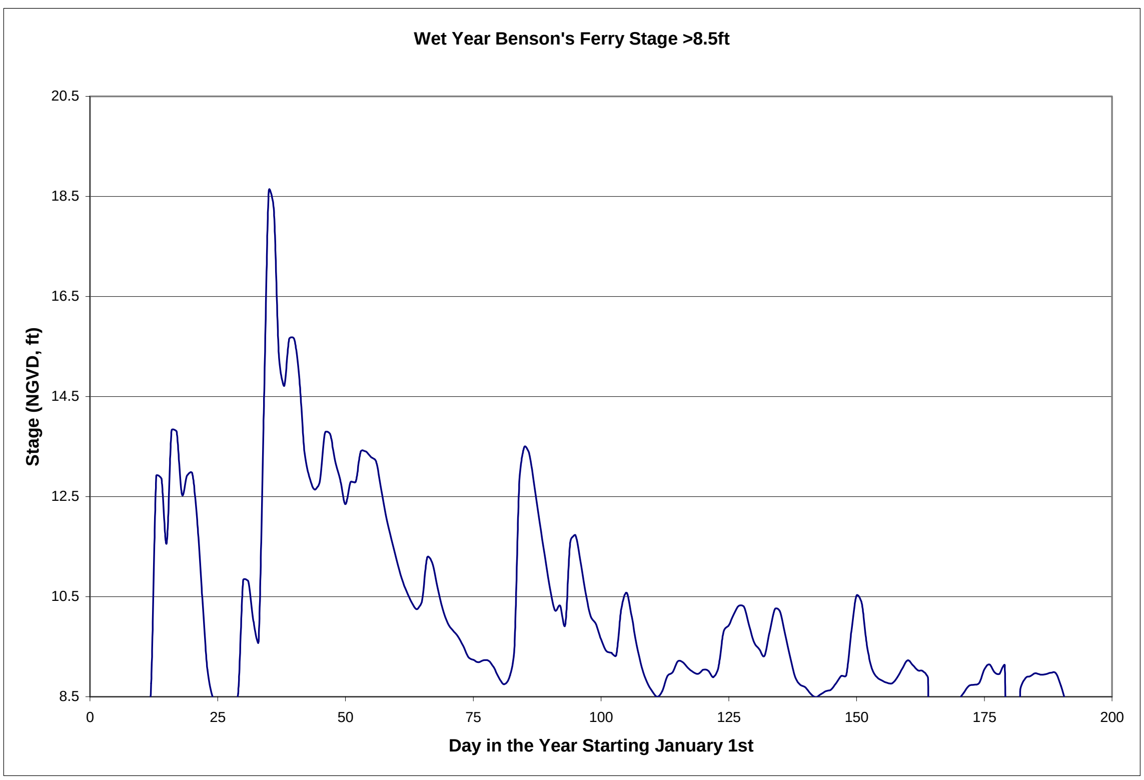


Figure 5. Water stages exceeding height of M-W Tract east levee for higher than average rainfall year (1998), based on Benson's Ferry gage data provided by the CDEC.

Topography
The McCormack-Williamson Tract (M-W Tract) elevation ranges from a low of -3' msl in the extreme southern tip to +3' msl in the northeast part of the M-W Tract. Much of the M-W Tract is between -2' msl and 1' msl. The northern half of the M-W Tract is more mineral soils and the southern half is more peat soils.

Floodplain Habitat
The M-W Tract was historically riverine with a meandering channel and floodplain habitat (Mount). After reclamation of the Tract in the late 1890s, M-W Tract was separated from surrounding channels by levees. As one of the last islands to be reclaimed and with levee heights restricted by the Reclamation Board to elevations lower than adjacent islands, the M-W Tract continued to flood more frequently than surrounding islands, though less frequently than prior to reclamation. The M-W Tract was farmed over several decades, resulting in appreciable subsidence of the peat soils in the southern half of the Tract.

Due to the subsided elevations, connecting the existing M-W Tract to adjacent channels would result in areas of shallow open water. Warmwater mostly exotic fish and vegetation are associated with shallow open water in the Sacramento-San Joaquin Delta (Whitener, Grimaldo). Exotic warmwater fish and vegetation are probably now more prevalent in the Delta than historically. Floodplain habitat has been postulated to give a competitive advantage to native species compared to permanent shallow-water habitat because floodplain habitat dries up during the summer months. Native floodplain spawning fish such as Sacramento splittail are adapted to spawning during the spring months, when California rivers and streams historically inundated the floodplain. Exotic fish such as striped bass spawn later in the summer.

The goal is to recreate floodplain on the M-W Tract. Elevations on the M-W Tract range from about -3' msl to 3' msl. The lowest area (elevations -3 to -2' msl) will be leveed off to create a subsidence reversal demonstration project area (emergent marsh). This area will be isolated from adjacent channels and the floodplain except for in higher water events. The north and southwest levees of the southern 250-acre subsidence reversal demonstration project area will be 5.5' msl, with the east and west levees being existing elevations (*about 13' msl*). See Emergent Marsh section below for more information.

Floodplain inundation is proposed for every January-June, and the M-W Tract will be dry every July-December. Annual floodplain inundation will provide the most possible floodplain habitat. The east levee will be lowered from an existing height of 17' to 18.5' msl to 8.5' msl to achieve desired flood control and ecosystem enhancements, and to maintain the current level of access to the transmission tower. The southwest levee will be lowered to 5.5' msl to allow flood waters to flow offsite yet still be high enough to prevent tidal flooding during low flow seasons. Self-regulating tidal gates in the southern portion of the M-W Tract will assist in draining and can provide some circulation of the water in the Tract when it is flooded.

The floodplain will be drained with a combination of gravity flow, perhaps through one-way culverts, supplemented by pumps if necessary. Given that the floodplain elevations range from about -1.5' to 3' msl, some pumping may be necessary.

Depending upon hydrology and water management decisions, the Tract may be flooded continuously January-June or could be managed to have separate flooding and draining events throughout the winter. First, any flooding is dependent upon having high water events, though the east levee will be lowered such that it should flood annually. The first flooding event may not occur in January, but could happen in later months, if at all. It is also possible that high-water flooding events could occur in the July-December period, but then the floodplain would be actively drained to avoid providing habitat for exotic species. Rather than allowing the floodplain to be continuously flooded all winter, it could potentially be desirable to drain the floodplain and have separate flooding events. Drainage (after 20-30 days) and allowing new flood events for example, could avoid stagnant water on the Tract and may mimic nature more closely by having multiple flood events. However, this must be weighed against lost opportunity for floodplain growth and spawning as well as pumping costs to dewater the Tract.

Water quality (dissolved oxygen, temperature, etc.) may be impacted with extended periods of inundation (30 to 45 days) at the M-W Tract. One approach to mitigating this issue would be to develop minimum water quality and flooding duration criteria to facilitate water management decisions regarding flooding frequency at the site.

Annual flooding should result in deposition of suspended sediment on the Tract. Over time elevations should increase. As studies on the Cosumnes Preserve floodplain have shown, sediment deposition should result in development of riparian forest. Over time, grassland on the floodplain should be replaced with riparian forest.

Hypotheses:
Lowering the east levee to 8.5' msl will provide on average annual flooding of the Tract.
Annual flooding will benefit native floodplain spawning fish such as Sacramento splittail.
Approximately 80% of the about 1400-acre floodplain area of the Tract will be inundated.
Fish will not be stranded during the draining of McCormack-Williamson Tract.
Exotic fish will not disproportionately benefit from annual flooding of the Tract January-June.

The M-W Tract can be drained through the use of self-regulating tidal gates and pumps.
There won't be appreciable standing water on the M-W Tract July-December (e.g., from seepage, scour ponds developed from flooding events).
Annual flooding will result in sediment deposition on the Tract, increasing elevations over time.
Riparian forest will replace grassland over time on the floodplain, given annual flooding events and associated sediment deposition.

Riparian
Low-slope wildlife-friendly levees will be built on the interior of levees surrounding the M-W Tract   These levee will add geotechnical stability to the levees, especially when the interior is subjected to water during the annual flooding events. In addition, they allow for gradation of habitats, from upland, to riparian/scrub-shrub, and emergent marsh and mudflat (when the interior is inundated).

Hypotheses:
Wildlife-friendly levees will add stability to the land-side of the perimeter levees.
Wildlife-friendly levees will provide upland, riparian, scrub/shrub, emergent marsh and mudflat (when interior flooded) habitats.

Emergent Marsh (Subsidence Reversal Demonstration Project Wetland)
The southernmost 250 acres that range in elevation from -3' to 1' msl will be isolated by levees to create a subsidence reversal demonstration project area. A subsidence reversal demonstration project is warranted in the southern area of the M-W Tract because the current elevations (-3' to 1' msl), if inundated and connected to the channels, would likely support warm shallow-water habitat. This habitat is undesirable because it is often dominated by exotic fish and vegetation in the Sacramento-San Joaquin Delta (Whitener, Grimaldo). By leveeing off the southern third of the M- W Tract, thereby creating an isolated subsidence reversal project wetland, we can restrict water level so as to not form open shallow-water habitat and use tule wetland growth and other techniques to increase elevation. Keeping the wetland isolated will also limit the possibility of creating habitat for exotic species that would disperse to adjacent channels.

Subsidence has occurred throughout the Sacramento-San Joaquin Delta as waterways were leveed and islands drained for agriculture. Exposure of peat to air, burning, compaction from farming and island draining have resulted in subsidence of Delta lands to as much as 35 feet below sea level. There are important implications for agriculture, water quality and water supply and ecology related to subsidence. Therefore, finding practical methods of reversing subsidence in the Delta is critical.

The Department of Water Resources, USGS, and Hydrofocus have been conducting subsidence reversal research on Twitchell Island since the 1990s.

The studies have been scaled up from small <1 acre plots to a 15-acre wetland. Water management and wetland promotion methods have been refined and preliminary accretion estimates made. The 15-acre wetland showed a gain of approximately 0.3 feet of low density material accumulated since 1997. USGS, Northwest Hydraulic Consultants and Hydrofocus have now obtained funding to test other technologies to enhance accretion including thin layer sediment application. Using a wetland-accretion model, HydroFocus estimated that thin-layer sediment application combined with wetland bioaccretion might result in rates of in land-surface-elevation as great as three inches per year. The pilot test plots for these experimental technologies are only about 500 square feet each. The wetland accretion model will be refined in conjunction with the ongoing work on Twitchell Island to better refine accretion estimates. After assessing the feasibility of various accretion technologies at the pilot scale, the subsidence reversal demonstration project proposed here will test the efficacy of the most promising accretion technologies at a demonstration scale.

The subsidence reversal demonstration project would be started before lowering the east levee to increase flooding on the M-W Tract. This would allow establishment of the tule marsh before it is subjected to floodflows. Currently, the land is in agriculture. Preferably, the cross-levee isolating the subsidence reversal demonstration project area would be constructed at the time the subsidence reversal project is begun. However, due to the cost of constructing the levee, it may be necessary to wait until the larger project is funded to construct the cross-levee. The subsidence reversal demonstration project could be started before constructing the cross-levee, though water added to the tule wetlands may also spread to areas further north on the M-W Tract.

To water the subsidence reversal demonstration project area, a siphon will be installed on the east side of the M-W Tract diverting water from the Mokelumne River. This siphon should be installed on the outside bend of the Mokelumne River, enhancing the likelihood that suspended sediment will be diverted along with Mokelumne River water to the subsidence reversal demonstration project area. It is anticipated that the subsidence area will require this supplemental irrigation so that the area is kept inundated year-round.

When the east levee is degraded with the North Delta Flood Control and Ecosystem Restoration project, the Tract should be subject to annual flooding. The cross-levee will be constructed to 5.5' msl elevation and the southwest levee will be lowered to 5.5' msl. These levee heights prevent tidal water from accessing the subsidence reversal demonstration project area; however annual floods will overtop these levees (so the subsidence reversal demonstration project will be connected to adjacent channels in flood events).

The subsidence reversal demonstration project will be approximately 250 acres. Different test plots can be randomly distributed over the 250-acre area. Some of the different treatments to be tested include the efficacy of different tule species on subsidence reversal and sediment trapping during flood events, and the efficacy of subsidence reversal techniques such as thin-layer sediment addition. The large area provides an opportunity to replicate these treatments in a relatively natural area with minimal effect from artifacts such as levees.

During flood events, the subsidence reversal demonstration project area will be flooded. At times, the subsidence reversal project area will be connected to channels adjacent to the M-W Tract. The tules should capture sediment. It is uncertain how long the tules can survive inundation. It will take some time to drain the M-W Tract, perhaps 2 weeks to a month. Depending upon the hydrology, many high water events may occur over a winter. Figures 1 – 5 illustrate water stages that would flood the M-W Tract for low, average, and greater than average rainfall years (3 years total) for the New Hope Tract and Benson's Ferry stage gage locations. Figures 2, 3, and 5, used 8.5' msl as the baseline for flooding because the Benson's Ferry gage is located in the vicinity of the M-W Tract's 8.5' msl east levee, and any water elevations greater than 8.5' msl would top the levee and cause flooding of the M-W Tract. The same methodology would apply to Figures 1 and 4 for the New Hope Tract gage in which 5.5' msl is used as the baseline for flooding. The New Hope gage is located in the vicinity of the M-W Tract's 5.5' msl southwest levee and any tidal flows greater than 5.5' msl would top the levee and flood the Tract. An inundation graph for the New Hope Tract for a low rainfall year was not included because tidal flow did not exceed 5.5' msl in 2001 and subsequently there was no overtopping of the southwest levee of the M-W Tract.

Regarding the efficacy of different tule species in reversing subsidence and in capturing sediment during the annual floods, two tule species, *Schoenoplectus californicus* and *Shoenoplectus acutus,* will be compared. *S. acutus* and *S. californicus* differ in that *S. acutus* senesces in the winter and transfers its energy underground in rhizomes, whereas *S. californicus* remains green year-round. Hypotheses include *S. californicus* might be more efficient at trapping sediment during winter floods; whereas *S. acutus* might contribute more to detritus, thereby promoting accretion. The effects of both species on flood flows will be measured.

After developing the project site and testing accretion methods, later phases of this project will be coordinated with potential dredging and flood control strategies of the proposed North Delta Flood Control and Ecosystem Restoration project. Dredging material may be used for thin-layer sediment application to the wetland.

The subsidence reversal demonstration project area may also be used to rear Sacramento perch, *Archoplites interruptus*. Sacramento perch are a native fish species that have been extirpated from the Sacramento-San Joaquin Delta. An off-channel site, such as the southern area of the M-W Tract, has been proposed as a potential rearing site for the perch. The perch need an isolated (isolated from predators in Delta channels) area to for rearing. They favor habitat with emergent vegetation, such as emergent tule marsh. During flood times, the perch would be introduced to Delta channels. It is not clear whether there would be natural recruitment in the subsidence area or whether it would need to be regularly stocked with perch. The perch may require greater circulation of the water to maintain sufficient dissolved oxygen and water temperature conditions than that required for the subsidence reversal demonstration project.

Another component of the project will likely be a study of mercury methylation in the subsidence reversal demonstration project marsh. Delta sediments are high in mercury, and wetlands have been shown to be areas of high mercury methylation. Mercury methylation monitoring may involve monitoring of mercury, organic carbon, and biota (mercury analysis of fish tissue and other species) to determine the degree of mercury methylation occurring in the wetland.

With estimated accretion rates of about three inches per year, the southern M-W Tract area may take 12 years to reach sea level. At that time, we would likely degrade the cross-levee (to increase connectivity of habitats within the Tract) and possibly degrade the southwest levee to connect the M-W Tract with the adjacent channels. This would allow the Tract to function in more natural manner. Connecting the M-W Tract with adjacent channels once elevations are near sea-level will minimize the risk of providing large extents of shallow-water habitat and create opportunity for establishment of more desirable habitat types such as tidal marsh.

Hypotheses:
An inundated emergent marsh will bioaccrete resulting in increased elevations.
The emergent marsh will trap sediment during floodflows.
5.5' msl levees will prevent most tidal water from accessing the site.
The tule wetland will persist despite floodflow inundation. If tules die then new tules will generate to sustain the marsh.
Schoenoplectus acutus and *S. californicus* may contribute differently to bioaccretion, may have different survival rates during flooding events, and may capture sediment differently.
Suspended sediment may be imported to the site through a siphon on the Mokelumne River.
Thin-layer sediment addition may enhance accretion rates.
Sacramento perch can be raised in a leveed emergent marsh and distributed to Delta channels with floodflows.
Permanent tule wetland may enhance mercury methylation.
Depending upon hydrology, the wetland area will accrete to sea level in about 12 years.

Overall
This alternative provides floodplain habitat for fish, but also avoids potential standing water and provides a subsidence reversal demonstration project area in the lowest area in the south. The subsidence reversal demonstration project

area would be created by building a cross-levee at 5.5’ msl to isolate the southern tip of the M-W Tract. The southwest levee would be degraded to 5.5’ msl to enhance flow-through during flooding events. The subsidence reversal demonstration project would be effectively isolated from the channels and the rest of the M-W Tract except for in flood events. Water would be siphoned onto the subsidence reversal demonstration project area to grow tules and enhance accretion rates; thereby building up elevation in this area. Alternative subsidence reversal techniques, such as thin-layer sediment addition could be part of this demonstration project. During flood events the tule marsh may also enhance sedimentation in this area. The subsidence reversal project area could also serve as a rearing area for Sacramento perch. Existing agricultural pumps would be used to pump the area after floods.

Hypotheses

The M-W Tract will flood annually.

The M-W Tract can be drained through gravity draining and some pumps.

The subsidence reversal project is compatible with annual flooding.

Sacramento perch can be raised in a subsidence reversal demonstration project.

References

Bennett, W.A. and P.B. Moyle. 1996. Where have All the Fishes Gone: Interactive Factors Producing Fish Declines in the Sacramento-San Joaquin Estuary. In JT Hollibaugh ed. *San Francisco Bay: the Ecosystem.* San Francisco AAAS, Pacific Division.

Florsheim, J.L and J.F. Mount. 2002. Restoration of floodplain topography by sand-splay complex formation in response to intentional levee breaches, Lower Cosumnes River, California. *Geomorphology*. 44. pp. 67-94.

Grimaldo, L. Personal communication.

Whitener, K. Personal communication.

Attachment 4

North Delta Flood Control and Ecosystem Restoration Project
Staten Island Setback Levee
Conceptual Model

Objectives

- Create additional channel, shallow-water, shaded riverine aquatic and riparian habitat by setting back existing levee
- Allow natural processes such as allowing breaches to occur on existing levee to form in-channel islands
- Promote flooding processes, especially overbank flooding from meander belt channel to levee bench
- Improve river floodplain connectivity
- Promote sedimentation
- Allow channel migration
- Promote foodweb productivity and water exchange with adjacent channels

Hydrology

Mokelumne River stage

The average stage in the Mokelumne River for the typical growing season (March-September) is 2 feet*. Stages (based on hourly data) throughout the year typically range from less than a foot below sea level to about 5 feet, although stages can reach 10-12 feet in some years due to high water events. Mokelumne River flows are affected by Camanche Dam releases, Delta Cross Channel operation and other factors.

Tidal range in the Mokelumne River is about 3 feet. The following tidal elevations were published by NOAA for the Mokelumne River at New Hope. Because there is considerable interannual and seasonal tidal variability, these tidal elevations may not be representative of any particular year or season.

	Tidal Datum (MLLW=0)	NGVD 29
MHHW	3.08	**3.31**
MHW	2.69	**2.92**
MTL	1.54	**1.77**
MLW	0.36	**0.59**
MLLW	0.00	**0.23**

NGVD 29.
National Oceanic and Atmospheric Administration (NOAA) from the New Hope gage data for the period of November 1978 to October 1979.

*All elevations correspond to National Geodetic Vertical Datum of 1929 (NGVD 29)

Setback Levee Habitats

Historically the Delta had meandering channels, greater areas of wetland, shallow-water and riparian habitat. The present-day Delta is characterized by riprapped channels with steep banks. Delta channels are often deep with fast-flowing water. By creating a setback levee on Staten Island, degrading the existing levee and creating some breaches in the existing levee, additional channel, shallow-water, shaded riverine aquatic and riparian habitat can be created. In addition, during times of flooding, the flood conveyance capacity of the Mokelumne River would be expanded. Figure 1 displays the 2 conceptual setback levee cross sections described in detail below:

Type 1

The existing Mokelumne River levee would be degraded to a height of 6 feet and function solely for habitat purposes. Riparian and emergent vegetation would be planted or colonize the existing levee dependent upon elevation. The levee crown would be approximately 16 feet wide, with a 5:1 slope on the landside. The waterside levee would not be reconfigured, but existing levee slopes are probably in the range of 3:1 to 5:1.

The setback levee would be set anywhere from 125 to 500 feet back from the existing Mokelumne River. The setback distance will be refined through hydraulic modeling. The setback levee crown height would be set to match the existing levee height or roughly 15 feet based on studies by Hultgren-Tillis. The crown width would be 16 feet wide and the side slopes would be 2.5:1 on the landside and 3:1 on the waterside (assuming existing peat depth shallow enough to be removed). The levee section would also include a 20 feet wide bench at about 4 feet elevation on the side of the levee towards the channel. Riparian habitat could be planted on the crown (where it won't interfere with road access) and waterside of the levee.

Between the degraded existing levee and the new setback levee will be a meander channel belt approximately 40 feet wide and about 0 feet. Breaches placed every 120' and offset in the existing levee would allow the Mokelumne River to flow through this area. In higher flows, the bench on the waterside of the setback levee will likely be inundated. In very high flood flows, the Mokelumne River channel will expand to the setback levee, adding at least 155 foot width to the existing channel, depending on the required setback distance determined by hydraulic modeling.

Habitats would likely develop as follows:

Upland > 6 feet
Riparian/Shaded Riverine Aquatic 3-6 feet
Emergent Marsh 0-3 feet

*All elevations correspond to National Geodetic Vertical Datum of 1929 (NGVD 29)

Type 2
A second conceptual model would apply to larger setback distances and would allow for a meander channel at original ground level in lieu of 0 NGVD. The new setback level would be placed anywhere from 200 to 500 feet away from the existing Mokelumne River, and the waterside edge of the 20 foot wide bench would have a minimum 3:1 slope. The Meander Channel belt would be significantly wider ranging from 20 to 100 feet, with an elevation at ground level or -5 NGVD. The Type 1 version in contrast, would have a meander channel belt of approximately 40 feet and a ground elevation of 0 NGVD. These modifications are intended to increase Mokelumne River flow through the meander channel belt and develop habitat more conducive to native flora and fauna.

Habitats would likely develop as follows:

Upland> 6 feet
Riparian/Shaded Riverine Aquatic 3-6 feet
Emergent Marsh -5 to 3 feet

Hypotheses:
Riparian habitat and emergent marsh will establish on abandoned existing levee and new setback levee according to elevation.
Riparian, emergent marsh and channel habitat will support special status species and increase foodweb productivity

Meander Channel Belt
The area between the existing abandoned levee and setback levee will become channel habitat. Constructed breaches in the existing abandoned levee will allow channel water to occupy this area. During high water events, the setback levee bench will flood. In very high events, the abandoned existing levee will be submerged resulting in a contiguous channel extending to the setback levee. These high water events may result in sedimentation on the setback levee bench. Over time, the abandoned existing levee may breach in additional places creating in-channel islands.

Hypotheses:
Channel habitat will be created in the meander channel belt.
High water events will result in sedimentation on the setback levee bench.
Over time, the abandoned existing levee may breach in additional places due to natural processes creating in-channel islands.

*All elevations correspond to National Geodetic Vertical Datum of 1929 (NGVD 29)

Appendix E
Tidal and Flood Hydraulic Modeling

Appendix E
Tidal and Flood Hydraulic Modeling

Introduction

This appendix presents an overview of the development and application of the North Delta tidal and flood hydraulic model. The model, built on MIKE 11 modeling engine platform, was used for evaluation of tidal and flood hydraulic impacts from the North Delta Flood Control and Ecosystem Restoration Project Alternatives. The following information is provided in this appendix; the theoretical basis of the MIKE 11 model engine, development of the North Delta Project area MIKE 11 hydraulic model, calibration and validation of the model, model inputs and assumptions, and flood control and ecosystem restoration modeling results. Most of the work described herein was completed throughout the course of three University of California at Davis (UCD) Masters theses. Sediment transport and water quality modules of the MIKE 11 have also been developed to analyze changes/impacts in sediment transport and sediment budget for different proposed Project Alternatives. The sedimentation study has been discussed in Chapter 3 of the EIR.

MIKE 11 Model

The MIKE 11 model (DHI 2000), developed by the Danish Hydraulic Institute, is a dynamic, one-dimensional modeling package, which simulates the water level and flow splits throughout a river/channel system. In addition to simulating hydraulics, the modeling package also includes modules for advection-dispersion, sediment transport, water quality, rainfall-runoff, flood forecasting, and GIS floodplain mapping and analysis. The hydraulic and sediment transport modules were developed and used to analyze potential impacts and benefits of the North Delta Project.

MIKE 11 solves the vertically integrated equations of conservation of mass and momentum, known as the St. Venant equations. The St. Venant equations are derived from the standard forms of the equations of conservation of mass and conservation of momentum based on the following four assumptions:

- The water is incompressible and homogeneous; therefore, there is negligible variation in density.

- The bottom (channel bed) slope is small, therefore the cosine of the slope angle can be assumed to equal 1.
- The water surface wavelengths are large compared to the water depth, which ensures that the flow everywhere can be assumed to move in a direction parallel to the bottom.
- The flow is subcritical. Subcritical flow conditions are solved with a reduced momentum equation, which neglects the nonlinear terms.

With the four assumptions applied, the standard forms of the equations of conservation of mass and momentum can be transformed into the equations below. These transformations are made with Manning's formulation of hydraulic resistance in SI units, and the incorporation of lateral inflows in the continuity equation.

Continuity Equation: $\frac{\partial Q}{\partial x} + \frac{\partial A}{\partial t} = q$

Momentum Equation: $\frac{\partial Q}{\partial t} + \frac{\partial \left(\alpha \frac{Q^2}{A} \right)}{\partial x} + gA\frac{\partial h}{\partial x} + \frac{n^2 gQ|Q|}{AR^{4/3}} = 0$

where

Q: discharge [ft^3/s] α: vertical velocity distribution coefficient

A: cross section area [ft^2] g: gravitational acceleration [ft/s^2]

X: downstream direction [ft] h: stage above datum [ft]

t: time [s] n: Manning coefficient

q: lateral inflow [ft^2/s] R: hydraulic radius [ft]

Within the MIKE 11 program, the above equations are transformed into a set of implicit finite difference equations, which are solved for each point in the grid (at each node). The above formulations of the St. Venant equations are further simplified for application in a rectangular channel. Natural river cross sections are rarely rectangular, so the MIKE 11 model integrates the equations piecewise in the lateral direction. In order to run the MIKE 11 model, several data inputs are required, including the river network alignment, channel and floodplain cross sections, boundary conditions and roughness coefficients.

The MIKE 11 GIS software package integrates MIKE 11 hydraulic model output with the spatial analysis capabilities of the Arc View GIS software developed by Environmental Science Resource Institute. MIKE 11 GIS, among other things, projects the water levels calculated within MIKE 11 as an interpolated water surface over a digital elevation model (DEM). The difference between the water level and the ground elevation is determined throughout the domain and visually presented based upon user defined flood depth increments. This software is designed to assess flood extent and provide insight with regards to the regional ecology driven by the disturbance of flooding. For example, depth inundation maps have been generated with MIKE 11 GIS to evaluate the habitat restoration potential of North Delta ecosystem restoration scenarios on McCormack-Williamson Tract. This provides a powerful graphical tool when evaluating each scenario based upon defined management objectives.

North Delta MIKE 11 Model Development

UCD staff worked cooperatively with DWR staff and the Project area stakeholders to develop the MIKE11 model. Model development was completed through the grant-funded work of several graduate students whose efforts built upon the others in succession. The students' work is documented in three Masters theses: "An Unsteady Hydraulic Surface Water Model of the Lower Cosumnes River, California, for the investigation of floodplain dynamics," by Stephen H. Blake; "Hydrodynamic Modeling and GIS Analysis for the Habitat Potential and Flood Control Benefits of the Restoration of a Leveed Delta Island," by Chris T. Hammersmark; and "Water Quality Modeling and Monitoring in the California North Delta Area," by Raffi J. Moughamian.

The North Delta MIKE11 modeling efforts described in this Appendix were coordinated with other area modeling efforts, such as the development of a regional HEC-RAS, a one-dimensional hydraulic model developed by US Army Corps of Engineers. Most of the channel geometry and boundary condition for the North Delta MIKE11 model were obtained from those kinds of efforts.

Project Area

The Project area lies within Sacramento and San Joaquin Counties. The Cosumnes River, its forks, and tributaries extend into the counties of El Dorado and Amador, with the uppermost reaches of the Mokelumne found in Calaveras and Alpine counties (Blake 2001). Project area watersheds, including Cosumnes and Mokelumne River watersheds, are shown in Figure E-1.

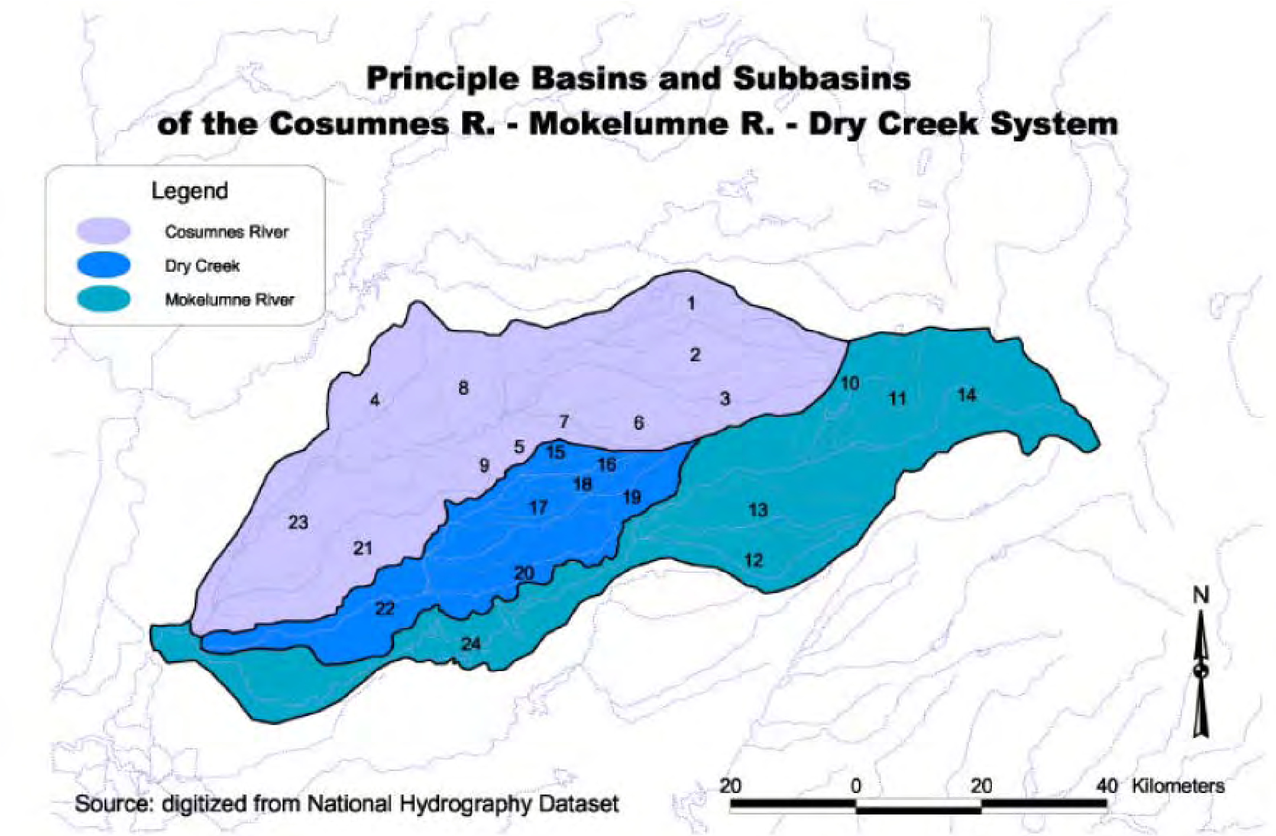


Figure E-1. Principle Basins and Subbasins of the Project Area

Model Geometry

The alignment of river channels, major sloughs, and floodplain areas in the North Delta model region dictates the model network of the hydraulic system for the Project (shown in Figure E-2). A total of 150 miles of river channels and sloughs are included in the model, not including the extensive off channel regions, which are also incorporated in the model network. The model utilizes 454 in-channel and floodplain cross sections obtained from a variety of sources (Hammersmark 2002). All cross section and boundary data are datum verified and translated as needed to the NGVD 29 datum (mean sea level).

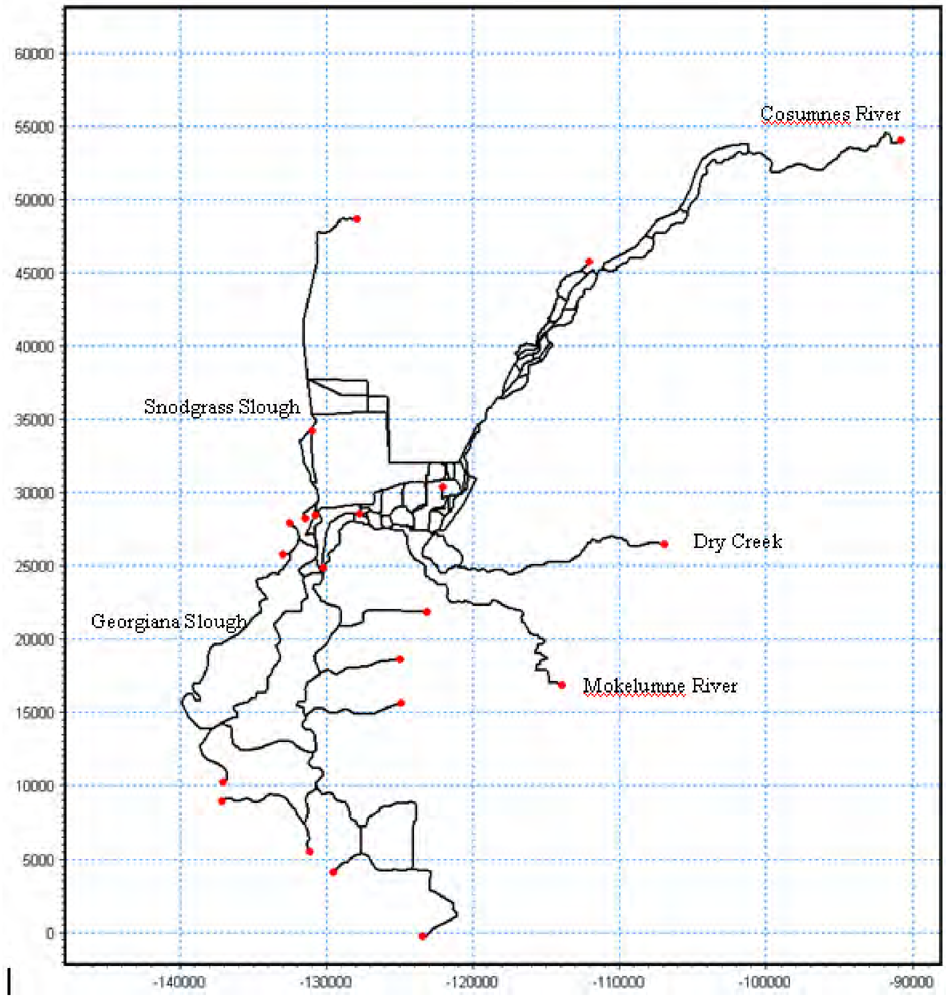


Figure E-2. North Delta MIKE11 Model Schematic (Model Domain)

Each river reach/branch is assigned a name and length in addition to its connectivity with the other branches in the model domain. The model incorporates the Cosumnes and Mokelumne Rivers, Dry Creek, Georgiana Slough, Snodgrass Slough, Morrison Creek Stream Group, the San Joaquin River, and many backwater sloughs to capture the hydrodynamics in the North Delta area. In this study, floodplains are identified as separate reaches in the model network, placed adjacent to the channel. The floodplain is then connected to the river reach with "link channels", which are basically simplified branches in which flow through the branch is calculated as flow over a broad crested weir, with user defined weir geometry. All levee breaches, in addition to floodplain connections have been simulated with this approach, providing a pseudo two-dimensional representation of floodplain flow. Detailed information on the model branch names, chainages, flow directions, and network connectivity can be found in Hammersmark (2002).

Topographic and cross section data for the original model development are detailed in Appendix A of the Stephen Blake thesis. Geometric data in the form of cross sections and digital elevation models from a variety of sources including USGS, CA-DWR, University of California at Davis (UCD), EBMUD, SAFCA, Phillip Williams and Associates (PWA), California Department of Transportation BIRIS system (BIRIS), Sacramento County Public Works Department, San Joaquin County Public Works Department, and the National Oceanic and Atmospheric Administration (NOAA) were used to develop the model. The data was collected in various forms such as DEMs, AutoCAD drawings, binary data sets used in other modeling platforms, field surveys, as-built drawings of bridges, and output from an NOAA NOS lidar mission. The data were location and datum verified, processed, and compiled into a cross-sectional database in MIKE 11. Figure E-3 presents the location and source (where available) of each cross section used in this effort.

Topographic data for large floodplain areas where no formal survey data exists were extracted from the USGS 30-meter DEM. These areas include Glanville Tract, Dead Horse Island, Erhardt Club, New Hope Tract, and Tyler Island. Topography data for the McCormack-Williamson Tract were obtained from the North Delta Study conducted in 1992 by DWR, and then partially verified for significant changes in the topography from the original survey (Hammersmark 2002).

Boundary condition data were gathered from a number of gages in the North Delta Project area. Those data were provided by a number of agencies including United States Geological Survey (USGS), California Department of Water Resources (CA-DWR), East Bay Municipal Utilities District (EBMUD), and Sacramento County Flood Control Agency (SAFCA). The availability of hydraulic gage data somewhat dictates the boundaries of the North Delta MIKE 11 model domain. The model extends upstream to hydraulic gages located at Michigan Bar on the Cosumnes River, Wilton Road on Deer Creek, above Galt on Dry Creek, Woodbridge on the Mokelumne River, and to Lambert Road at the Stone Lakes Outfall. To the west, the model includes a short portion of the Sacramento River extending from above the Delta Cross Channel to below the divergence of Georgiana Slough. There are four downstream boundary conditions on the San Joaquin River including the San Joaquin River at San Andres Landing, Venice Island, Turner Cut, and Rindge Pump. Gage data from two internal locations, Benson's Ferry and New Hope, were used as calibration and verification points. Figure E-4 shows the locations of the North Delta MIKE11 boundary conditions. Types of boundary condition data used are listed in Table E-1.

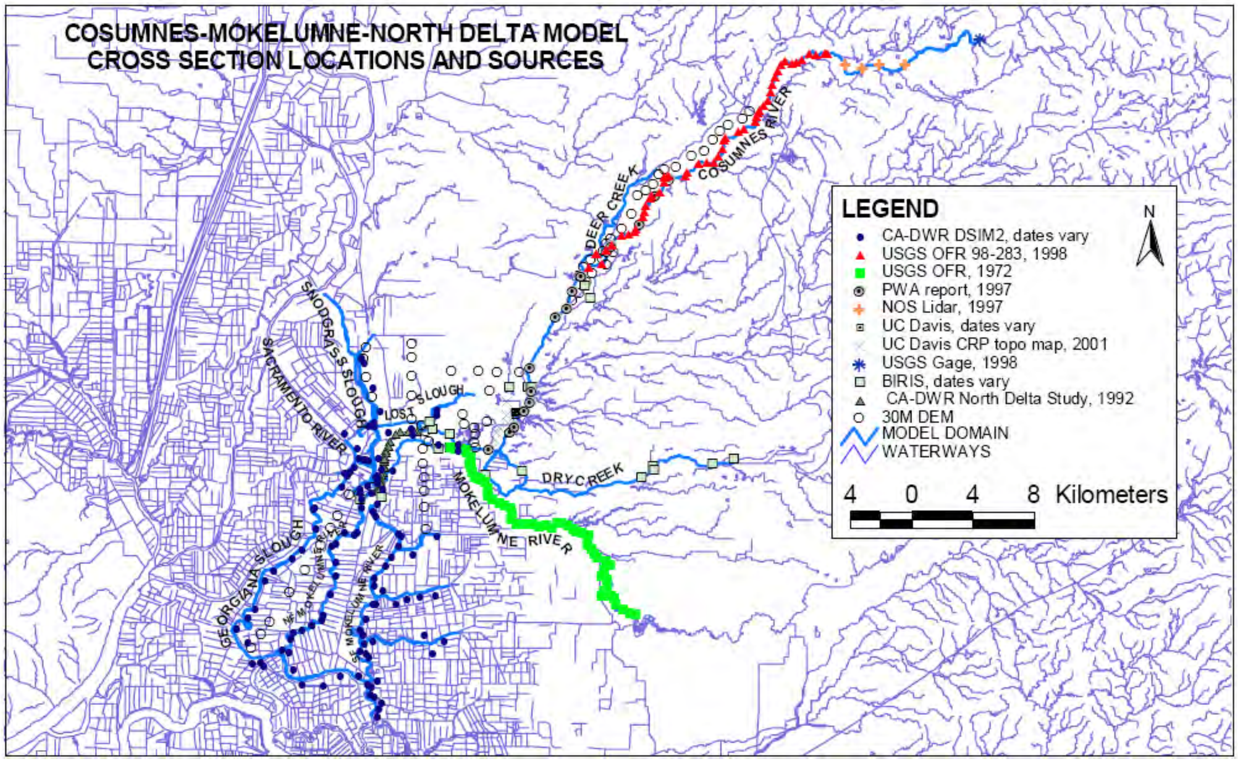


Figure E-3. Cross section locations and data sources used in the North Delta Model.

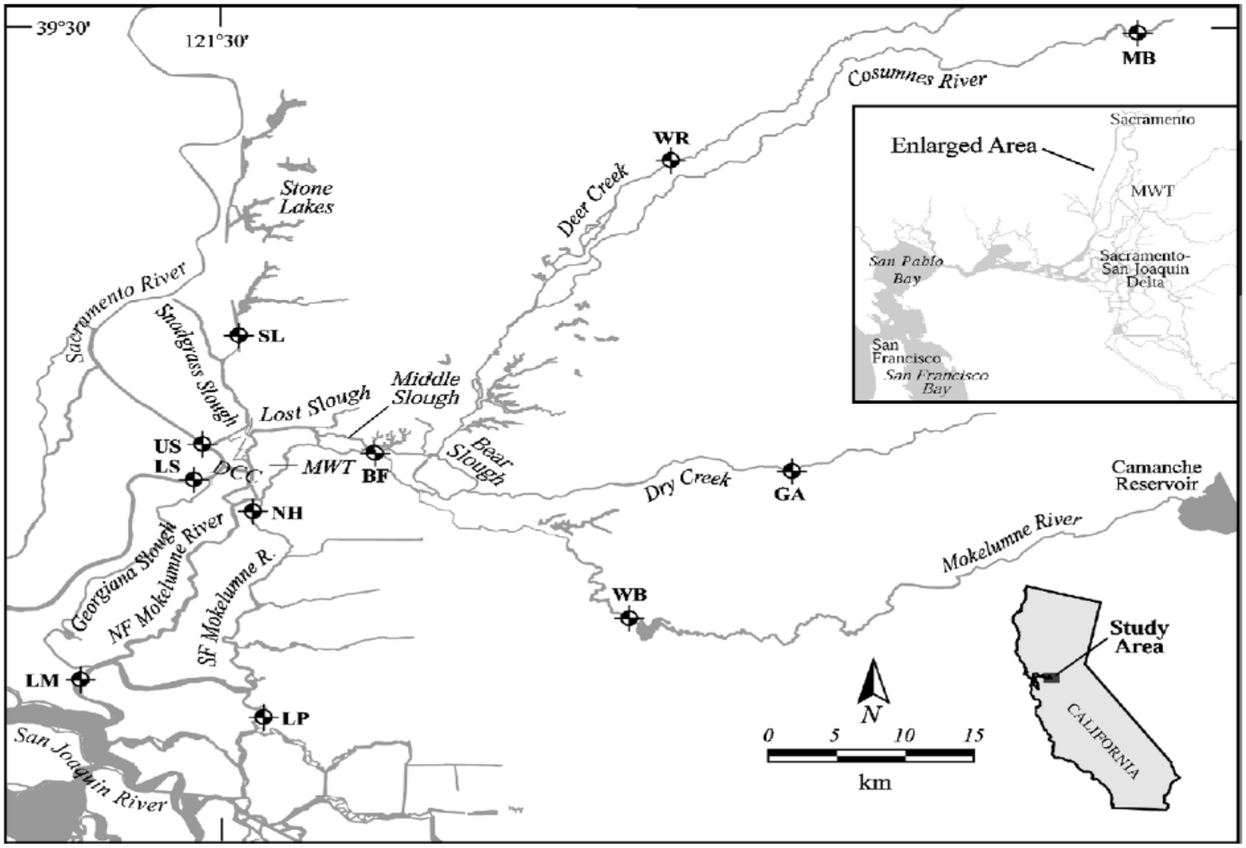


Figure E-4. Regional and Local Setting of the McCormack-Williamson Tract and Location of Gages Used for Boundary Conditions and Internal Validation Points.

Model result validation and scenario comparison is conducted at Benson's Ferry (BF) where the Cosumnes River converges with the Mokelumne River and at New Hope (NH) where the North and South Forks of the Mokelumne River diverge. Model boundary conditions are labeled as follows: MB: Michigan Bar on the Cosumnes River, WR:Wilton Road on Deer Creek, GA: Galt on Dry Creek, WB:Woodbridge on the Mokelumne River, SL: Stone Lakes Outlet at Lambert Road, US: Sacramento River above the Delta Cross Channel (DCC), LS: Sacramento River below Georgiana Slough, LM: Lower Mokelumne River at Georgiana Slough and LP: Little Potato Slough below Terminous.

Table E-1. Hydraulic Model Boundary Condition Data Type

Hydraulic Gage Location	Sensor ID	Agency	Simulation Year/Data Type[1]				
			1986	1997	1998	1999	2000
Upstream Boundary							
Cosumnes River @ Michigan Bar	RCSM075	USGS	Q&h	Q&h	Q&h	Q&h	Q&h
Sacramento River upstream of the DCC	RSAC128	USGS	--[2]	Q&h	Q&h	Q&h	Q&h
Dry Creek upstream of Galt	DRY1	USGS	Q	e	e	e	e
Mokelumne River at Woodbridge	RMKL070	EBMUD	Q&h	Q&h	Q&h	Q&h	Q&h
Deer Creek at Wilton Road	DEER2	SAFCA	E	Q&h	Q&h	Q&h	Q&h
Stone Lakes Outlet at Lambert Road	SGS1	SAFCA	e	h	h	H	h
Downstream Boundary							
Sacramento River downstream of Georgiana Slough	RSAC121	USGS	h	Q&h	Q&h	Q&h	Q&h
San Joaquin River at San Andres Landing	B95100	DWR	h	h	h	h	h
San Joaquin River at Venice Island	B95580	DWR	h	h	h	h	h
San Joaquin River at Turner Cut	--	DWR	h	h	h	h	h
San Joaquin River at Rindge Pump	B95620	DWR	h	h	h	h	h
Internal Boundary							
Mokelumne River at Benson's Ferry	RMKL027	DWR	h	h	h	h	h
South Fork Mokelumne River at New Hope Landing	RSMKL024	DWR	h	h	h	h	h

1 Q = discharge, h = stage, e = estimated as explained in text

2 For the 1986 simulation, stage data at Sacramento River downstream of Georgiana Slough were used for the upstream end of Georgiana Slough and the Sacramento River reach was removed from the model network.

Data collected at different times, and by different agencies does not always utilize the same reference datum, and in some cases does not document the reference datum used. To ensure uniformity and confidence in the modeling results, data from each source have been datum checked and converted as needed to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Bridges and Structures

All bridges and structures were included in the model as cross-sections to allow the model to calculate the effects of the restrictions. The data for the bridges came from the State and County drawings available for the structures, and the data for the DCC from the USBR ‘as built’ drawing number 214-D-16819.

Roughness Coefficients

The MIKE11 model requires the input of channel roughness in each reach for calculating water surface elevations. Roughness values were input by designating a roughness coefficient, Manning’s n for each reach. The value of this coefficient depends on many things, but primarily upon bed and bank materials, the amount of vegetation, and channel irregularity. For this Project, a number of n-value tables and photographs were used to estimate “n” values for various regions of the model domain. The final values are shown in Table E-2. More detail on the method of choosing the Manning’s n values is given in Hammersmark (2002).

Table E-2. North Delta MIKE 11 Manning Coefficients

	Global value[1]	Cosumnes River[2]	Deer Creek	Dry Creek	Delta Islands and Tracts	Floodplains
Manning’s “n”	0.036	0.04	0.05	0.05	0.05	0.1

[1] The global value was applied to all model regions unless otherwise specified.

[2] For the 1986 runs, Cosumnes River “n” value was increased to 0.045 to account for the increases effect of vegetation at high water levels.

Calibration and Validation of the Model

For a successful comparative evaluation of Project Alternatives, it is important to have a well calibrated and validated hydraulic model. The MIKE 11 model for the North Delta Project was calibrated and validated for a range of flows to ensure that the model was capable of simulating a range of storm events. This section documents the flow data used for calibration and validation, the methodology, and comparisons between model outputs and the measured data.

Flow Data

The range of flows, considered for modeling the Project Alternatives, varies from a 2.5-year to over 200-year return interval at Michigan Bar. The return interval for various flood pulses at Michigan Bar has been chosen as the distinguishing variable because the Cosumnes River is the dominant source of floodwater to the North Delta region. Michigan Bar has a comparatively long record of gage data. The return interval or flood recurrence interval is defined as the expected period of time within which a flood of a given magnitude will be equaled or exceeded. In other words, the chance that a 50-year recurrence interval flood will occur in a given year is 1 in 50.

Flood frequency analyses were performed by the USGS for the Cosumnes River based upon 91 years of data (1907-1997) recorded at the Michigan Bar gaging station (Guay et al. 1998). Philip Williams and Associates (PWA) performed another flood frequency analysis for the Cosumnes River based upon 89 years of data (1907-1995) recorded at the Michigan Bar gaging station (Vick et al 1997). As well, David Ford Consulting Engineers Inc. performed a flood frequency analysis as part of work prepared for Sacramento County. These flow frequency analyses have been used to describe the recurrence intervals of flood pulses in this study. Of note, all the analyses clearly show that the peak Michigan Bar flow for 1997, which was reported at 93,000 cfs, significantly exceeded a 100 year event and the two most recent analyses (PWA and David Ford) have the 1997 event exceeding a 200 year event. Table E-3 shows the peak flows for different return intervals for Michagan Bar from the various analyses.

Table E-3. Comparison of peak flow (cfs) at Michigan Bar

	Return Period (Year)					
	10	25	50	100	200	500
USGS	34,200		66,800	82,900		125,000
PWA	30,548			68,000	79,900	
David Ford	40,846	53,865	60,400	73,022	82,340	

Index Points

In addition to utilizing gage data as boundary conditions for the simulated hydraulic system, gage data from locations within the model domain, including Benson's Ferry and New Hope Landing, were used to calibrate and validate the model results. Figure E- 5 shows the index points that were used in the model to interpret and compare results for different Project Alternatives.

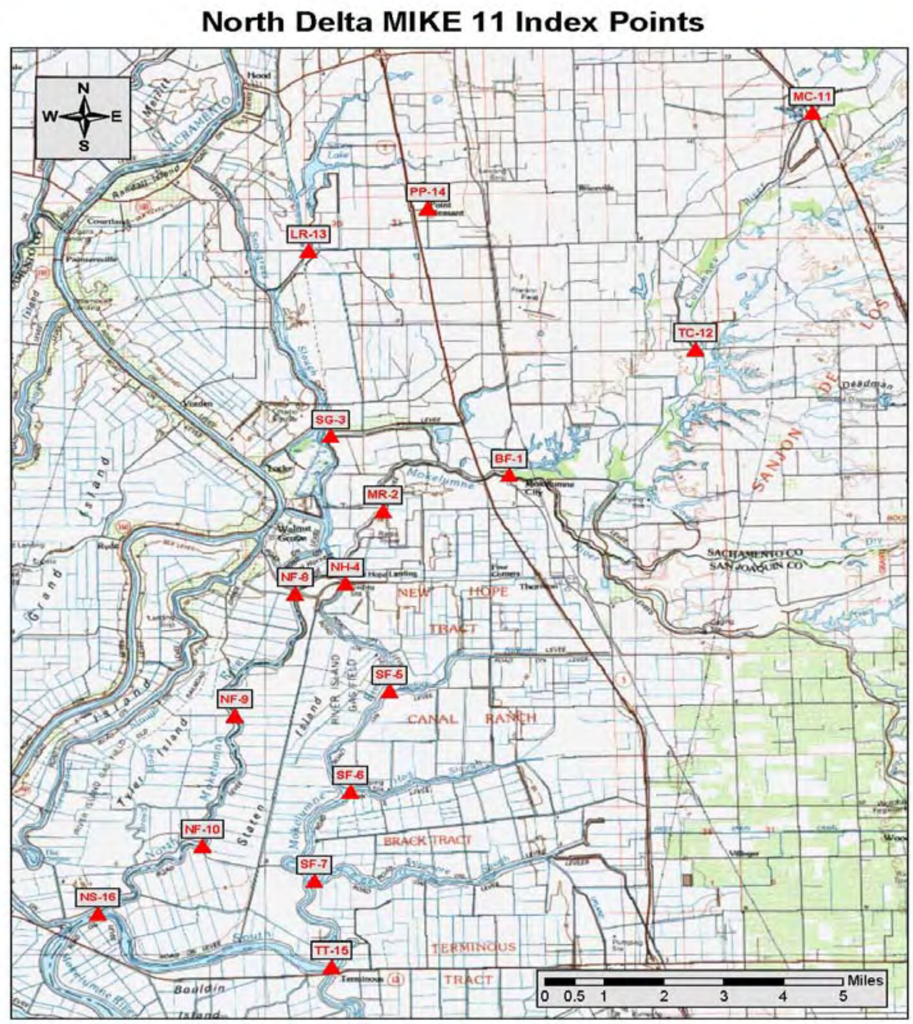


Figure E-5. North Delta MIKE11 Index Points

Model Limitations

One-Dimensional Model

It is also important to understand the simplifications and assumptions which are often made when applying a model and evaluating a physical system. The MIKE 11 hydraulic model used for the North Delta Project area is hydraulic not hydrologic. Hydrologic elements of river and floodplain systems, which are not incorporated, include the groundwater-surface water interaction, as well as surface water interaction with the atmosphere and vegetation. Water movement is simulated based upon water forces, and assumed to act only in the longitudinal direction. Thus effects from an eddy or a rapid, formed by a constriction in the river channel or at a levee breach are not captured in this model (or in any one dimensional hydrodynamic model).

Cross Sections and Boundary Conditions

A great deal of real data have been utilized in compiling, calibrating, and validating the model. However, many crucial data elements including cross sectional geometry, boundary conditions, and system connectivity are not available, and hence, have been estimated. Other uncertainties arise when using cross sectional data, which were measured at different times with different methods. For example, data from as early as 1934 were used in the model. Yet another element of uncertainty is the lack of channel cross sectional data in some reaches, with 2.1 miles between cross sections in some cases.

Estimation of certain boundary condition data was necessary. Boundary condition estimation was required for Deer Creek at Wilton Road, Dry Creek above Galt, Stone Lakes Outfall at Lambert Road, and Little Potato Slough below Terminous Tract, for various time periods of the 1986, 1997, 1998, 1999, and 2000 storm events.

Dry Creek Flow

The Dry Creek watershed is known to contribute significant flows to the North Delta Project area during storms. Gage data at the Dry Creek Galt gage is available for limited periods. Data for the gage during the 1986 storm is available, but in order to simulate the years of 1997, 1998, 1999, and 2000 an estimation of the Dry Creek flow contribution was required. A comparison of daily average discharge values in 1986 suggests that during storm events, the Dry Creek at Galt discharge is roughly 40% of Cosumnes River discharge at Michigan Bar. Based upon this comparison of historic discharge data the Dry Creek at Galt boundary condition were estimated for the 1998, 1999, and 2000 model runs to be 40% of the discharge of the Cosumnes River at Michigan Bar (USACE 1990). However, 30% of the Michigan Bar discharge was used for the 1997 run. A limitation to this approach is that it overestimates Dry Creek discharge during low flow conditions, and may underestimate Dry Creek discharge during flood pulses.

Stage Data

Data from the stage gages located at Wilton Road on Deer Creek and Lambert Road at the Stone Lakes Outfall, both operated by SAFCA, do not exist for 1986. For the Wilton Road gage, a correlation to an adjacent gaging station for which data were available was not attempted. Instead, an average low flow water elevation of 53.8 feet was assumed. This value was chosen by inspection of available data for the period of 1998-2000. No attempt was made to synthesize flood pulse water levels. At the Stone Lakes Outfall at Lambert Road, a control structure prevents water from flowing south to north at this location. For a brief period during the large flood of 1986, flow traveled over Lambert Road north into the Stone Lakes Region (USACE 1988). For 1986 model simulations a weir was inserted at Lambert Road, which prevented flow during non-flood conditions, but allowed some water to travel north over Lambert Road during the peak of the flood pulse (Hammersmark 2002).

Calibration Methodology

The high degree of uncertainty in various model inputs such as channel geometry, assumed boundary conditions, and system connectivity, made calibration and verification of the model a complex undertaking. The model improvement and calibration proceeded in two phases, focusing on different flow conditions. Initially, the low flow, tidally dominated portion of the hydrograph was considered, and adjustments were made so that the model would accurately reflect the amplitude and timing of observed tidal signal data.

The second phase of model calibration focused on improving the timing, magnitude and hydrograph shape of various flood pulses. This involved refining the connectivity of the simulated hydraulic system to result in the best agreement with observed data. In particular, the manner in which the Cosumnes River channel flow accesses (through overtopping, breaching, etc.) floodplain regions, and the effect of such regions on attenuating flood pulses was refined. (Hammersmark 2002)

Comparison to Observed Data

Ultimately, the North Delta MIKE 11 model was applied to simulate the flooding period of the following five years: 1986, 1997, 1998, 1999, and 2000. Calibration plots (shown in Figures E-6 through E-10) illustrate that the model is in good agreement with the observed data for the range of storm events. They include tidal influence and floods of various magnitudes, including two large storm events (1986 and 1997). Deviations in some of the peaks are most likely the result of the use of a constant percentage of Michigan Bar flows applied for Dry Creek. There was no apparent basis to manipulate the Dry Creek flows for year to year to better represent the flow ranges. The observed agreement of the model results with the measured data ensured that it could be confidently used for the comparative evaluation of flood control and ecosystem restoration Alternatives.

One additional method of evaluating the model results for the 1986 flooding event was a comparison of maximum floodwater volume stored in the various areas flooded as levees failed. Maximum floodwater storage in McCormack-Williamson Tract, Glanville Tract, Dead Horse Island, Tyler Island, and New Hope Tract were estimated by the Sacramento District of the U. S. Army Corp of

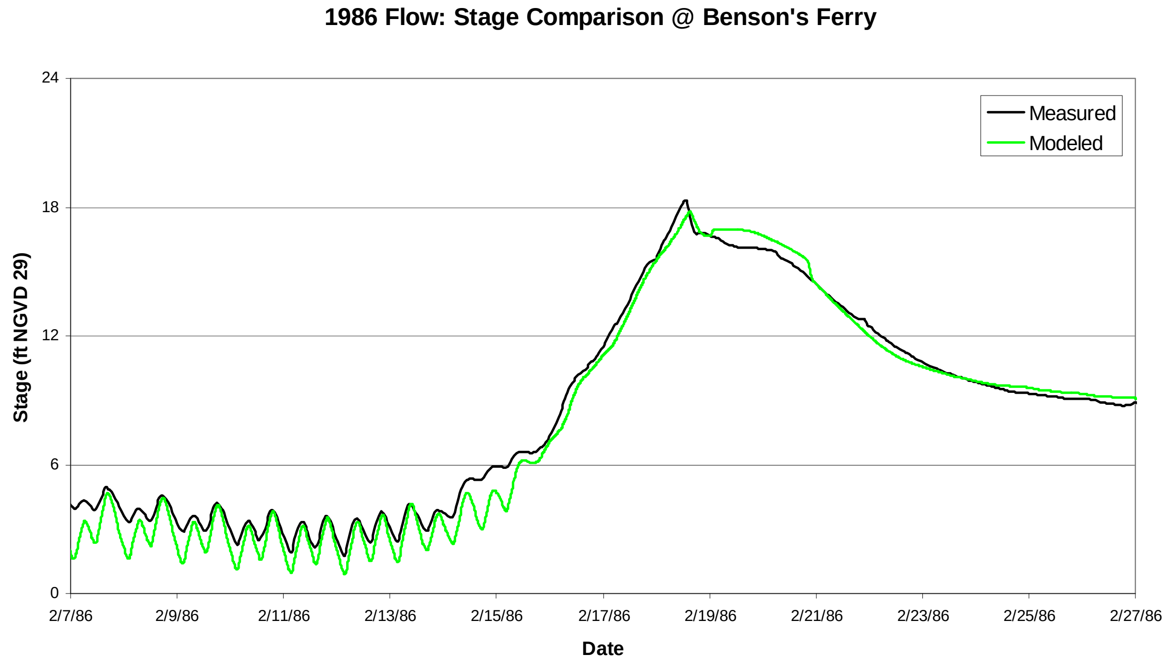
Engineers (1988). Table E-4 presents the values that support a reasonable agreement between the estimate and the model.

Table E-4. Comparison of Model Simulation Results to Estimated Values of Maximum Floodwater Storage for Each Flooded Island or Tract During the 1986 Flood Event

	Maximum Floodwater Storage (ac-ft)	
Flooded Region	Simulation	Estimated [1]
Glanville Tract	48,900	45,000
M-W Tract	18,900	17,000 – 20,000
Dead Horse Island	2,700	2,000 – 3,000
Tyler Island	108,000	130,000 -150,000
New Hope Tract	49,300	60,000

Note:

[1] Estimated maximum floodwater storage values obtained from U. S. Army Corps of Engineers, 1988.



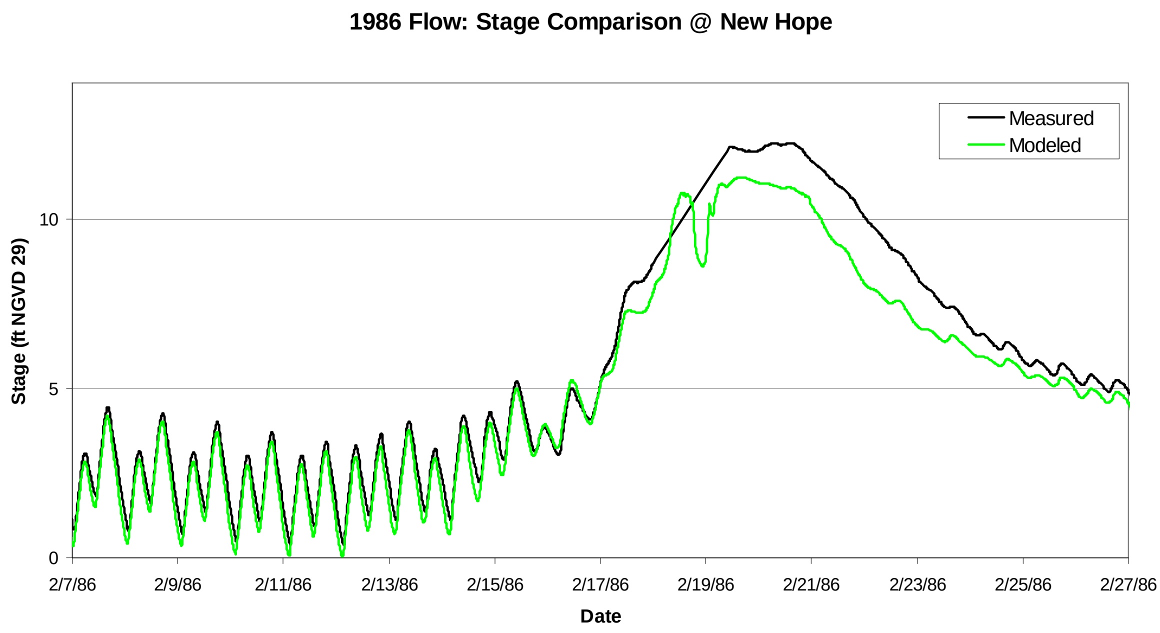


Figure E-6. Model results Compared to Measured Data at Benson's Ferry (top panel) and New Hope (bottom panel) for the Year 1986 Flow

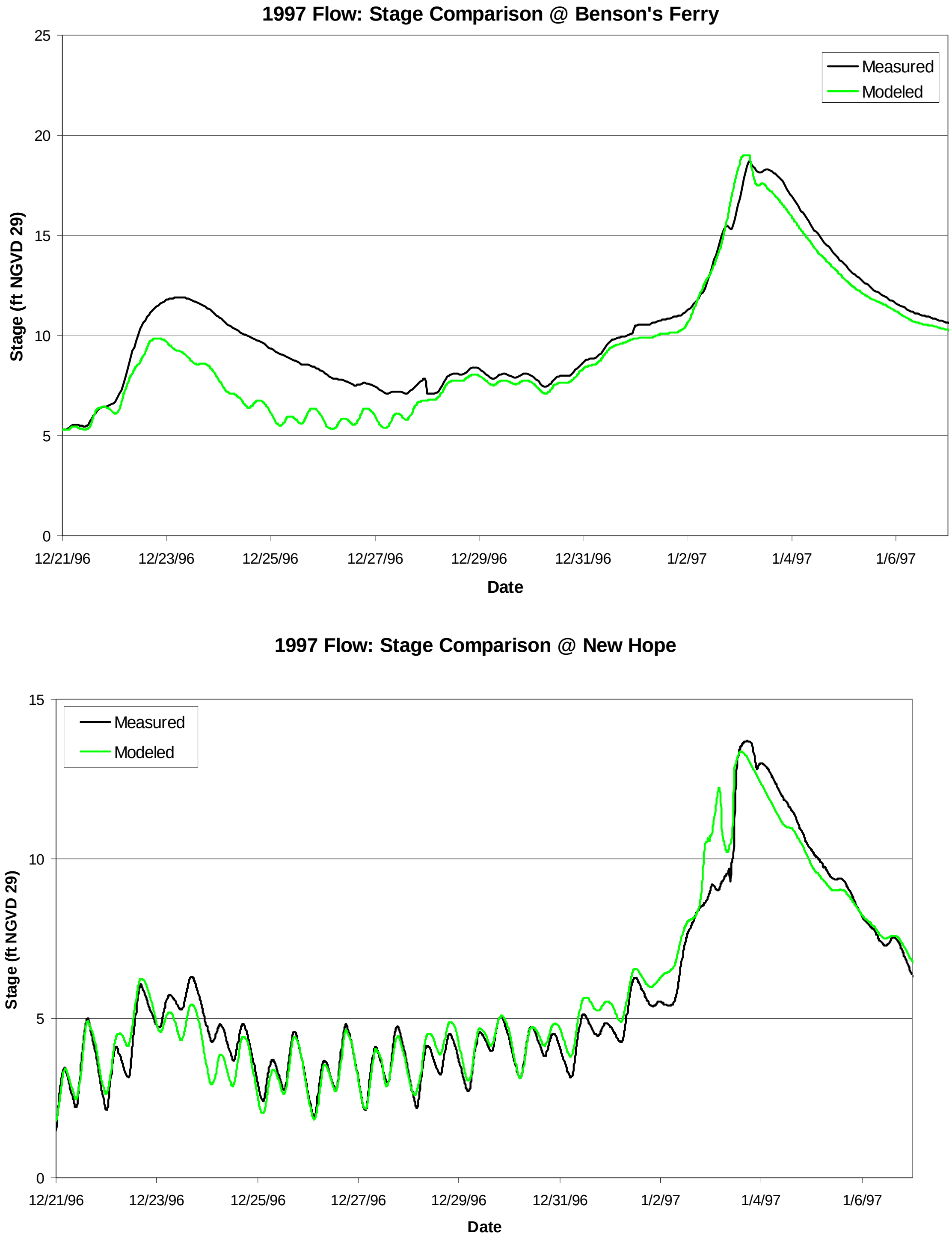
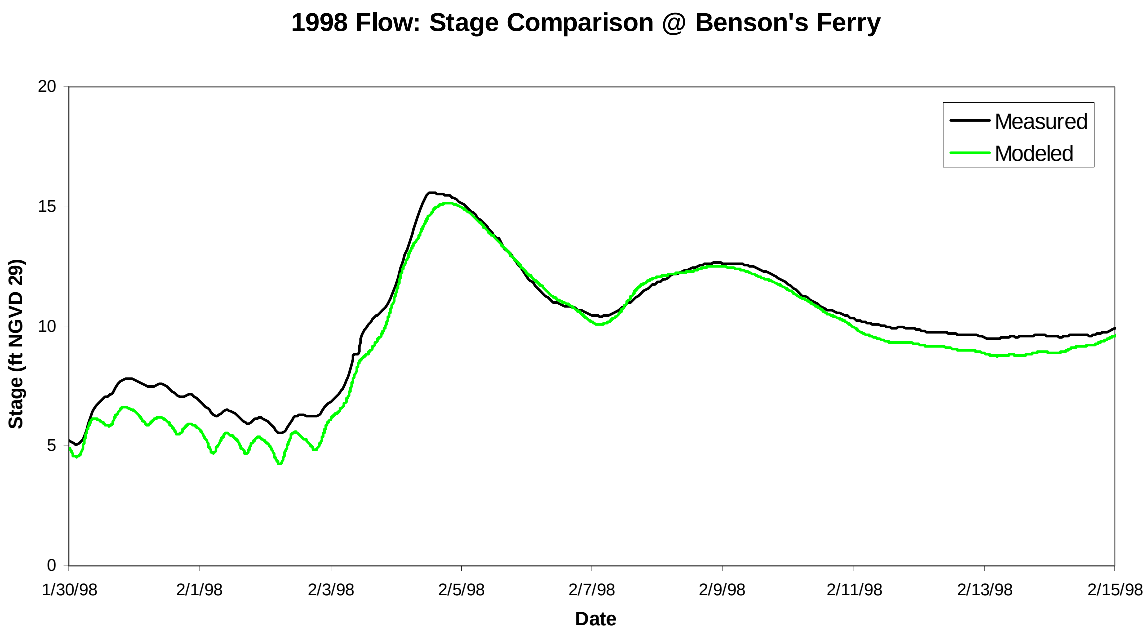


Figure E-7. Model Results Compared to Measured Data at Benson's Ferry (top panel) and New Hope (bottom panel) for the Year 1997 Flow.



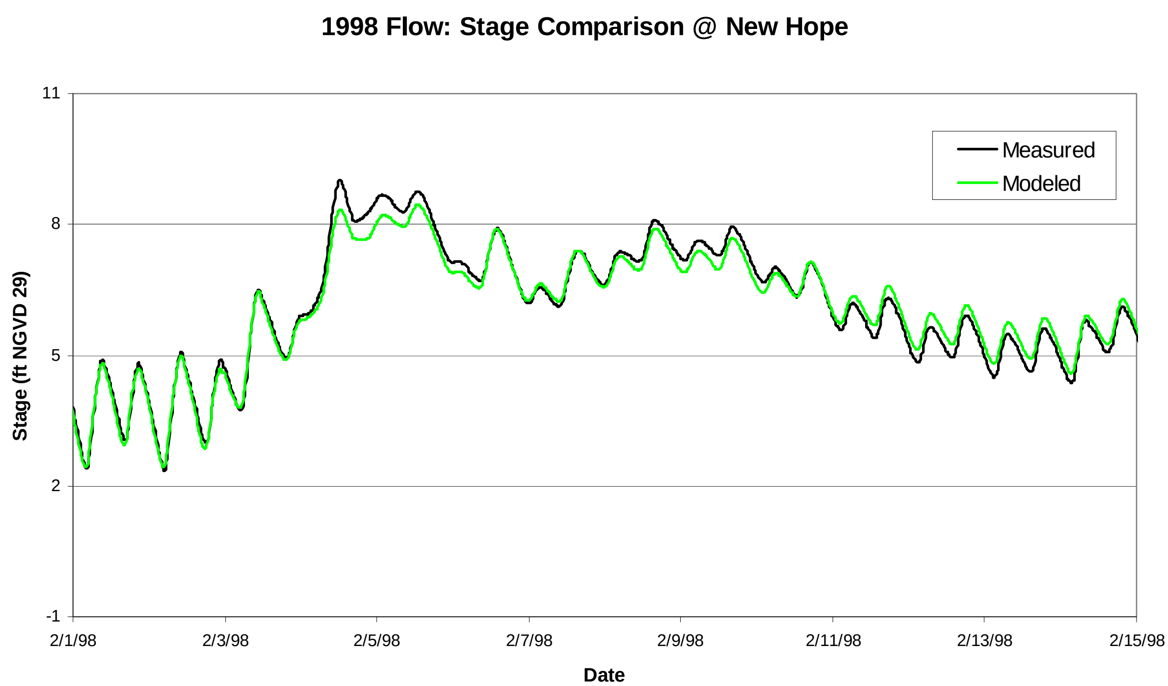
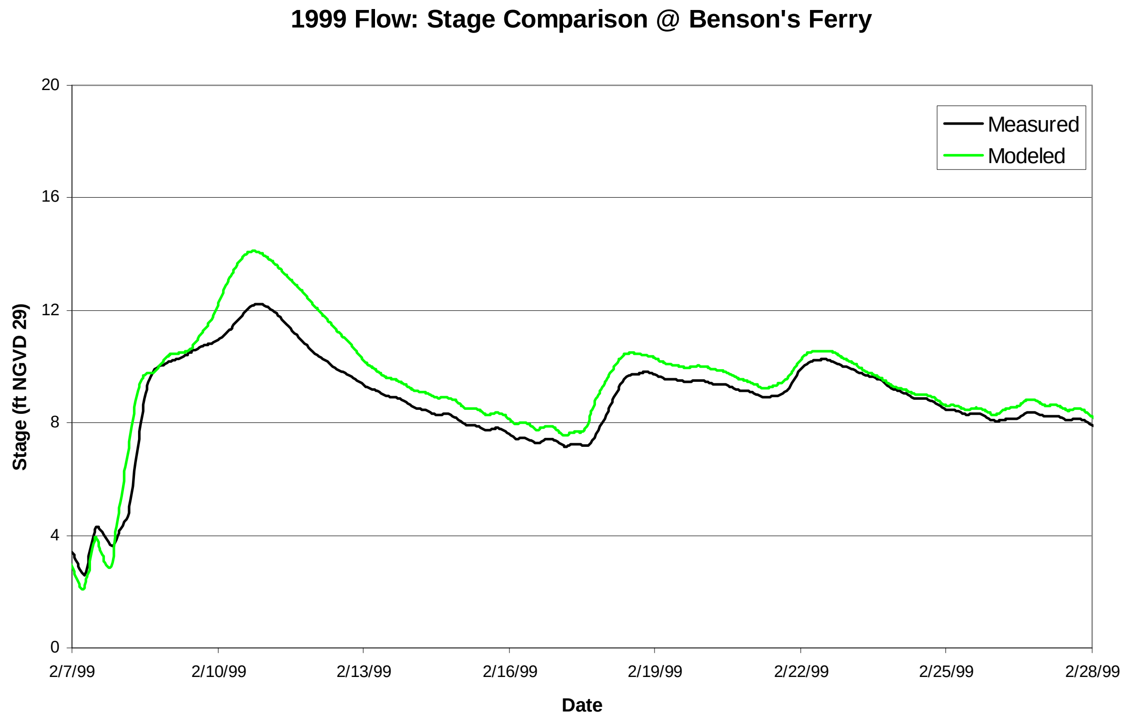


Figure E-8. Model Results Compared to Measured Data at Benson's Ferry (top panel) and New Hope (bottom panel) for the Year 1998 Flow



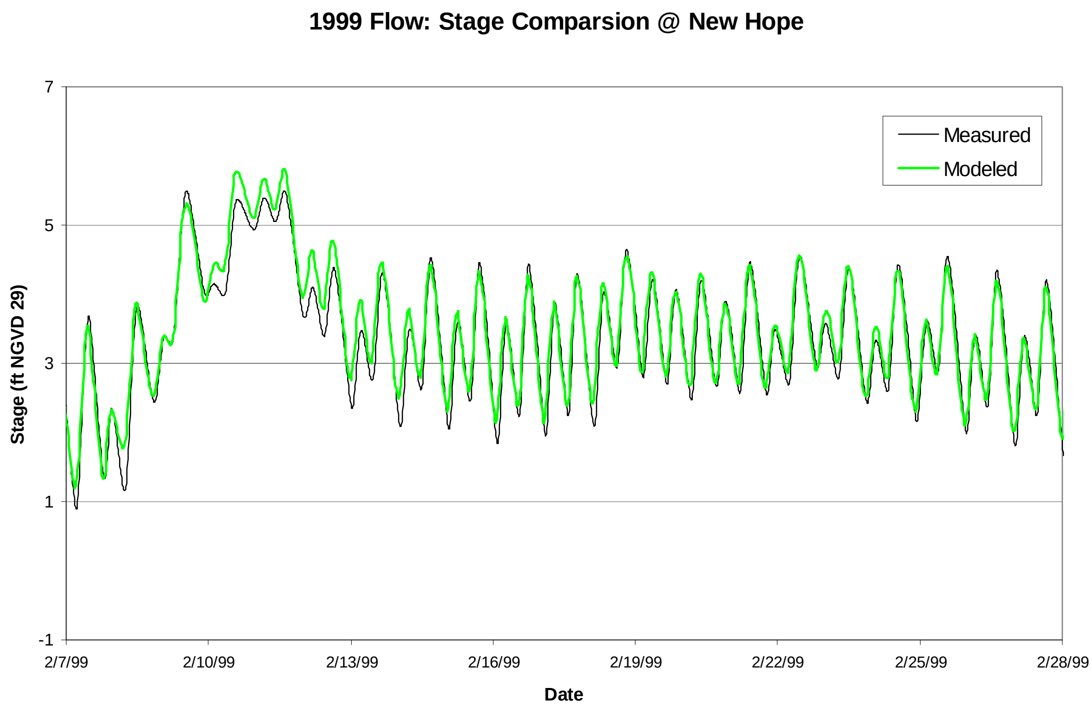
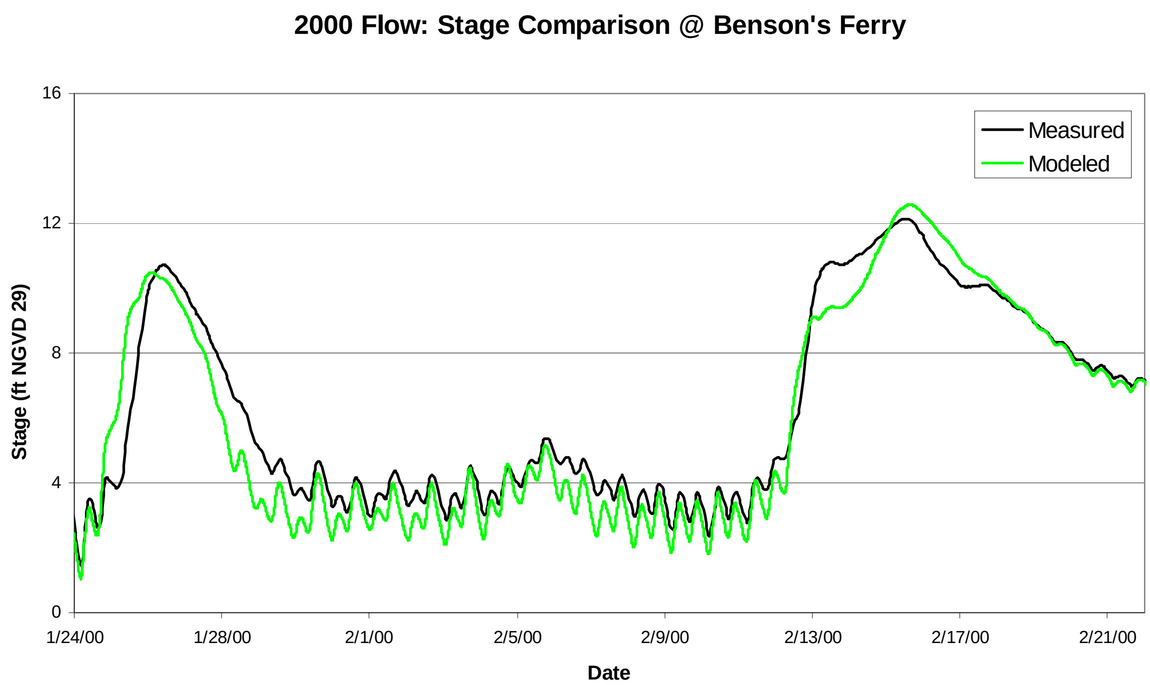


Figure E-9. Model Results Compared to Measured Data at Benson's Ferry (top panel) and New Hope (bottom panel) for the Year 1999 Flow



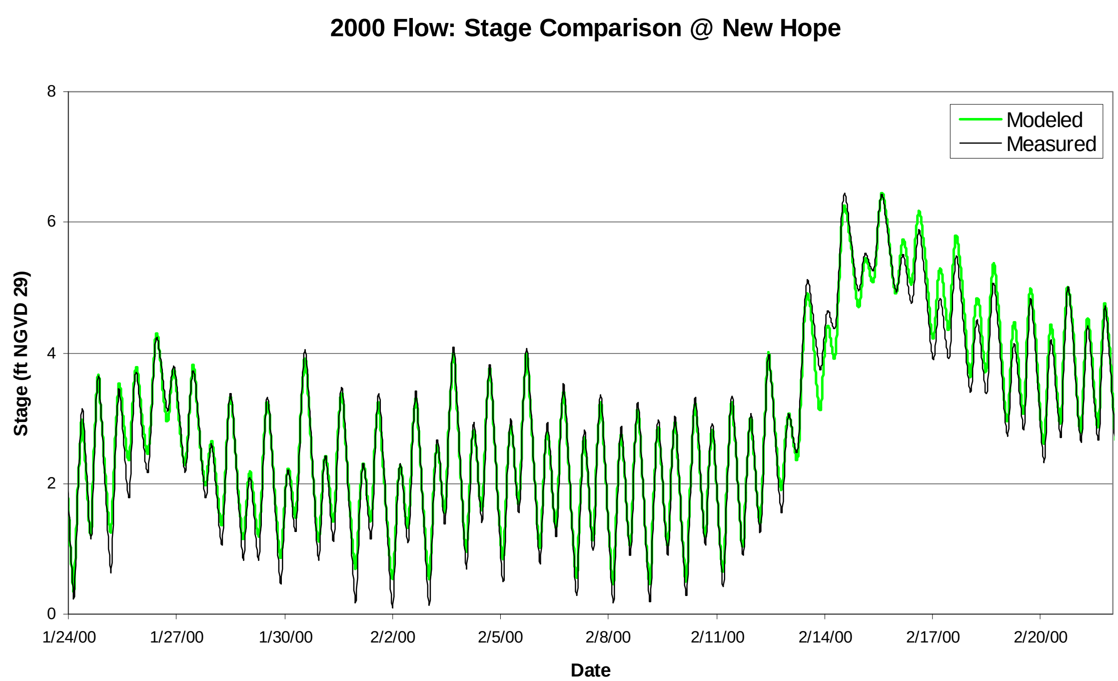


Figure E-10. Model Results Compared to Measured Data at Benson's Ferry (top panel) and New Hope (bottom panel) for the Year 2000 Flow

Sensitivity Analysis

To determine the sensitivity of the model's results to various input parameters, sensitivity runs were performed. In conducting a sensitivity analysis, one input parameter was adjusted while all other parameters were left unchanged. The model sensitivity to three types of input parameters were investigated:

- The timing and magnitude of upstream discharge (Cosumnes River at Michigan Bar, Dry Creek above Galt, Mokelumne River at Woodbridge and the Sacramento River at Georgiana Slough),
- Downstream water level (Mokelumne River at Georgiana Slough and Little Potato Slough near Terminous Tract), and
- Channel roughness.

The first four months of flow in 1998 (1/3/98 to 4/30/98) were chosen for the sensitivity analysis, to allow for the analysis of tidally dominated/low river flow conditions in addition to flood events of varying magnitude (up to ~10 year return interval at Michigan Bar). The sensitivity analysis indicated that the model was sensitive to alterations of most input parameters, with varying degrees of sensitivity observed at Benson's Ferry and New Hope Landing.

Levee Failure Criteria

Levee failures have a significant influence upon water levels in the North Delta. Many levee failures occurred during the floods of 1986 and 1997, which impacted the water surface elevations in the channels and inundated adjacent lands. Reasonably good data exists for the levee failures that occurred during the 1986 and 1997 floods. Therefore, it was possible to calibrate the model for these events. Historic levee breaks from these floods were triggered in the model by water surface elevation. Breach dimensions were estimated based on the data available. However, further consideration was required regarding the potential for other levee failures when the system was modified to simulate Alternatives.

Regardless of the methods used to develop levee failure criteria, there was much uncertainty when predicting a levee failure due to high water levels. The Department of Water Resources, in coordination with the North Delta Improvements Group, adopted systematic levee failure criteria for the North Delta MIKE11 model. Levee failure criteria were developed for river reaches west of Interstate 5 based on existing North Delta area breach data. Due to lack of topographic data in many areas on the upper and lower Cosumnes River east of I-5, historic breaks were simulated along these reaches in the model for all model 1997 runs. Because the magnitude of the 1997 event was large and the levees along the Cosumnes are very low and expected to overtop in large events, this was deemed a reasonable assumption.

Lateral flow due to levee overtopping allows for exchange of flow between floodplain conveyance and the river channel. Floodwater enter the overbank areas by overtopping and breaching the levee structure. The rate of levee overflow was computed by the broad-crested weir relationship. The model has the capability to compute flow through breached levees. Input parameters were the failure mode, final bottom width, final bottom elevation, left slope, right slope, and final formation time.

Breach locations were identified by determining the point on each river reach where the distance from the top of the levee (from topographic data) and the maximum water surface elevation (from 1997 base condition MIKE11 runs) was minimum. The failure mode was by overtopping. The final breach dimensions and other parameters are as follows:

- Final bottom width: 500 feet (recommendation from General Characterization of Unplanned Levee Breach Geometries – DWR)
- Breach depth: 40 feet (recommendation from General Characterization of Unplanned Levee Breach Geometries – DWR)
- Final bottom elevation: Existing ground surface elevation on landside of levee
- Left slope: 1
- Right slope: 1
- Model breach as a broad crested weir with weir coefficient of 2.6 (coefficient varies between 2.6 and 3.1 depending on levee cross sectional characteristics – Skogerboe and Hyatt, 1967)
- Rate of breach formation: 1 ft/hr (Powledge et al. 1989)

Flood Control and Ecosystem Restoration Alternatives Modeling

Hydraulic modeling of the North Delta area over a wide range of flows was performed to characterize the current system hydraulically, and to comparatively evaluate the potential impacts of flood control and ecosystem restoration Project Alternatives. The following list includes the hydrologic events and simulation periods for the modeling results presented in this section.

Table E-5. Simulation period and return interval of hydrology

Year	Simulation Period	Return Interval[1]
2000	1/3/2000 till 4/30/2000	~2.5
1999	1/3/1999 till 4/30/1999	~5
1998	1/3/1998 till 4/30/1998	~10
1986	1/3/1986 till 4/30/1986	~25
1997	12/3/1996 till 1/15/1997	200+

[1] Return interval for annual peak flow at Michigan Bar gage on Cosumnes River.

Comparative Simulations for Alternatives

Simulations of Project Alternatives were performed for the flood events listed in Table E-5 and for a 100-yr flood event. Early modeling runs established that there were no appreciable differences between the various flood control and ecosystem restoration configurations on McCormack-Williamson Tract (Group 1 Actions as described in Chapter 2) with regard to system-wide flood performance. This is because all the scenarios on McCormack-Williamson Tract include lowering the East levee to 8.5 ft (NGVD 29) which is the greatest significant flood performance control in the area. Therefore, the Group 2 Alternatives were run with Ecosystem option #2 (i.e., Alternative 1-B) only, and this was taken as representative of performance of any of the McCormack-Williamson Tract Group 1 options in combination with the modeled Group 2 component.

For the purpose of displaying the modeling results in this Appendix, the following naming conventions are used in the Tables and Figures herein. Detailed descriptions of the components of each Alternative are provided in Chapter 2 of the EIR.

- Eco-Scenario #2 = Alternative 1-B or Seasonal Floodplain Optimization
- Flood Option #1 = Alternative 2-A or North Staten Detention
- Flood Option #2 = Alternative 2-B or West Staten Detention
- Flood Option #3 = Alternative 2-C or East Staten Detention
- Flood Option #4 = Alternative 2-D or Dredge and Levee Modifications

The results of the flood control modeling are presented in several ways. The maximum stage at each of the model index points for each of the runs are shown in Table E-6 for 1986 hydrology, Table E-7 for the 1997 hydrology, and Table E-8 for the 100-yr flood hydrology. Stage hydrographs are shown in Figures E-11 through E-30 at representative points including New Hope, Benson's Ferry, and downstream locations on the North and South Forks of the Mokelumne for the

1997 hydrology. The plots are focused in the time windows where noticeable changes were observed. These provide a comparison of stage duration with and without the Project Alternative. A full set of stage hydrographs at each index point for each modeled hydrology can be made available on CD by request.

Table E-9 provides a comparison of maximum velocities at key points for each of the flood control Alternatives (combined with Alternative 1-B, ecological option 2) for 1986 and 1997 hydrology. Figures E-31 and E-32 show flow splits for the North and South Forks of the Mokelumne River for each of the Alternatives for 1986 and 1997 hydrology. South Fork and North fork flows were estimated at approximately 2 miles downstream from the New Hope Bridge and Miller Ferry Bridge, respectively. The flow-split comparisons are intended to provide a rough qualitative idea of how flow-splits may change for each of the Project Alternatives. Of note, because of the complexity of the hydraulic system, the flow splits should be considered in context with the respective stage hydrographs, detention basin volumes, and other flows throughout the system. For example, there is not necessarily a direct correlation between volumes captured in Staten detention basins and instantaneous flow remaining in the North and South Forks.

Table E-6. Comparison of Group 2 Project Alternatives: Water Level Impacts for 1986 Flood Hydrology

Index Point	Location	Peak Stage (ft NGVD 29)						
					Group 2 Alternatives, Combined with Alternative 1-B			
		1986 Flood	1986 No Failures	Alternative 1-B (Base Case)	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	Benson's Ferry	17.8	18.8	16.3 (2.5)[1]	15.6 (3.2)	15.8 (3.0)	15.8 (3.0)	15.5 (3.3)
MR-2	Mokelumne River	14.4	15.6	13.6 (2.0)	11.6 (4.0)	12.5 (3.1)	12.6 (3.0)	12.1 (3.5)
SG-3	Snodgrass Slough	12.9	15.0	14.3 (0.7)	12.7 (2.3)	13.4 (1.6)	13.5 (1.5)	13.0 (2.0)
NH-4	New Hope	12.5	13.3	13.3 (0)	11.0 (2.3)	12.1 (1.2)	12.2 (1.1)	12.0 (1.3)
SF-5	SF[2] Mokelumne	8.7	9.4	9.3 (0.1)	8.2 (1.2)	8.7 (0.7)	8.3 (1.1)	9.1 (0.3)
SF-6	SF Mokelumne	7.2	7.6	7.6 (0)	7.2 (0.4)	7.3 (0.3)	7.2 (0.4)	7.9 (-0.3)
SF-7	SF Mokelumne	6.9	7.3	7.3 (0)	7.0 (0.3)	7.1 (0.2)	7.0 (0.3)	7.4 (-0.1)
NF-8	NF Mokelumne	11.3	12.5	12.7 (-0.2)	10.8 (1.7)	11.2 (1.3)	11.7 (0.8)	11.5 (1.0)
NF-9	NF Mokelumne	8.4	9.6	9.7 (-0.1)	8.6 (1.0)	8.8 (0.8)	9.1 (0.5)	9.0 (0.6)
NF-10	NF Mokelumne	6.9	7.9	7.9 (0)	7.4 (0.5)	7.5 (0.4)	7.6 (0.3)	7.7 (0.2)
MC-11	McConnell	46.3	46.3	46.3 (0)	46.2 (0.1)	46.2 (0.1)	46.2 (0.1)	46.3 (0)
TC-12	Twin Cities Road	24.9	24.9	24.7 (0.2)	24.6 (0.3)	24.6 (0.3)	24.6 (0.3)	24.7 (0.2)
LR-13	Lambert Road	12.9	15.0	14.3 (0.7)	12.7 (2.3)	13.4 (1.6)	13.5 (1.5)	13.0 (2.0)

Index Point	Location	Peak Stage (ft NGVD 29)						
		1986 Flood	1986 No Failures	Alternative 1-B (Base Case)	Group 2 Alternatives, Combined with Alternative 1-B			
					Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
PP-14	Point Pleasant	13.5	13.9	13.5 (0.4)	11.2 (2.7)	13.4 (0.5)	13.4 (0.5)	13.4 (0.5)
TT-15	Terminous Tract	6.8	7.1	7.2 (-0.1)	6.9 (0.2)	7.0 (0.1)	7.0 (0.1)	7.2 (-0.1)
NS-16	Confluence of NF and SF	6.8	7.2	7.2 (0)	7.0 (0.2)	7.0 (0.2)	7.0 (0.2)	7.2 (0)
Detention basin volume (ac-ft)					48,300[3]	35,600[4]	32,400[4]	N/A

[1] Value in parentheses denotes: stage difference (ft) = Stage for "No Failure" – Stage for "Alternative";

Positive value denotes <u>stage drop.</u>

[2] SF, NF: South Fork and North Fork of Mokelumne River, respectively.

[3] 10-ft weir height

[4] 9-ft weir height

Table E-7. Comparison of Group 2 Project Alternatives: Water Level Impacts for 1997 Flood Hydrology

Index Point	Location	Peak Stage (ft NGVD 29)						
					Group 2 Alternatives, Combined with Alternative 1-B			
		1997 Flood	1997 No Failures	Alternative 1-B (Base Case)	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	Benson's Ferry	19.2	19.9	17.4 (2.5)[1]	16.8 (3.1)	17.2 (2.7)	17.1 (2.8)	16.6 (3.3)
MR-2	Mokelumne River	16.1	16.9	14.6 (2.3)	12.1 (4.8)	13.3 (3.6)	13.6 (3.3)	12.9 (4.0)
SG-3	Snodgrass Slough	15.0	16.3	15.4 (0.9)	13.9 (2.4)	14.4 (1.9)	14.7 (1.6)	13.8 (2.5)
NH-4	New Hope	14.3	14.5	14.3 (0.2)	11.4 (3.1)	12.7 (1.8)	13.1 (1.4)	12.8 (1.7)
SF-5	SF[2] Mokelumne	9.6	9.7	9.7 (0)	7.9 (1.8)	8.7 (1.0)	8.2 (1.5)	9.3 (0.4)
SF-6	SF Mokelumne	7.2	8.3	7.2 (1.1)	6.4 (1.9)	6.7 (1.6)	6.6 (1.7)	7.6 (0.7)
SF-7	SF Mokelumne	6.7	6.8	6.7 (0.1)	6.2 (0.6)	6.4 (0.4)	6.3 (0.5)	6.9 (-0.1)
NF-8	NF Mokelumne	13.4	13.6	13.6 (0)	11.1 (2.5)	11.5 (2.1)	12.7 (0.9)	12.2 (1.4)
NF-9	NF Mokelumne	9.9	10.0	10.1 (-0.1)	8.4 (1.6)	8.8 (1.2)	9.4 (0.6)	9.2 (0.8)
NF-10	NF Mokelumne	7.7	7.8	7.8 (0)	6.9 (0.9)	7.1 (0.7)	7.4 (0.4)	7.4 (0.4)
MC-11	McConnell	49.8	49.8	49.8 (0)	49.7 (0.1)	49.7 (0.1)	49.7 (0.1)	49.8 (0)
TC-12	Twin Cities Road	25.8	25.8	25.6 (0.2)	25.6 (0.2)	25.6 (0.2)	25.6 (0.2)	25.6 (0.2)
LR-13	Lambert Road	15.0	16.3	15.4 (0.9)	13.9 (2.4)	14.4 (1.9)	14.7 (1.6)	13.8 (2.5)

Index Point	Location	Peak Stage (ft NGVD 29)						
		1997 Flood	1997 No Failures	Alternative 1-B (Base Case)	Group 2 Alternatives, Combined with Alternative 1-B: Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
PP-14	Point Pleasant	12.5	12.7	12.5 (0.2)	12.3 (0.4)	12.4 (0.3)	12.5 (0.2)	12.5 (0.2)
TT-15	Terminous Tract	6.5	6.5	6.5 (0)	6.0 (0.5)	6.2 (0.3)	6.2 (0.3)	6.6 (-0.1)
NS-16	Confluence of NF and SF	6.7	6.7	6.7 (0)	6.3 (0.4)	6.4 (0.3)	6.5 (0.2)	6.6 (0.1)
Detention basin volume (ac-ft)					36,900[3]	24,800[4]	21,200[4]	N/A

[1] Value in parentheses denotes: stage difference (ft) = Stage for "No Failure" – Stage for "Alternative";
Positive value means stage drop.

[2] SF, NF: South Fork and North Fork of Mokelumne River, respectively.

[3] 10-ft weir height

[4] 9-ft weir height

Table E-8. Comparison of Group 2 Project Alternatives: Water Level Impacts for 100-Yr Flood Hydrology

Index Point	Location	Peak Stage (ft NGVD 29)					
		100-year No Failures	Alternative 1-B (Base Case)	Group 2 Alternatives, Combined with Alternative 1-B			
				Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	Benson's Ferry	18.7	16.1 (2.6)[1]	15.9 (2.8)	16.0 (2.7)	16.0 (2.7)	15.7 (3.0)
MR-2	Mokelumne River	15.3	13.0 (2.3)	12.0 (3.3)	12.5 (2.8)	12.6 (2.7)	11.8 (3.5)
SG-3	Snodgrass Slough	14.6	13.8 (0.8)	11.5 (3.1)	13.4 (1.2)	13.5 (1.1)	12.2 (2.4)
NH-4	New Hope	12.9	12.8 (0.1)	11.5 (1.4)	12.2 (0.7)	12.3 (0.6)	11.7 (1.2)
SF-5	SF[2] Mokelumne	8.7	8.5 (0.2)	7.9 (0.8)	8.2 (0.5)	8.1 (0.6)	8.5 (0.2)
SF-6	SF Mokelumne	6.9	6.9 (0)	6.7 (0.2)	6.8 (0.1)	6.8 (0.1)	7.2 (-0.3)
SF-7	SF Mokelumne	6.7	6.7 (0)	6.5 (0.2)	6.6 (0.1)	6.6 (0.1)	6.8 (-0.1)
NF-8	NF Mokelumne	12.1	12.1 (0)	11.2 (0.9)	11.2 (0.9)	11.7 (0.4)	11.2 (0.9)
NF-9	NF Mokelumne	8.9	8.8 (0.1)	8.4 (0.5)	8.5 (0.4)	8.6 (0.3)	8.4 (0.5)
NF-10	NF Mokelumne	7.3	7.3 (0)	7.2 (0.1)	7.3 (0)	7.3 (0)	7.1 (0.2)
MC-11	McConnell	48.0	48.0 (0)	48.0 (0)	48.0 (0)	48.0 (0)	48.0 (0)
TC-12	Twin Cities Road	25.5	25.4 (0.1)	25.4 (0.1)	25.4 (0.1)	25.4 (0.1)	25.4 (0.1)
LR-13	Lambert Road	14.6	13.8 (0.8)	13.1 (1.5)	13.4 (1.2)	13.5 (1.1)	12.5 (2.1)
PP-14	Point Pleasant	11.9	11.8 (0.1)	11.8 (0.1)	11.8 (0.1)	11.8 (0.1)	11.7 (0.2)
TT-15	Terminous Tract	6.5	6.5 (0)	6.4 (0.1)	6.5 (0)	6.5 (0)	6.6 (-0.1)
NS-16	Confluence of NF and SF	6.8	6.8 (0)	6.7 (0.1)	6.7 (0.1)	6.7 (0.1)	6.7 (0.1)
Detention basin volume (ac-ft)				23,400[3]	16,000[4]	16,100[4]	N/A

[1] Value in parentheses denotes: stage difference (ft) = Stage for “No Failure” – Stage for “Alternative”;
Positive value denotes stage drop.

[2] SF, NF: South Fork and North Fork of Mokelumne River, respectively.

[3] 10-ft weir height

[4] 9-ft weir height

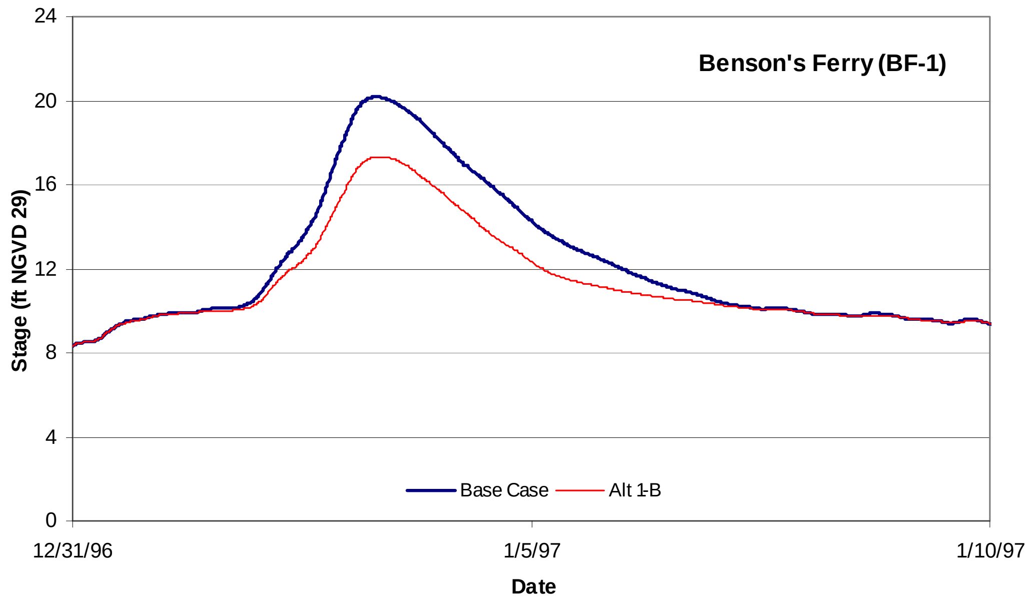


Figure E-11. Model Results at Benson's Ferry for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 1-B and the Base Case (Alternative NP).

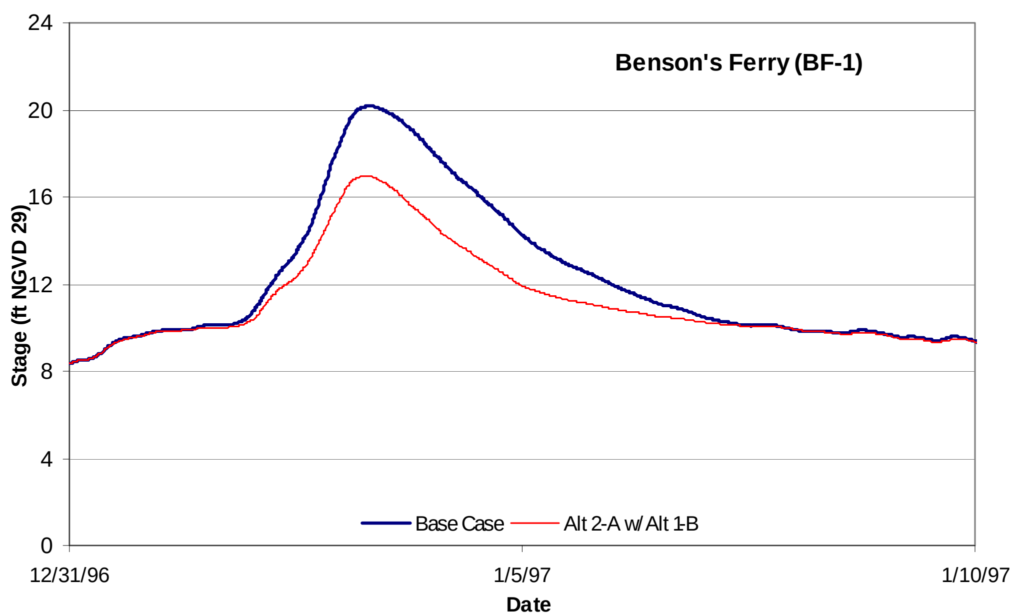


Figure E-12. Model Results at Benson's Ferry for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-A w/ 1-B and the Base Case (Alternative NP).

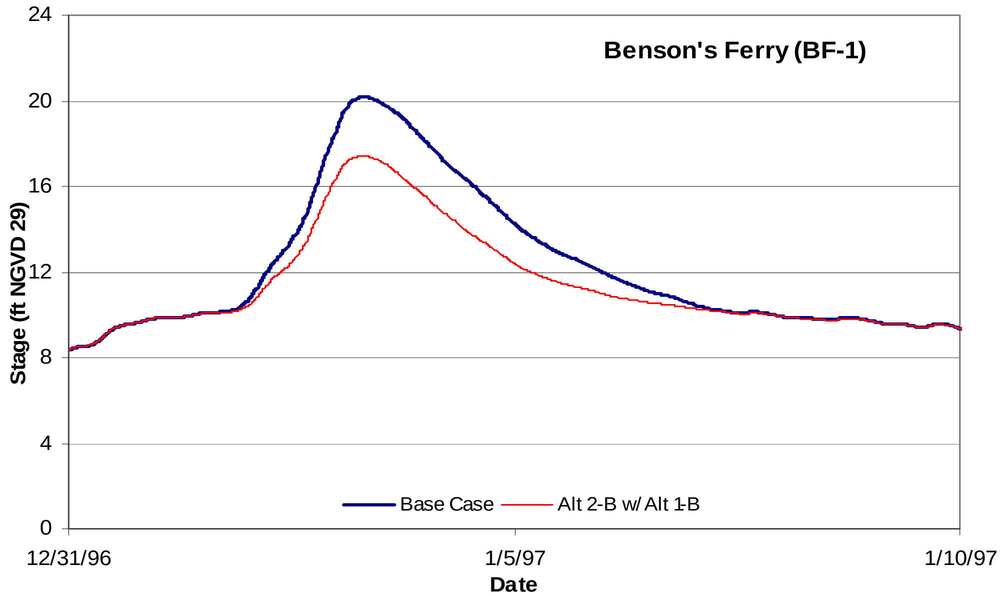


Figure E-13. Model Results at Benson's Ferry for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-B w/ 1-B and the Base Case (Alternative NP).

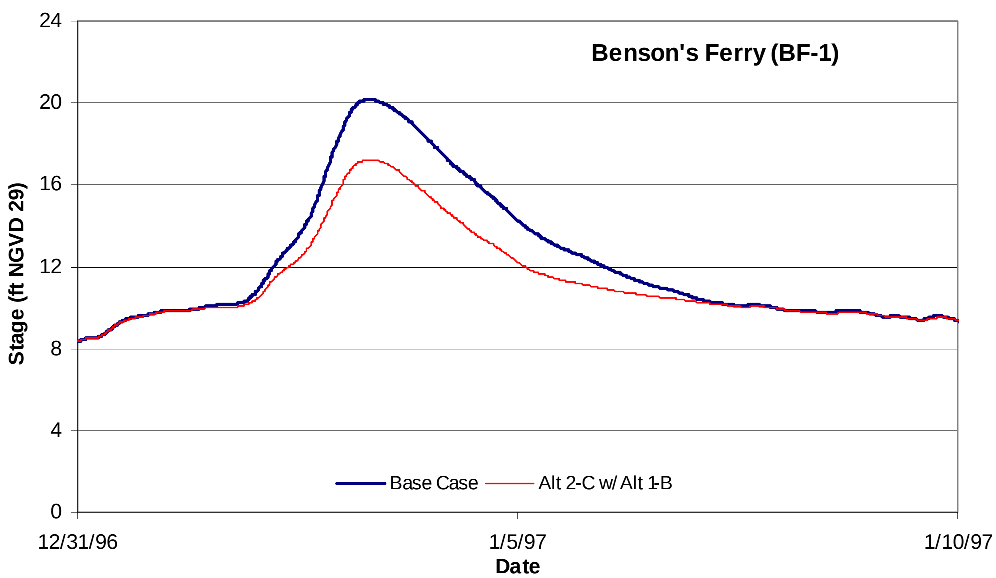


Figure E-14. Model Results at Benson's Ferry for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-C w/ 1-B and the Base Case (Alternative NP).

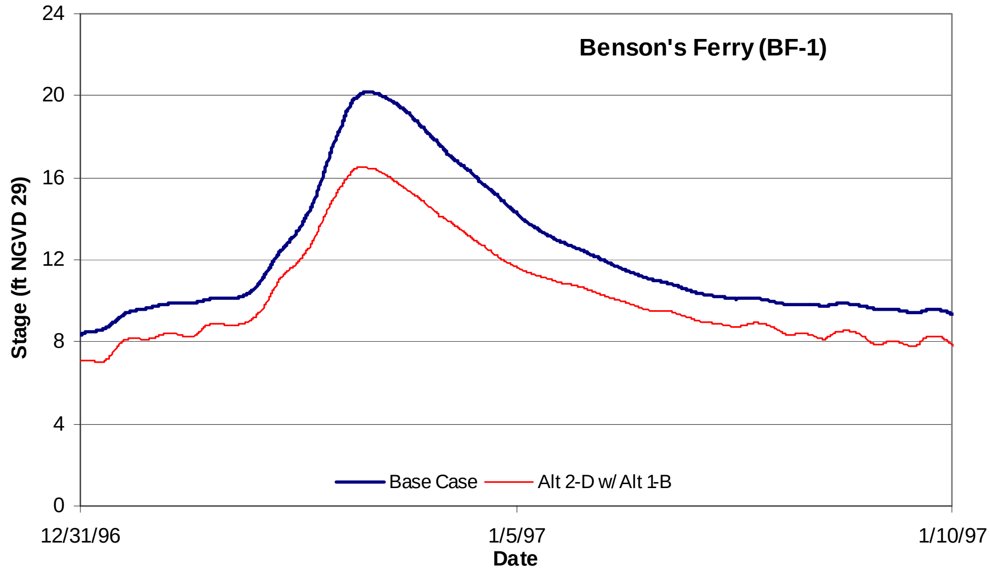


Figure E-15. Model Results at Benson's Ferry for the 1997 Flood Hydrology (with no levee failure): Comparison between Alternative 2-D w/ 1-B and the Base Case (Alternative NP).

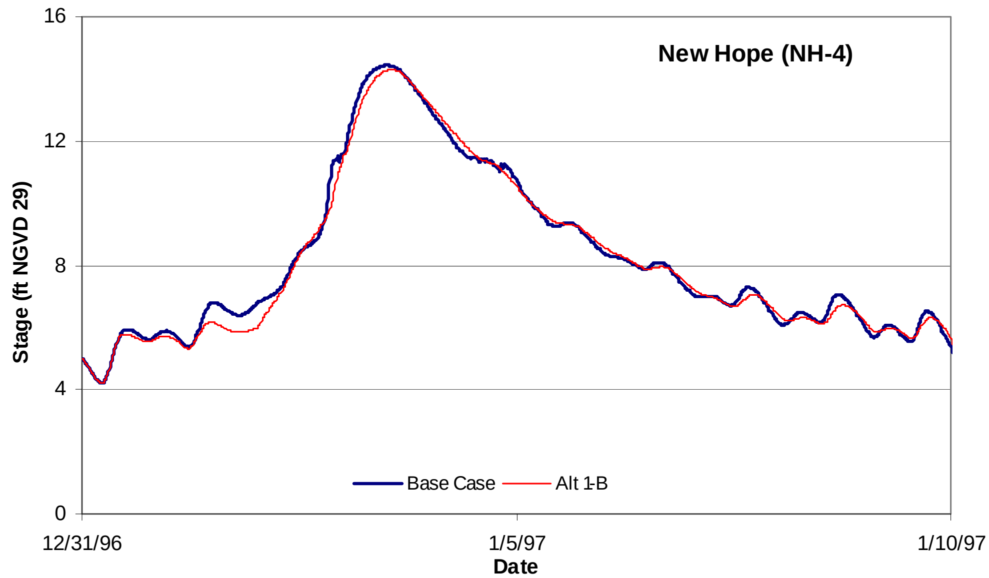


Figure E-16. Model Results at New Hope for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 1-B and the Base Case (Alternative NP).

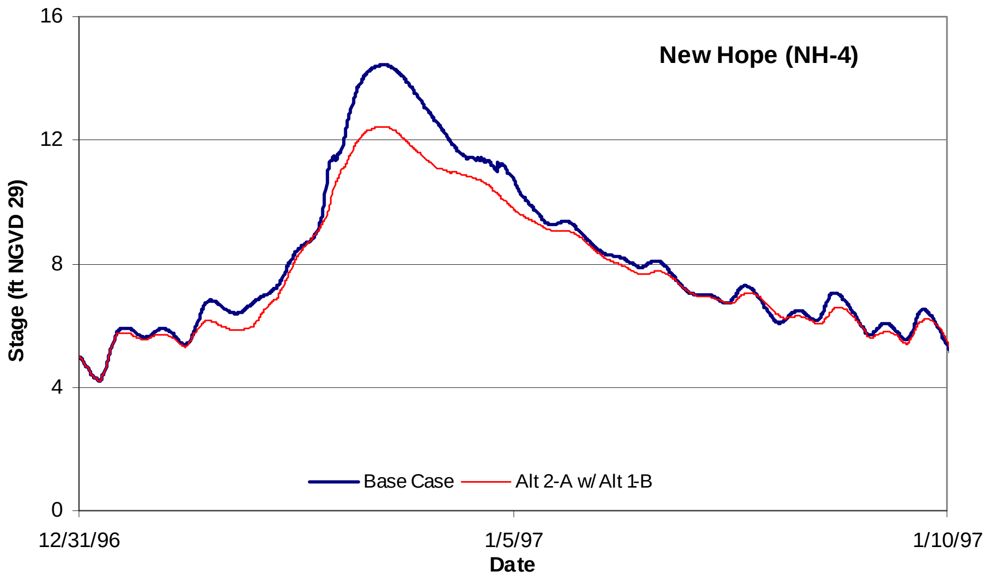


Figure E-17. Model Results at New Hope for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-A w/ 1-B and the Base Case (Alternative NP).

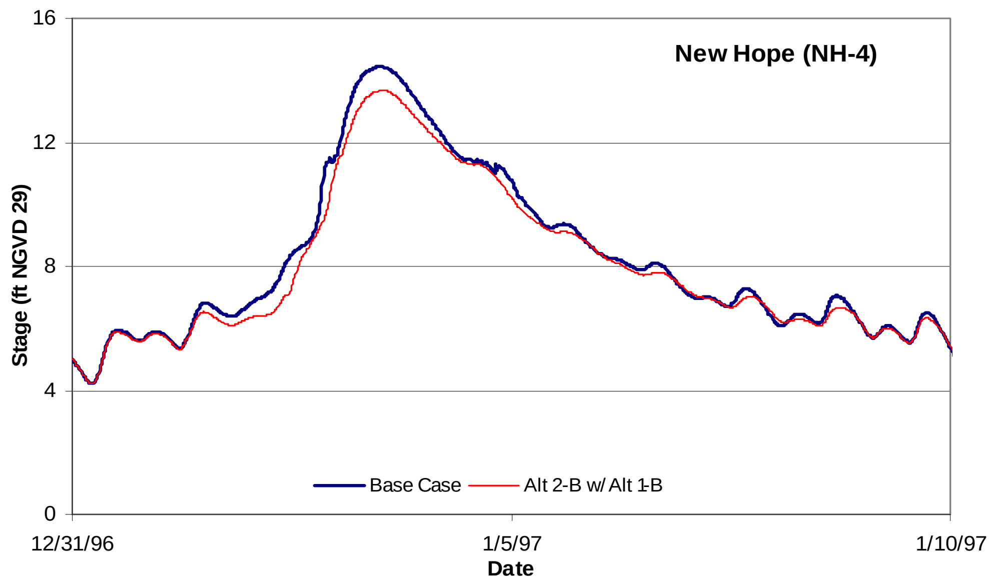


Figure E-18. Model Results at New Hope for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-B w/ 1-B and the Base Case (Alternative NP).

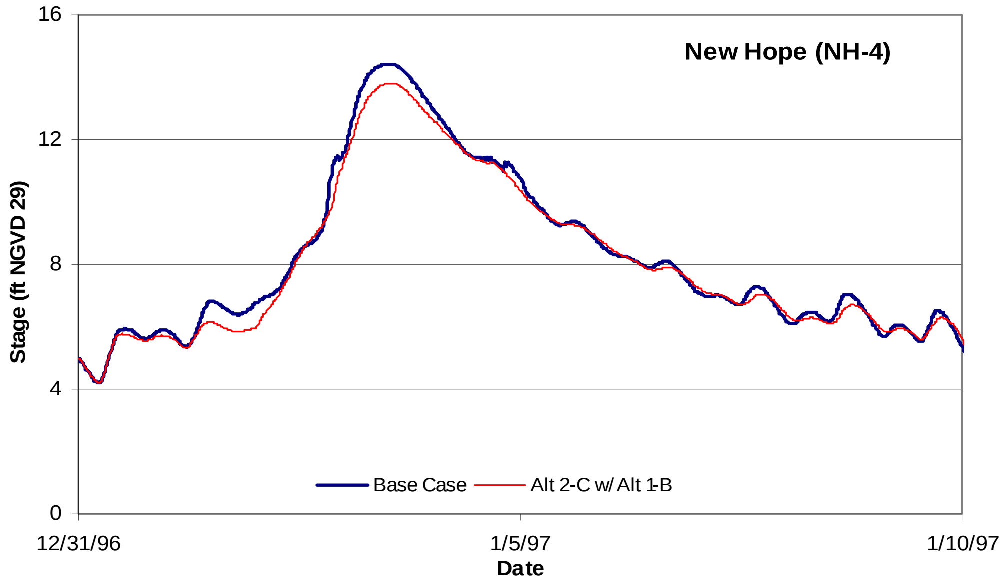


Figure E-19. Model Results at New Hope for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-C w/ 1-B and the Base Case (Alternative NP).

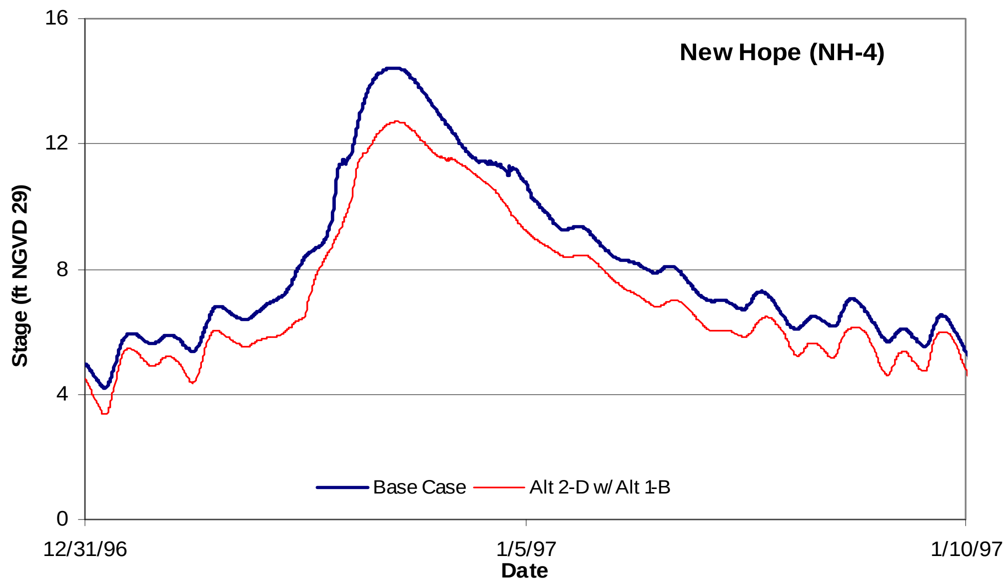


Figure E-20. Model Results at New Hope for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-D w/ 1-B and the Base Case (Alternative NP).

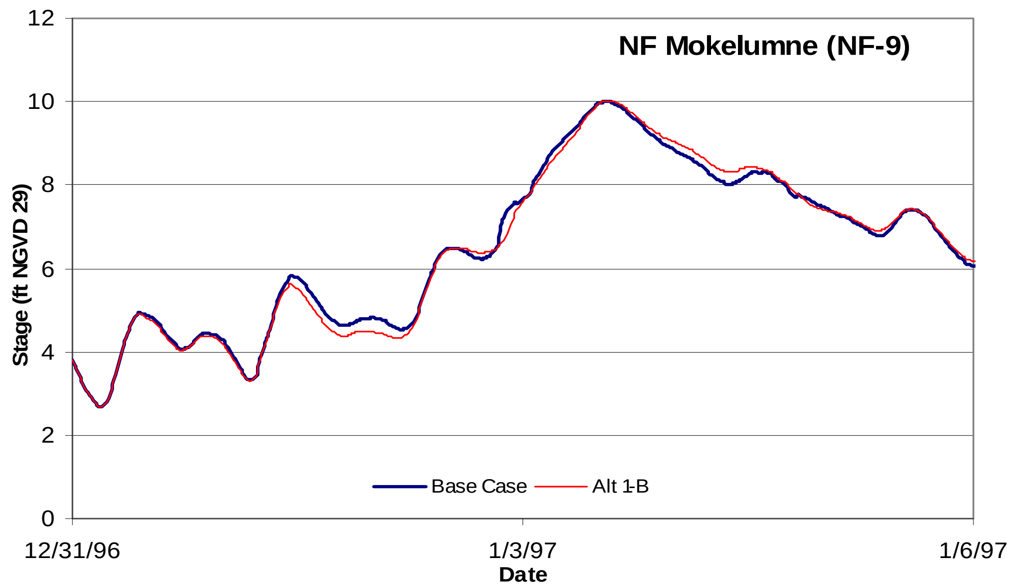


Figure E-21. Model Results at NF-9 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 1-B and the Base Case (Alternative NP).

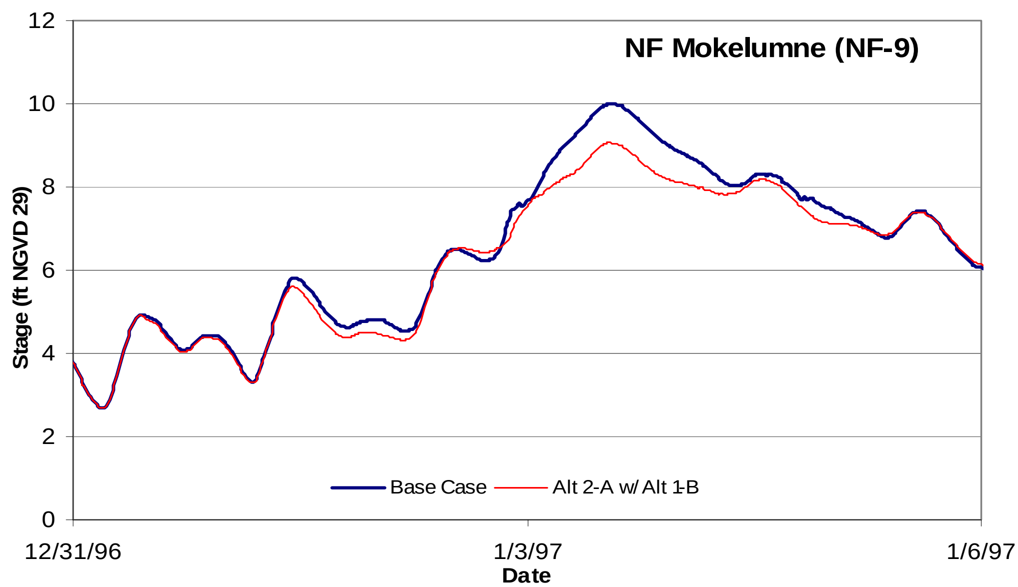


Figure E-22. Model Results at NF-9 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-A w/ 1-B and the Base Case (Alternative NP).

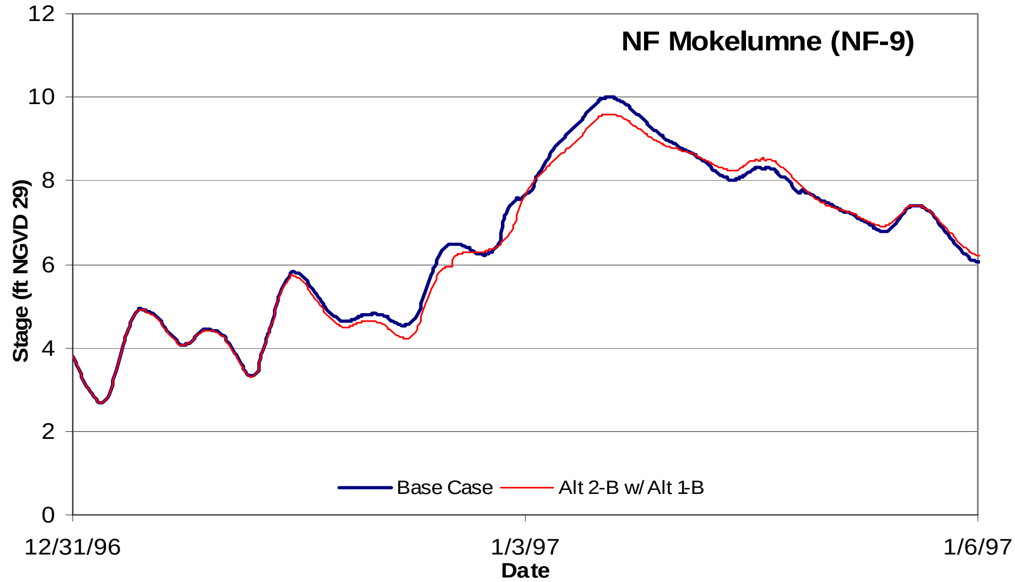


Figure E-23. Model Results at NF-9 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-B w/ 1-B and the Base Case (Alternative NP).

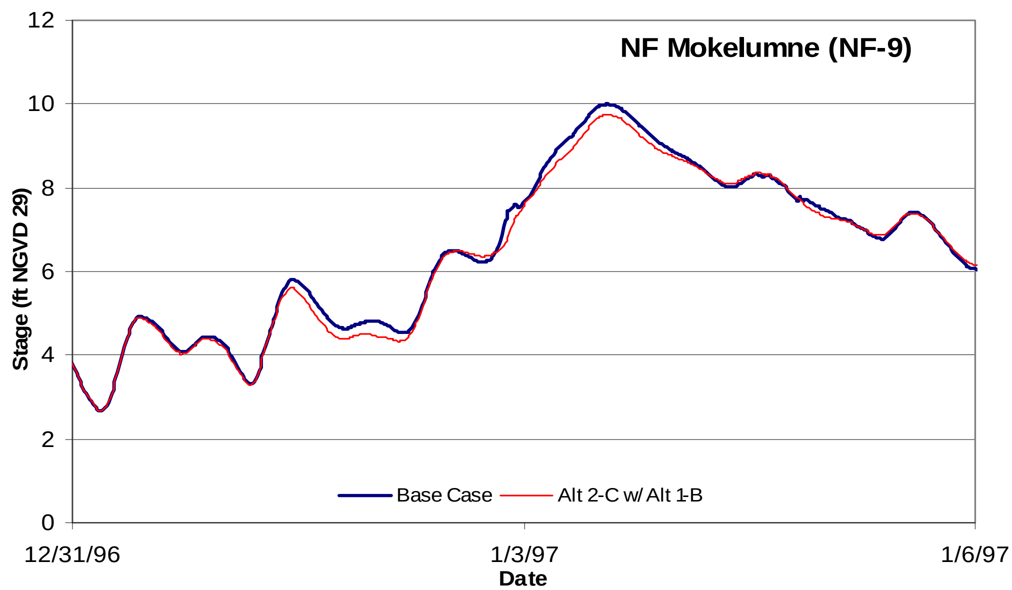


Figure E-24. Model Results at NF-9 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-C w/ 1-B and the Base Case (Alternative NP).

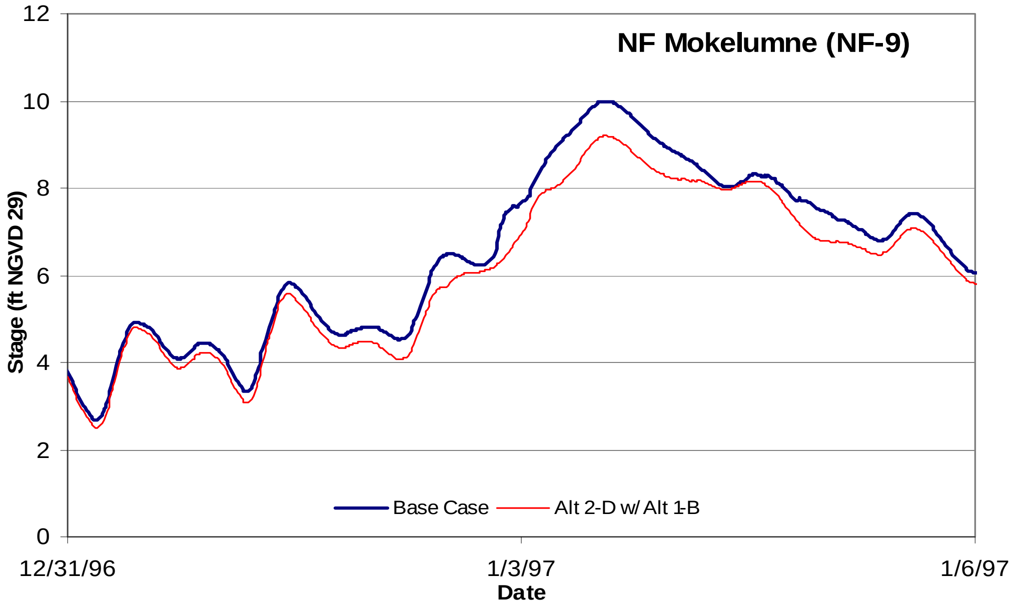


Figure E-25. Model Results at NF-9 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-D w/ 1-B and the Base Case (Alternative NP).

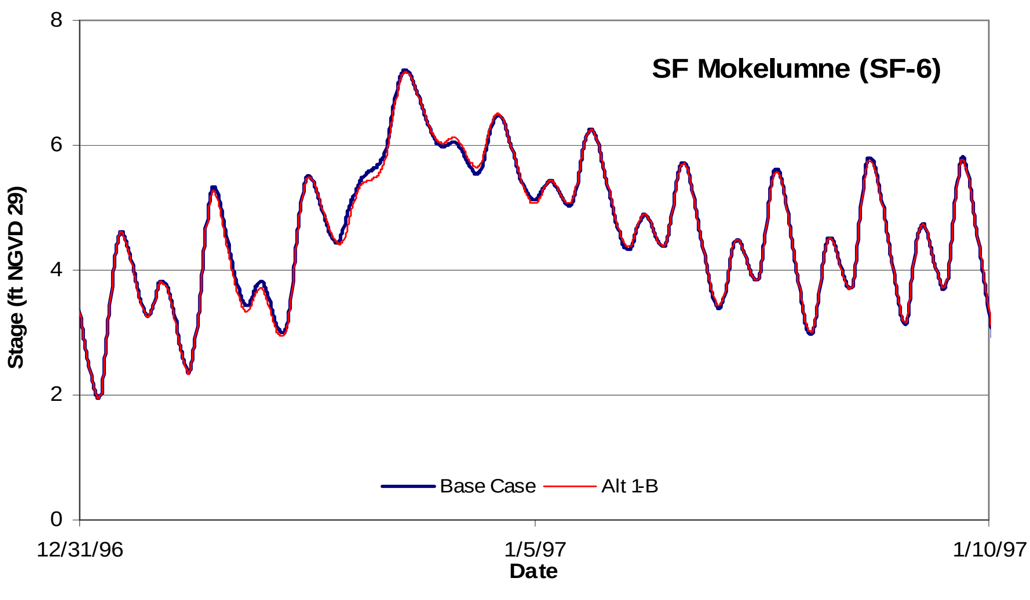


Figure E-26. Model Results at SF-6 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between 1-B and the Base Case (Alternative NP).

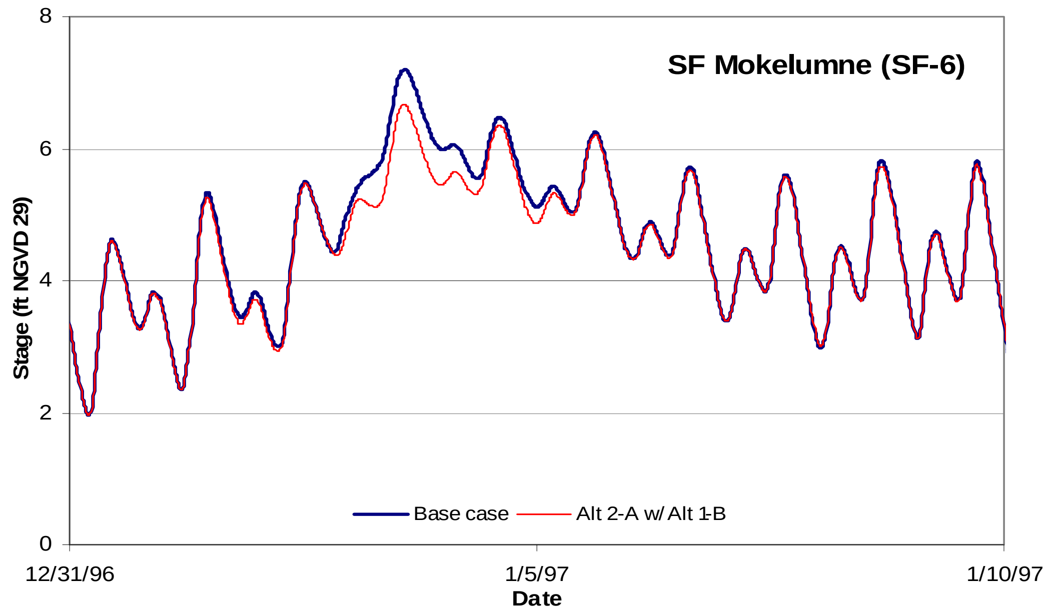


Figure E-27. Model Results at SF-6 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-A w/ 1-B and the Base Case (Alternative NP).

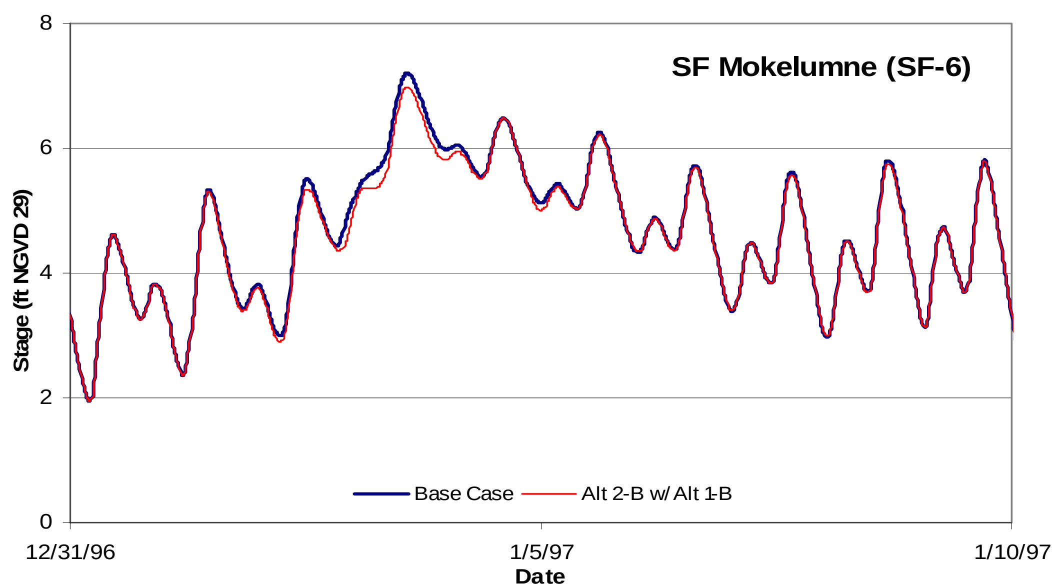


Figure E-28. Model Results at SF-6 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-B w/ 1-B and the Base Case (Alternative NP).

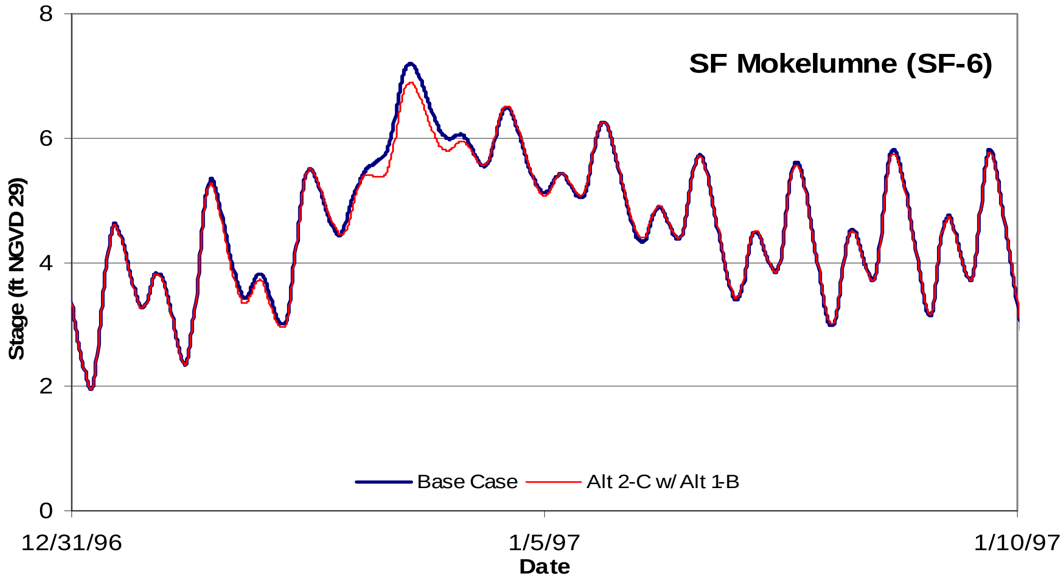


Figure E-29. Model Results at SF-6 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-C w/ 1-B and the Base Case (Alternative NP).

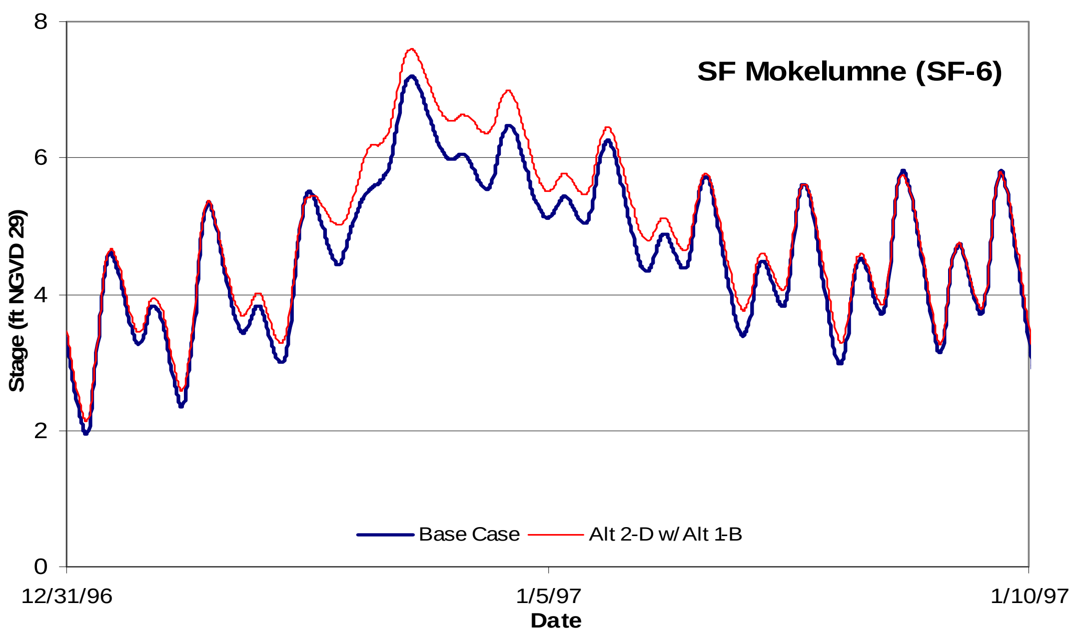


Figure E-30. Model Results at SF-6 (for location, see Figure A-5) for the 1997 Flood Hydrology (with no levee failure): Comparison Between Alternative 2-D w/ 1-B and the Base Case (Alternative NP).

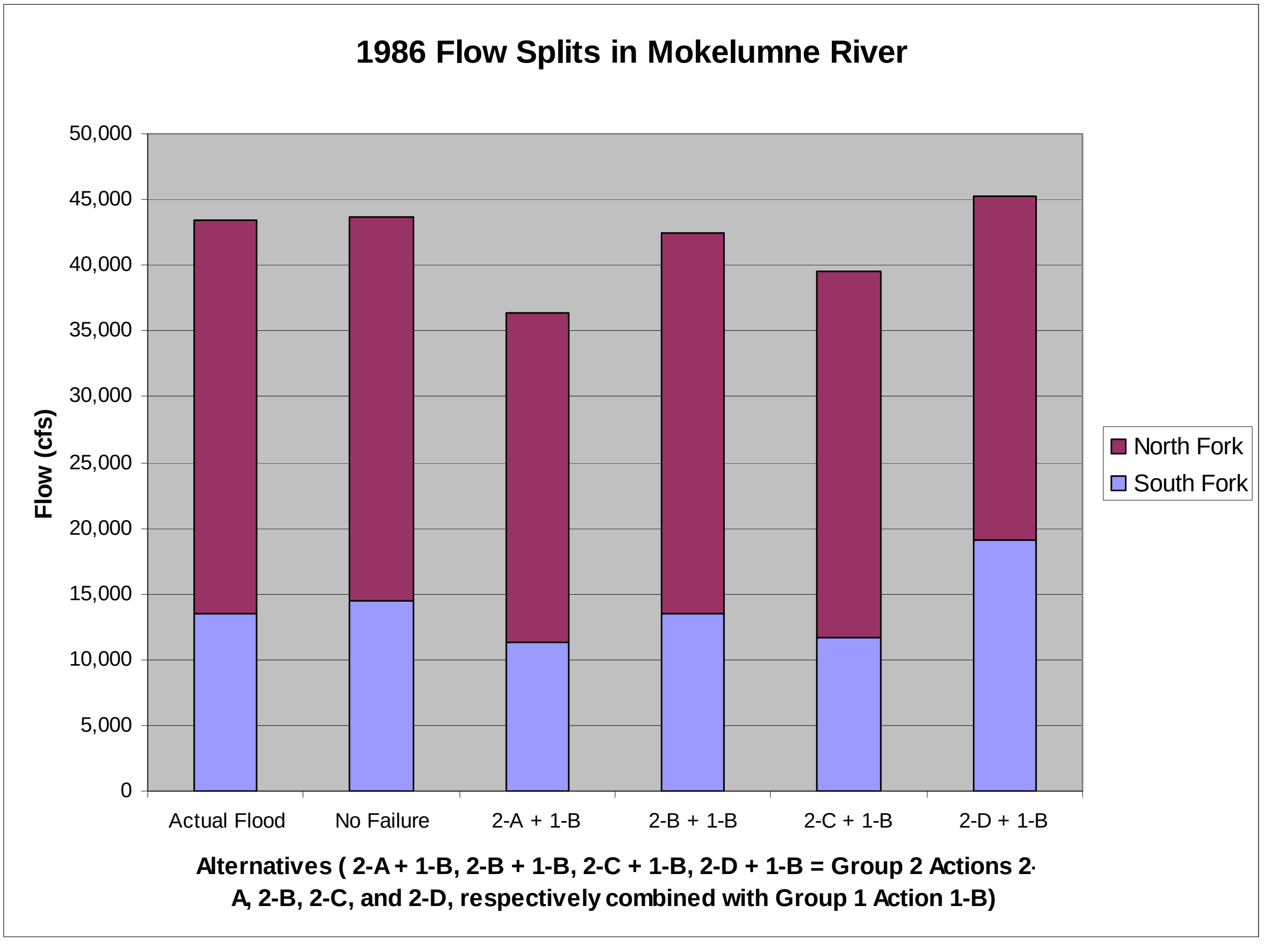


Figure E-31. Flow Splits in the South and North Fork of the Mokelumne River for the 1986 Flood Hydrology.

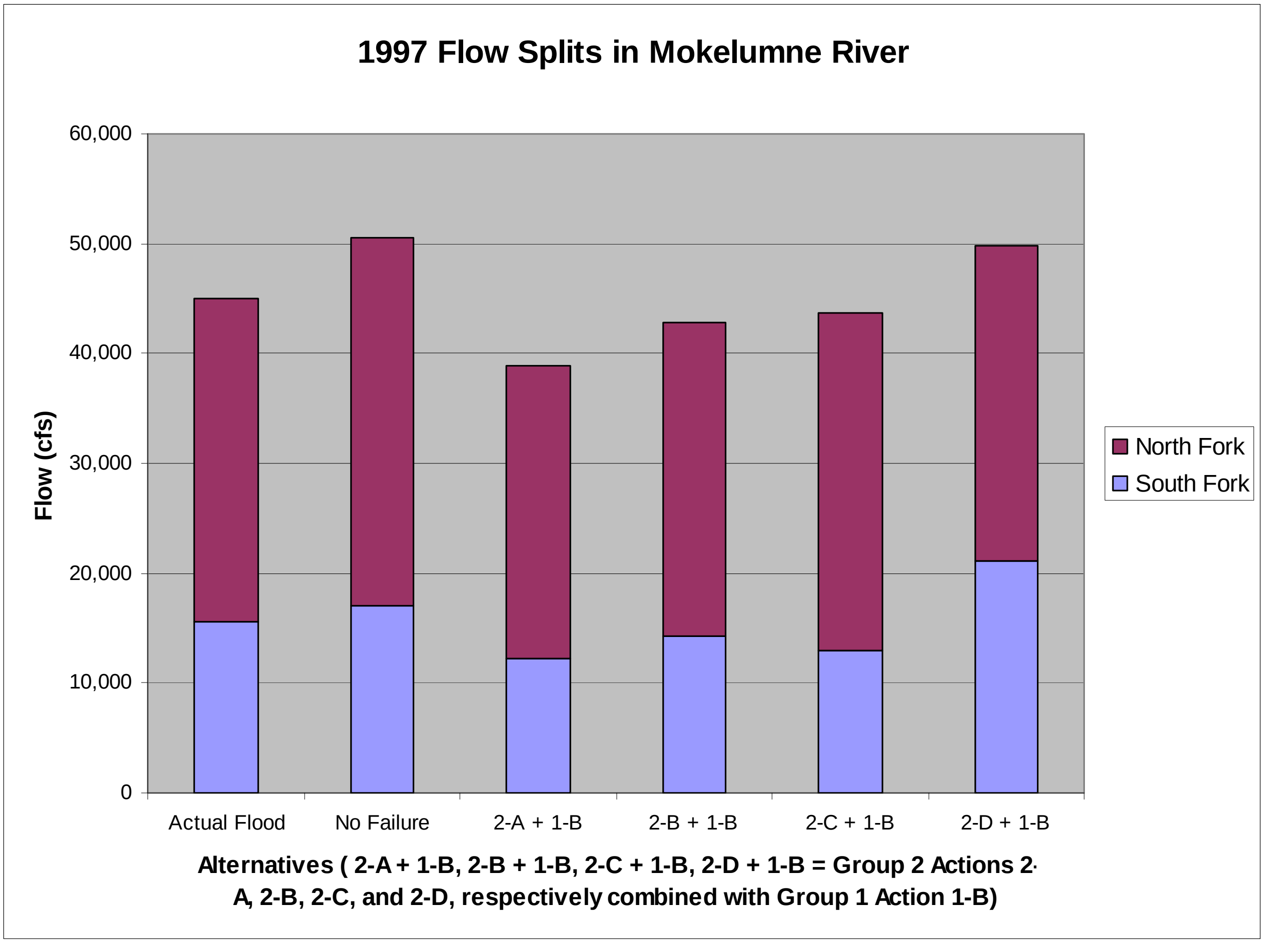


Figure E-32. Flow Splits in the South and North Fork of the Mokelumne River for the 1997 Flood Hydrology.

Table E-9. Comparison of Group 2 Project Alternatives: Maximum Velocities (ft/sec) at Key Points

	1986 Flood						1997 Flood					
			Group 2 Alternatives, Combined with Alternative 1-B						Group 2 Alternatives, Combined with Alternative 1-B			
Index Point[1]	Actual Flood	No Levee Failure	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D	Actual Flood	No Levee Failure	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	3.2	3.0	3.6	3.6	3.6	3.9	3.0	3.2	3.6	3.4	4.5	3.7
MR-2	4.5	4.6	3.7	3.7	3.6	3.9	5.1	5.1	3.1	3.3	3.1	3.5
NH-4	2.9	2.6	2.6	2.6	2.6	2.2	3.1	2.8	2.8	2.8	2.8	1.9
SF-5	3.9	4.1	3.6	3.9	4.0	4.2	4.8	4.7	4.1	4.5	4.4	4.7
NF-8	5.2	4.9	4.6	5.4	4.8	4.5	5.3	5.4	5.0	5.9	5.2	4.9
NF-9	4.5	4.9	4.6	5.4	4.8	4.5	4.2	4.4	4.1	4.3	4.3	4.0

[1] For Index Point locations, see Figure E-5.

Low Flow Simulations

Simulations of low flows for different Project Alternatives were performed for the 1998, 1999, and the 2000-yr hydrology events. The results of the low flow modeling are presented similarly to the high flow runs. Because the detention basin elements in Alternatives 2-A thru 2-C do not come into play at low flow, only the Group 1 Actions were modeled for the low flow events. The maximum stage at each of the model index points for each of the runs are shown in Table E-10 for 1998 hydrology, Table E-11 for the 1999 hydrology, and Table E-12 for 2000 hydrology.

Stage hydrographs for the 1999 hydrology, are shown in Figures E-33 thru E-43 at representative points including New Hope, Benson's Ferry, and downstream locations on the North and South Forks of the Mokelumne River. The plots are focused in the time windows where changes are observed. These provide a comparison of stage duration with and without the Project Alternative. A full set of stage hydrographs at each index point for each modeled hydrology can be made available on CD by request.

Table E-10. Comparison of Group 1 Project Alternatives: Water Level Impacts for 1998 Flood Hydrology

Index Point	Location	Peak Stage (ft NGVD 29)			
		1998 Flood	Group 1 Alternatives		
			1-A	1-B	1-C
BF-1	Benson's Ferry	15.2	13.8	14.0	14.0
MR-2	Mokelumne River	10.9	8.8	9.2	9.2
SG-3	Snodgrass Slough	10.0	9.8	9.8	9.8
NH-4	New Hope	8.5	8.4	8.4	8.4
SF-5	SF[1] Mokelumne	7.5	7.4	7.4	7.4
SF-6	SF Mokelumne	7.3	7.3	7.3	7.3
SF-7	SF Mokelumne	7.3	7.2	7.2	7.2
NF-8	NF Mokelumne	8.2	8.2	8.1	8.2
NF-9	NF Mokelumne	7.4	7.3	7.3	7.3
NF-10	NF Mokelumne	7.2	7.2	7.2	7.2
MC-11	McConnell	47.3	47.3	47.3	47.3
TC-12	Twin Cities Road	28.3	28.3	28.3	28.3
LR-13	Lambert Road	10.9	10.9	10.9	10.9
PP-14	Point Pleasant	N/A	N/A	N/A	N/A
TT-15	Terminous Tract	7.2	7.2	7.2	7.2
NS-16	Confluence of NF and SF	7.1	7.1	7.1	7.1

[1] SF, NF: South Fork and North Fork of Mokelumne River, respectively.

Table E-11. Comparison of Group 1 Project Alternatives: Water Level Impacts for 1999 Flood Hydrology

Index Point	Location	Peak Stage (ft NGVD 29)			
		1999 Flood	Group 1 Alternatives		
			1-A	1-B	1-C
BF-1	Benson's Ferry	14.2	13.0	13.2	13.2
MR-2	Mokelumne River	9.4	6.9	8.0	8.0
SG-3	Snodgrass Slough	7.0	6.9	6.9	6.9
NH-4	New Hope	5.9	5.8	5.9	5.9
SF-5	SF[1] Mokelumne	4.7	4.6	4.7	4.7
SF-6	SF Mokelumne	4.5	4.5	4.5	4.5
SF-7	SF Mokelumne	4.6	4.6	4.6	4.6
NF-8	NF Mokelumne	5.6	5.6	5.6	5.6
NF-9	NF Mokelumne	4.9	4.8	4.9	4.9
NF-10	NF Mokelumne	4.8	4.7	4.8	4.8
MC-11	McConnell	43.1	43.1	43.1	43.1
TC-12	Twin Cities Road	25.8	25.8	25.8	25.8
LR-13	Lambert Road	7.4	7.4	7.4	7.4
PP-14	Point Pleasant	N/A	N/A	N/A	N/A
TT-15	Terminous Tract	4.4	4.4	4.4	4.4
NS-16	Confluence of NF and SF	4.7	4.7	4.7	4.7

[1] SF, NF: South Fork and North Fork of Mokelumne River, respectively.

Table E-12. Comparison of Group 1 Project Alternatives: Water Level Impacts for 2000 Flood Hydrology

Index Point	Location	Peak Stage (ft NGVD 29)			
		2000 Flood	Group 1 Alternatives		
			1-A	1-B	1-C
BF-1	Benson's Ferry	12.8	11.9	11.9	11.9
MR-2	Mokelumne River	8.9	7.1	8.0	7.9
SG-3	Snodgrass Slough	7.4	7.2	7.2	7.1
NH-4	New Hope	6.5	6.2	6.2	6.2
SF-5	SF[1] Mokelumne	5.9	5.7	5.8	5.8
SF-6	SF Mokelumne	5.7	5.6	5.7	5.7
SF-7	SF Mokelumne	5.6	5.6	5.6	5.6
NF-8	NF Mokelumne	6.2	6.0	6.1	6.0
NF-9	NF Mokelumne	5.8	5.6	5.8	5.7
NF-10	NF Mokelumne	5.5	5.6	5.6	5.6
MC-11	McConnell	41.9	41.9	41.9	41.9
TC-12	Twin Cities Road	24.8	24.8	24.8	24.8
LR-13	Lambert Road	7.9	7.9	7.9	7.9
PP-14	Point Pleasant	N/A	N/A	N/A	N/A
TT-15	Terminous Tract	5.6	5.6	5.6	5.6
NS-16	Confluence of NF and SF	5.5	5.5	5.5	5.5

[1] SF, NF: South Fork and North Fork of Mokelumne River, respectively.

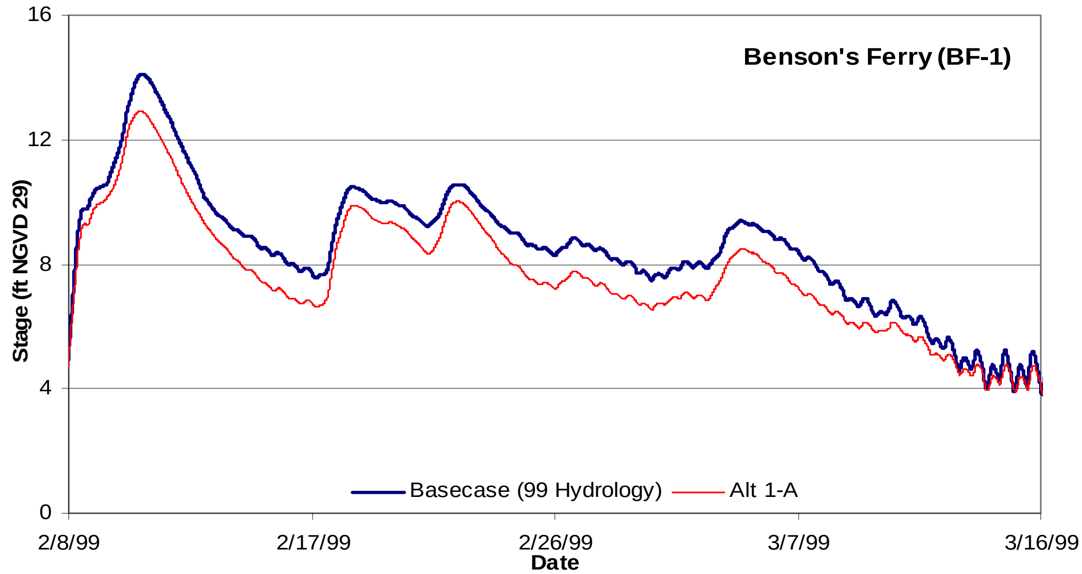


Figure E-33. Model Results at Benson's Ferry for the 1999 Flood Hydrology Showing the Impact of Alternative 1-A Compared to Alternative NP (No Project)

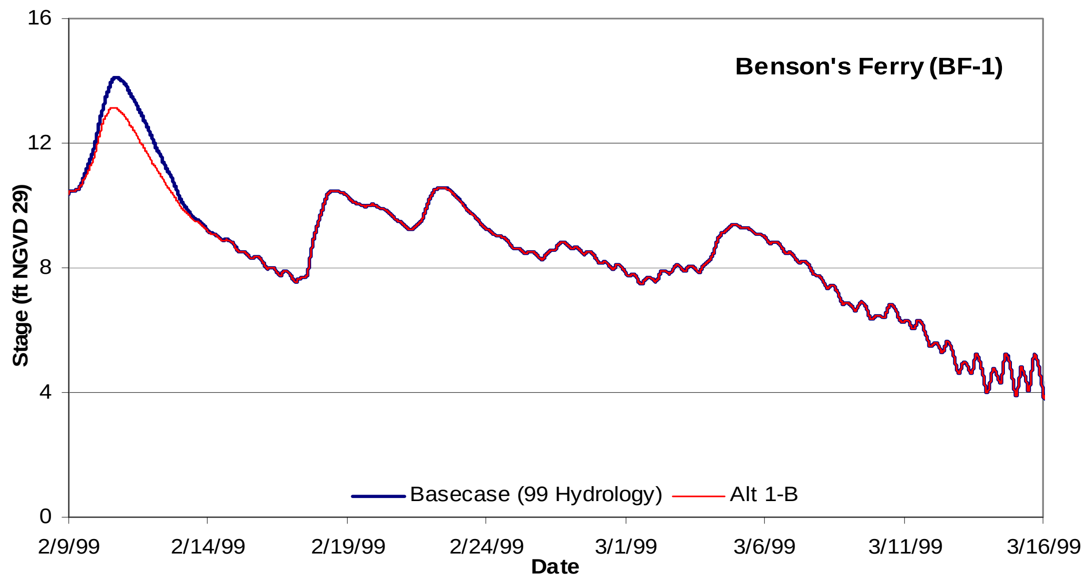


Figure E-34. Model Results at Benson's Ferry for the 1999 Flood Hydrology Showing the Impact of Alternative 1-B Compared to Alternative NP (No Project).

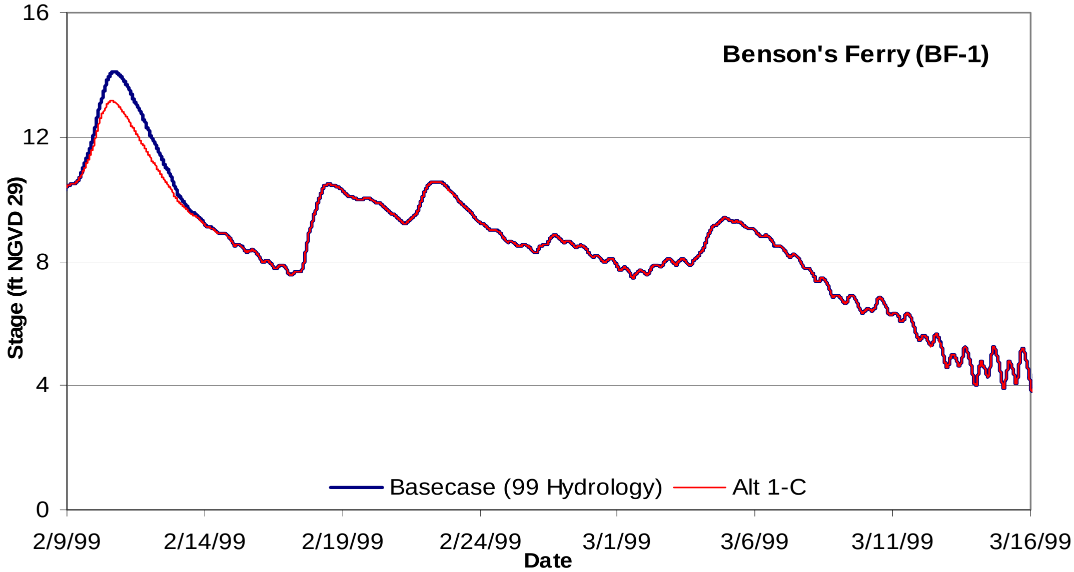


Figure E-35. Model Results at Benson's Ferry for the 1999 Flood Hydrology Showing the Impact of Alternative 1-C Compared to Alternative NP (No Project).

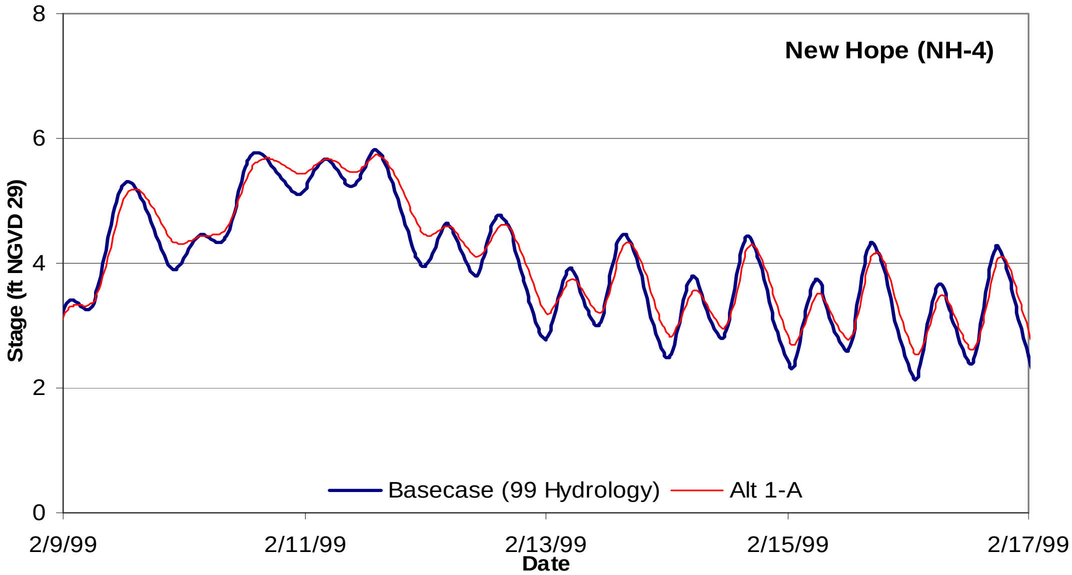


Figure E-36. Model Results at New Hope for the 1999 Flood Hydrology Showing the Impact of Alternative 1-A Compared to Alternative NP (No Project).

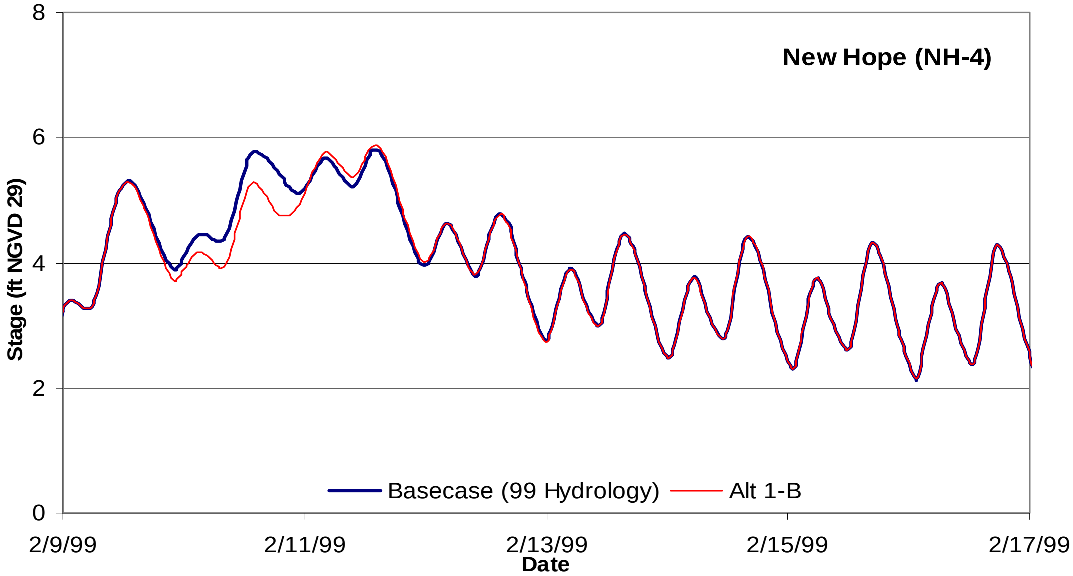


Figure E-37. Model Results at New Hope for the 1999 Flood Hydrology Showing the Impact of Alternative 1-B Compared to Alternative NP (No Project).

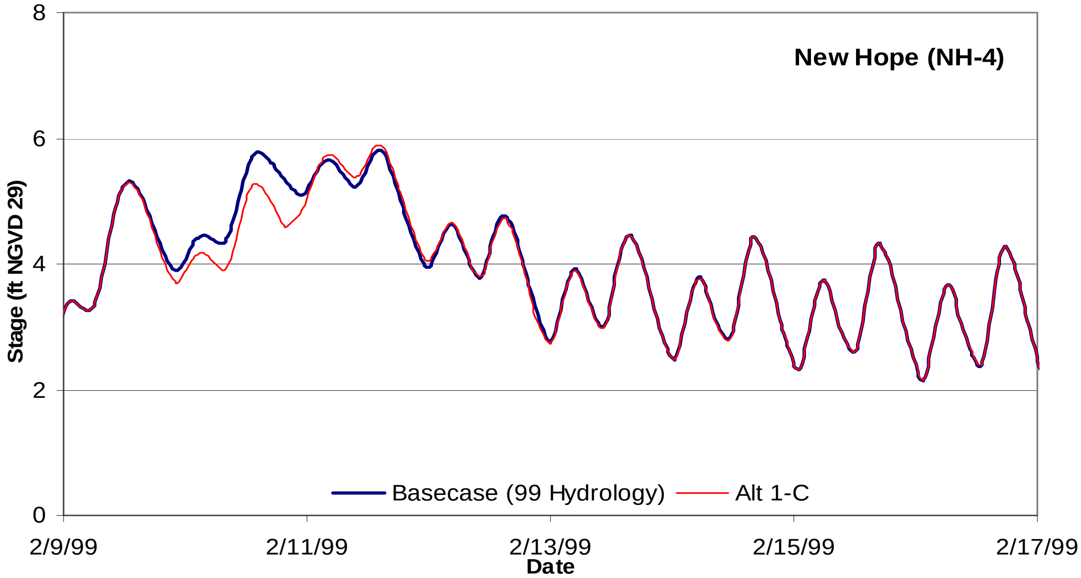


Figure E-38. Model Results at New Hope for the 1999 Flood Hydrology Showing the Impact of Alternative 1-C Compared to Alternative NP (No Project).

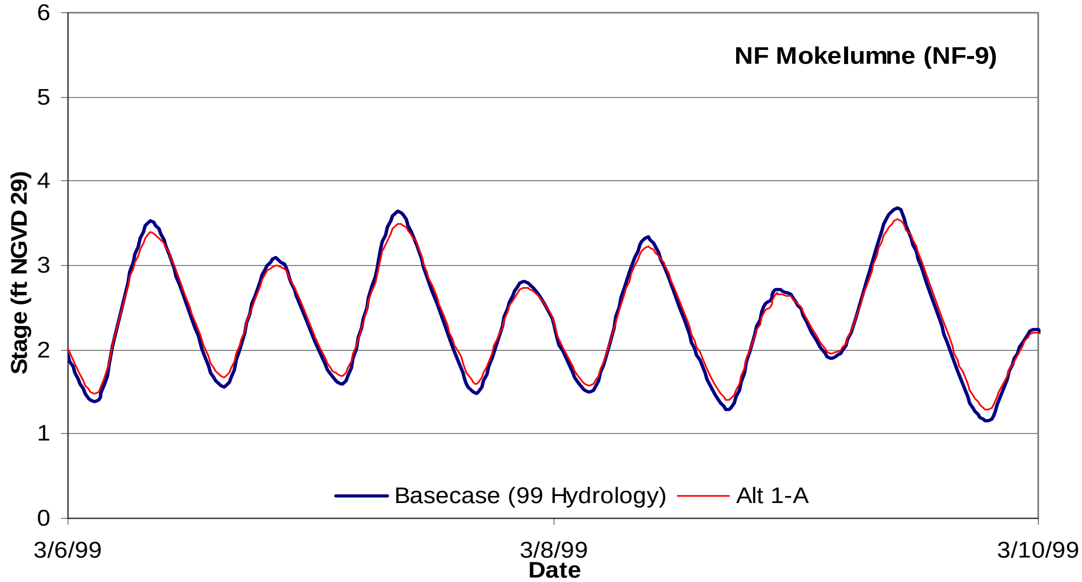


Figure E-39. Model Results at NF-9 (for location, see Figure A-5) for the 1999 Flood Hydrology Showing the Impact of Alternative 1-A Compared to Alternative NP (No Project).

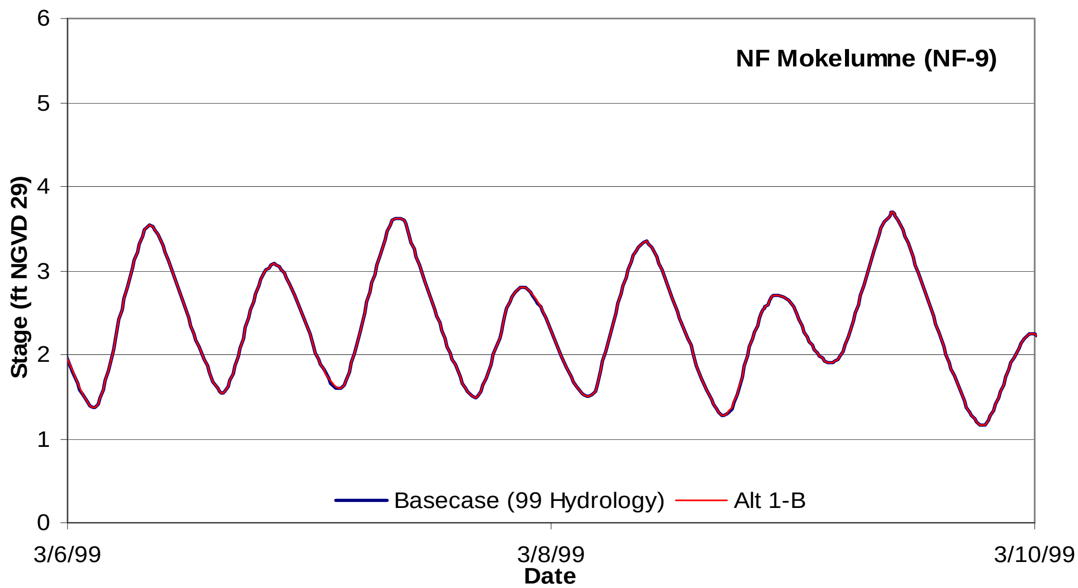


Figure E-40. Model Results at NF-9 (for location, see Figure A-5) for the 1999 Flood Hydrology Showing the Impact of Alternative 1-B Compared to Alternative NP (No Project).

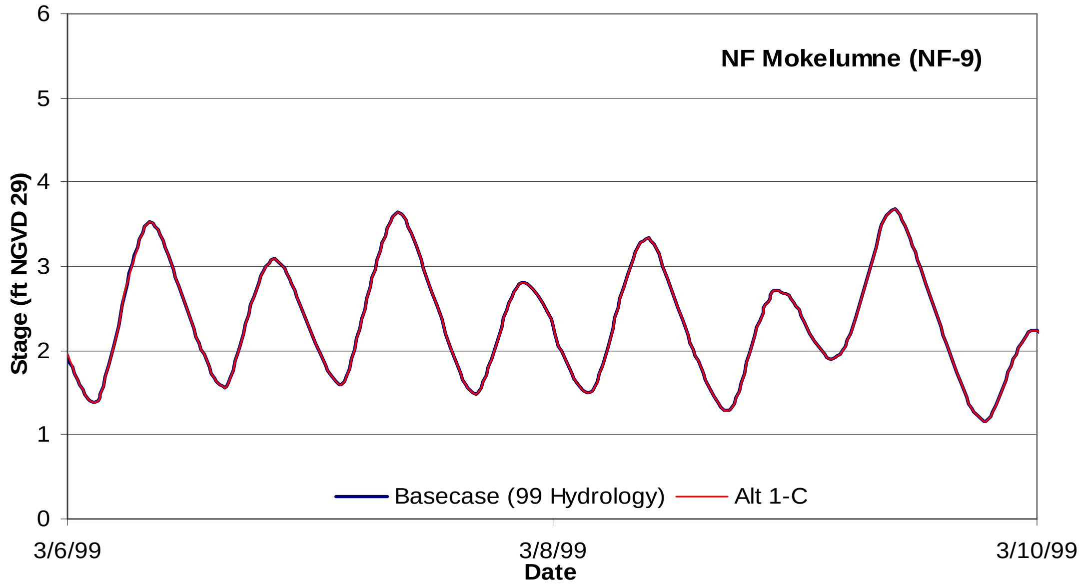


Figure E-41. Model Results at NF-9 (for ocation, see Figure A-5) for the 1999 Flood Hydrology Showing the Impact of Alternative 1-C Compared to Alternative NP (No Project).

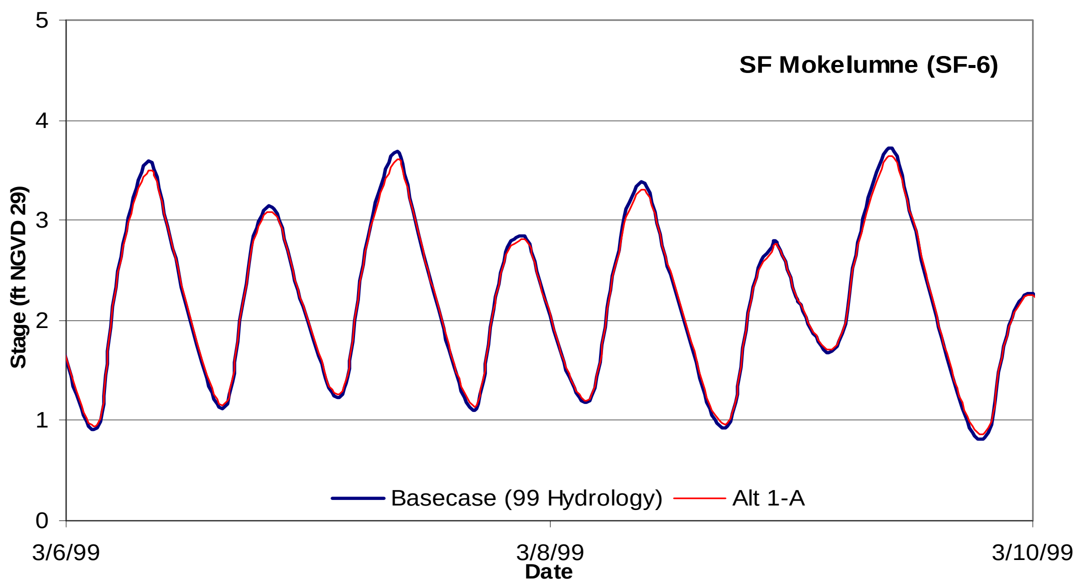


Figure E-42. Model results at SF-6 (for location, see Figure A-5) for the 1999 flood hydrology showing the impact of Alternative 1-A compared to Alternative NP (No Project).

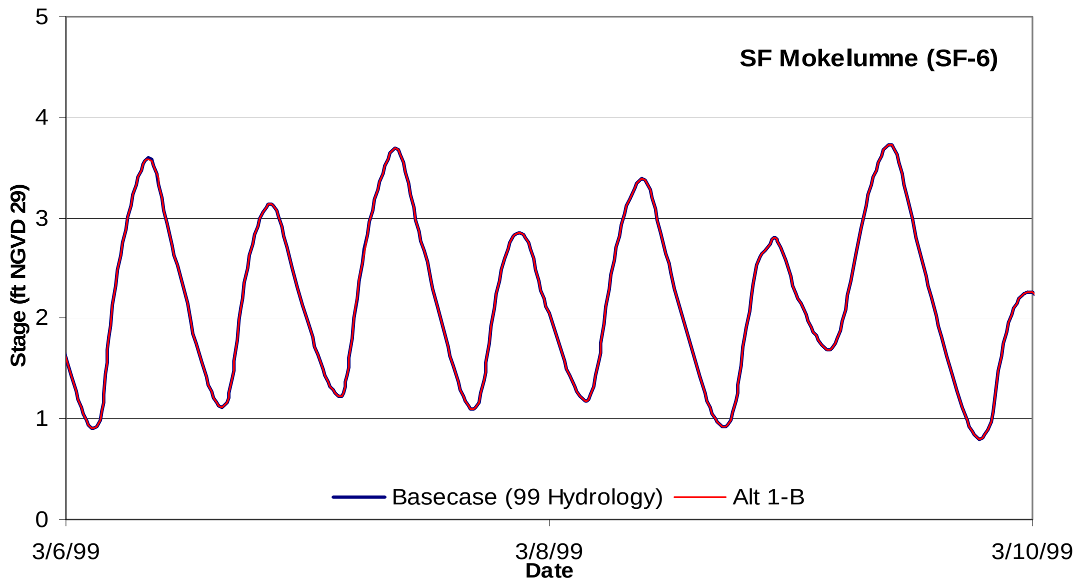


Figure E-43. Model Results at SF-6 (for location, see Figure A-5) for the 1999 Flood Hydrology Showing the Impact of Alternative 1-B Compared to Alternative NP (No Project).

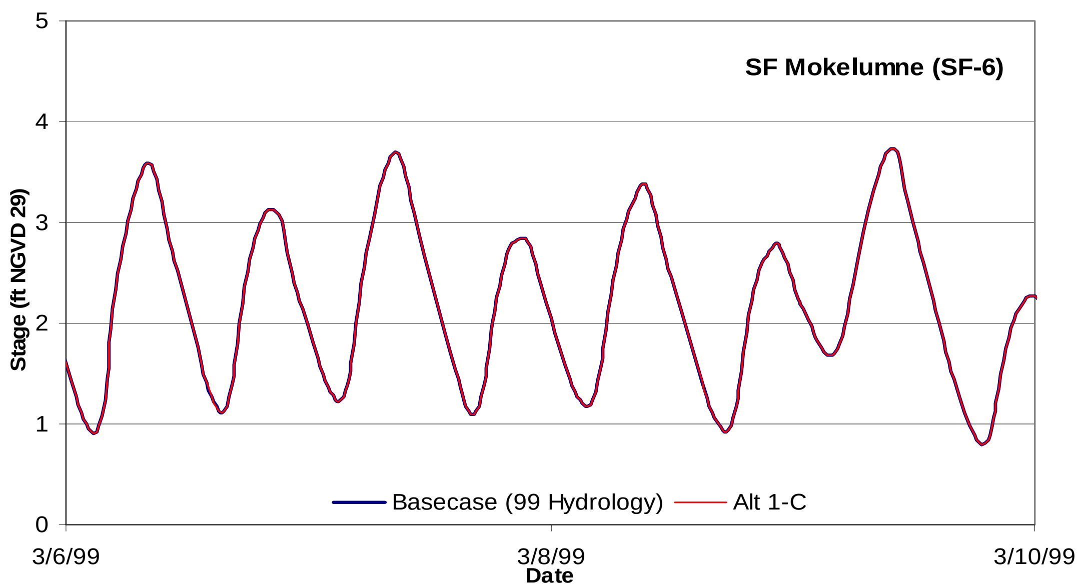


Figure E-44. Model Results at SF-6 (for location, see Figure A-5) for the 1999 Flood Hydrology Showing the Impact of Alternative 1-C Compared to Alternative NP (No Project).

References

Blake, Stephen H., 2001. An unsteady hydraulic surface water model of the Lower Cosumnes River, California, for the investigation of floodplain dynamics (Master's Thesis, University of California, Davis, 2001).

Danish Hydraulic Institute, 2000. MIKE11 Reference manual, Appendix A. Scientific background, Danish Hydraulic Institute.

Guay, J.R., J.G. Harmon, et al., 1998. Flood-inundation map and water-surface profiles of selected frequencies, Cosumnes River and Deer Creek, Sacramento County, California. Sacramento, U.S. Department of the Interior, U.S. Geological Survey.

Hammersmark, Chris T., 2002. Hydrodynamic Modeling and GIS Analysis for the Habitat Potential and Flood Control Benefits of the Restoration of a Leveed Delta Island (Master's Thesis, University of California, Davis, 2002).

Moughamian, Raffi J., 2005. Water Quality Modeling in the California North Delta Area (Master's Thesis, University of California, Davis, 2005).

Powledge, George R., D.C. Ralston, P. Miller, Y.H. Chen, P.E. Clopper, and D.M. Temple, 1989. "Mechanics of Overflow Erosion on Embankments. II: Hydraulic and Design Considerations," Journal of Hydraulic Engineering, Vol. 115, No. 8, August 1989, p. 1056-1075.

Skogerboe, G. V., and Hyatt, M. L., 1967 "Analysis of Submergence in Flow Measuring Flumes." Journal of the Hydraulics Division, ASCE, Vol. 93, No. HY4, July.

U.S. Army Corps of Engineers, *Mokelumne River, California 1% Flood at Franklin 1990*, May 1990.

U.S. Army Corps of Engineers, *Sacramento District, Downstream flood impacts for the proposed Lambert Road outlet facility*, 1988.

Vick, J., E. Andrews, et al. 1997. Analysis of opportunities for restoring a natural flood regime on the Cosumnes River floodplain. Philip Williams and Associates, LTD.

Appendix F
North Delta Sedimentation Study

Jones & Stokes

Memorandum

Date: November 3, 2006

To: Zaffar Eusuff – Department of Water Resources

Cc: Brad Hall – Northwest Hydraulic Consultants

From: Chris Elliott

Subject: **North Delta: Sedimentation Study Review Comments and Responses**

Northwest Hydraulic Consultants (NHC), working as a sub-consultant to Jones & Stokes, prepared the North Delta Sedimentation Study, March 2006, for the California Department of Water Resources (DWR). Based on peer review comments, the report has been revised and finalized as attached. This transmittal memo provides further responses to key peer review comments. Responses are shown in *italics*.

It should be noted that this report is based on preliminary conceptual designs and best available data. It is understood that the findings should be re-evaluated with new information developed through more detailed field investigation and engineering design.

1. The sediment transport model did not consider McCormack-Williamson Tract (MWT) in the transport mechanism through the project area. It was stated that sedimentation on MWT would be minor, but it has been hypothesized that it would work as a sediment trap. It is expected in a long-term analysis, MWT would get a substantial amount of sediment as wash load. Moreover, understanding the effect of MWT on sedimentation in the project area was one of the major reasons for doing this study.

   It is agreed that MWT sedimentation would primarily result from wash-load sediments in the Mokelumne/Cosumnes system. As the MIKE-11 sedimentation modeling was primarily focused on channel morphology and not set up for prediction of wash loads, a separate supplemental study of wash-load sedimentation has been added to the report.

2. Analysis did not include Delta Cross Channel. Please provide a discussion of the contribution of DCC to the overall sediment picture. Does it have any meaningful contribution to the system? Why or why not? Page 31 of the report notes that the Sacramento River is the main contributor of sediment to the Delta, so flows through DCC seem worth discussion.

The DCC is closed during the typical high-flow season, thereby blocking the sediment pathway from the Sacramento to the Mokelumne system. Very little sediment is moved through the system and the DCC at low flow (primarily low sediment loads that remain in suspension). Although insignificant in its contribution to low-flow sedimentation, it is acknowledged that the DCC may have a more substantial role in water quality issues (e.g., nutrients, salinity, temperature, etc.) and stage-habitat relationships.

3. The sediment model was run with an upstream boundary condition of a "representative flow duration curve," developed by NHC. These hydrographs (on average) represent only the 2.5-yr return interval flow. It looks like the model was run for 20-year period—was 1986 or 1997 flood included in the model? Clarify with better overall explanation of hydrologies used for model runs.

   The method applied for flow-duration sediment modeling is professional standard practice (in accordance with U.S. Army Corps of Engineers EM 1110-2-4000 Sedimentation Engineering). The period of record included 1986 and 1997 event. A detailed description of the gages, period of record, and procedures is provided in Section 8.2.7.

4. Model results and descriptions are presented in both metric and English units. To be consistent with other project-related studies, the results should be in English units. With the possible exception of grain size, English units should be consistently used (seems to go between English and metric as written).

   All units have been reviewed and revised to be reported in the most typical customary unit for that measurement.

5. The study summarizes that net sedimentation would go up in the project area. However, DWR scour monitoring data do not agree with this conclusion. Please address this apparent conflict.

   The model simulations show the propensity for increased sediment deposition generally throughout the project area based on with-project conditions. The validity of these findings can be reasonably founded on the consistency of the model results for existing conditions with actual field observations. However, it is acknowledged that this is a broad, area-wide prediction of trend, and localized scour may occur within the project area as a site-specific phenomenon.

Specific Comments

Chapter	Page	Section	Comment
3	14	3.3.2	Discussion of available cross section data is confusing. Is it "1934 through 2001" or "1934 and 2001?" *1934 through 2001*
3	15	3.4	Please clarify the position that existing waterways have more capacity than historic times. Discrete channels or the whole project area? *Historically, the Delta functioned as a vast floodplain with networks of numerous shallow channels and frequent (seasonal) overland flow. Reclamation efforts since European/Asian settlement of the region have resulted in fewer, concentrated, and developed (i.e., leveed and incised) channels to convey flow. These modern channels have greater capacity than pre-settlement times.*
3	15	3.4	Historic data shows incision; this is opposite the summary conclusions of the report, what is causing the change in the trend? *Historic data may show incision for a number of reasons including effects from levees, localized response from specific events, and dredging. The sediment modeling is based on existing geometry and long-term hydrology. Under these conditions, the model is predicting general deposition at a system-wide level.*
3	15	3.4	Last bullet, last sentence: "followed by a gradual steady of sediment…" Word is missing (increase/decrease) or should it be "steadying," which is it? *"…gradual steady* ***reduction****…"*
4	16	4.1	Which version of MIKE-11 did NHC receive from UCD? *Input files (i.e., geometry and flow boundary condition) were exchanged, not the MIKE-11 model platform.*
4	18	4.2	UCD and NHC were working in parallel – are both models identical currently? *No, the NHC model modifications were set up specifically for assessment of bed material transport.*

4	18	4.2	Were bridge contraction and expansions included with the pier-only modeling method? Bridge crossings should have been modeled in detail since bridge scour will impact project alternatives. *It is agreed that bridge effects may be an important discriminator between project alternatives. However, the focus of the study was to determine general trends in the project area and not site-specific predictions; therefore, the MIKE-11 sedimentation model is based on and applicable to reach-averaged conditions. The model should not, and was not set up to be, used to assess local scour at bridge sections. Bridge scour analysis is a very different process than reach-averaged sedimentation budget modeling as done with MIKE-11.*
4	20	4.5	2000 results: Tides are still too high, does the model need more work – what is the sensitivity to the tides? High flows vs. low flows? *General sedimentation characteristics in the project area are considered to be insensitive to tidal fluctuation. Therefore, tidal fluctuation is considered insignificant to the long-term sedimentation trends which were the focus of this study.*
4	20	4.5	1997 results: Results are not valid. Does this mean that the 1997 flood event is not considered in the sedimentation calculation? *Yes, the 1997 flood event is included in the input data but the model does not account for deposition from levee overtopping. The 1997 flood was included in the flood duration curve used to develop the representative synthetic hydrographs applied to the sediment model. However, some of the specific levee breaches and local overtoppings are not simulated in the sediment model because they are event-based and not relevant to estimation of long-term sedimentation trends.*
5	29	Table 2	Diff Q – it is explained in the paragraph above, but does the junction really store flow? How does this work physically? Is the Diff Q at all impacted by the ADCP accuracy? *Junction does not store flow. The point of this discussion is that the ADCP measurements reasonably measured the split/ total flow at bifurcations.*

5	29	Table 2	Can the ADCP report to 1 CFS precision? Seems like the error may be as great as 1,166 CFS on Jun 10 at the DCC, unless channel storage can be explained and verified. *The data were reported as provided by the instrument.*
6	32	6.3	Second paragraph totals: Do they include bed load that was described as ignored in the previous paragraph? Seems as though it may. *Assessment is for total load (bed load plus wash load).*
8	40	8.2.3	What is the basis of the assumption that grain sizes are finer than reported in Figure 16 and coarser for Snodgrass? Was the multiple grain size function implemented properly or is this related to other program flaws? *Model adjustment was made to better match observed bed change. The need for adjustment is attributed to limitations in the program and model documentation by DHI.*
8	40	8.2.5	What is the rationale for using passive channels? Any data to support the assumption? Passive channels are included for hydraulic connectivity but *Passive channels are not used for sediment transport modeling because they do not move or receive significant amounts of sediment and are, therefore, relatively unimportant when considering long-term sedimentation trends.*
8	41	8.2.6	Any data to support the assumed transport capacity? *Standard sediment modeling protocol is to assume capacity at the upstream junction.*
8	41	8.2.7	Boundary conditions: How was Figure 23 developed from Figure 22? What was the rationale to use different year hydrographs for different upstream points? Please explain the June-July peak. Figure 23 is confusing. *The representative synthetic hydrographs presented in Figure 22 are based on the entire available datasets for the streams shown. The synthetic hydrographs presented in Figure 23 were developed from a single year of flow data. They are meant to represent typical annual flow conditions for a given stream. The representative synthetic hydrographs developed from this typical annual data were used to verify the predictions of the sediment transport model by comparing*

			the results obtained using the "real" hydrographs to that obtained using the "synthetic" ones. Note that the representative synthetic hydrographs are the same as the real ones in magnitude and volume. The peak of the synthetic hydrographs is always in the center due to symmetry of the curve and is not meant to line up with the peak in the real hydrograph. Refer to revised text in Section 8.2.7)
8	44	8.2.7	Idea of using the top 10% of the hydrograph eliminates the potential of sediment deposit. *The top 10% represents the most significant sediment deposition conditions. It is predicted that there is insignificant sediment movement and depositional conditions at lower flows.*
8	44	8.2.8	DCC is always closed given the top 10% assumption. This may not be correct. DCC is a big summertime contributor to the project area. *As described previously, the DCC is closed during high flows when most sediment is in transport and when depositional conditions occur. While the DCC flows may have more substantial effects on water quality, they are considered relatively minor or inconsequential to the Mokelumne system sedimentation characteristics.*
8	44	8.2.8	With the bridge structures removed, were the cross section geometries altered to represent bridge impacts? *The study was focused on reach-averaged conditions and overall trends, not localized effects such as bridges. Figures show reasonable agreement between model and observed bed scour.*
8	44	8.3	East of I-5 was not modeled for stability purposes; can you discuss potential impacts to overall model quality of results due to the reduced domain? *The reduced domain is not expected to have any considerable effect on model quality. The model results are reasonable and demonstrate relative agreement with observed conditions.*

8	45,46	Fig. 24	Figures may not indicate good agreement. *As discussed previously, while the model is not focused on nor is to be used as a predictive tool for site-specific effects, the results for long-term sedimentation effects are considered reasonable and can be interpreted with confidence.*
8	47	Table 5	5% and 20% flows yielded the same results, why (probably because flows are not significant)? *Yes, the assumption is correct that the 10 to 20% range is not significant. The 5% is slightly different from the 20%, as reported.*
8	49	8.5.2	Were the 1986 or 1997 flood events included in the model? *Yes, both.*
8	50	Table 7	It is hard to make sense of most of the results. Please provide better interpretation. *Table 7 presents changes in sediment storage volumes, so the values represent scour or deposition in comparison to existing conditions. Results can be directly applied to assess dredging requirements if deposition is to be mitigated.*
8	51	8.5.5	Discussion that a factor of 2 was used to determine significance needs to be supported – currently presented as a best guess. *Factor of 2 was used for illustrative purposes and based on professional judgment for a relative comparison.*

North Delta Sedimentation Study

November 2006

Prepared for:
California Department of Water Resources

Prepared by:
northwest hydraulic consultants

nhc

Contents

Section 1.0
Introduction

The nature, distribution, and transport of sediments in the Sacramento-San Joaquin Delta impacts many activities in the region including navigation, recreation, fisheries development, and flood control. The physical processes that initiate and control sediment transport in the Delta are sensitive to the hydrology and hydraulics of the system, and small changes in these variables have been found to initiate substantial responses sometimes with unforeseen results. Sedimentation analyses are, therefore, an essential part of any proposal that may affect local waterways.

1.1 Study Objectives

This report presents the findings of a sedimentation study performed by Northwest Hydraulic Consultants (**nhc**), in conjunction with North Delta Flood Control and Ecosystem Restoration Project proposed by the California Department of Water Resources (DWR). The study investigates the nature of sedimentation in the Delta using both historical and recently obtained data, and computer modeling techniques. The objectives of the study are to develop an appropriate tool for modeling sediment transport and channel morphology within the study area and to evaluate the effects of proposed project alternatives. The results of the study will be used to better understand the sedimentation characteristics of the region and to evaluate the impacts of proposed flood control and environmental enhancements, which include the re-establishment of aquatic habitat, subsidence reversal, and erosion control. The analyses presented herein are appropriate for the preliminary design phase of the North Delta Flood Control and Ecosystem Restoration Project. Additional sediment monitoring and analysis will be required in subsequent project design phases.

1.2 Project Area

Located in the North Delta, the project area encompasses McCormack-Williamson Tract, Dead Horse Island, Staten Island, and adjacent waterways. The extent of the project area is presented in Figure 1. Significant waterways include the Delta Cross Channel, Snodgrass Slough, and the Mokelumne River, which enters the Delta along the southern boundary of the McCormack-Williamson Tract. Within the project area, the Mokelumne River bifurcates into a North Fork and a South Fork, which surround Staten Island before rejoining again at the southern end. Snodgrass Slough borders the western edge of McCormack-Williamson Tract and Dead Horse Island and is connected to the Sacramento River via the Delta Cross Channel, an important contributor of fresh water to the Mokelumne River. The Delta Cross-Channel typically operates during low flow conditions in summer and diverts flows from the Sacramento River to the Mokelumne River.

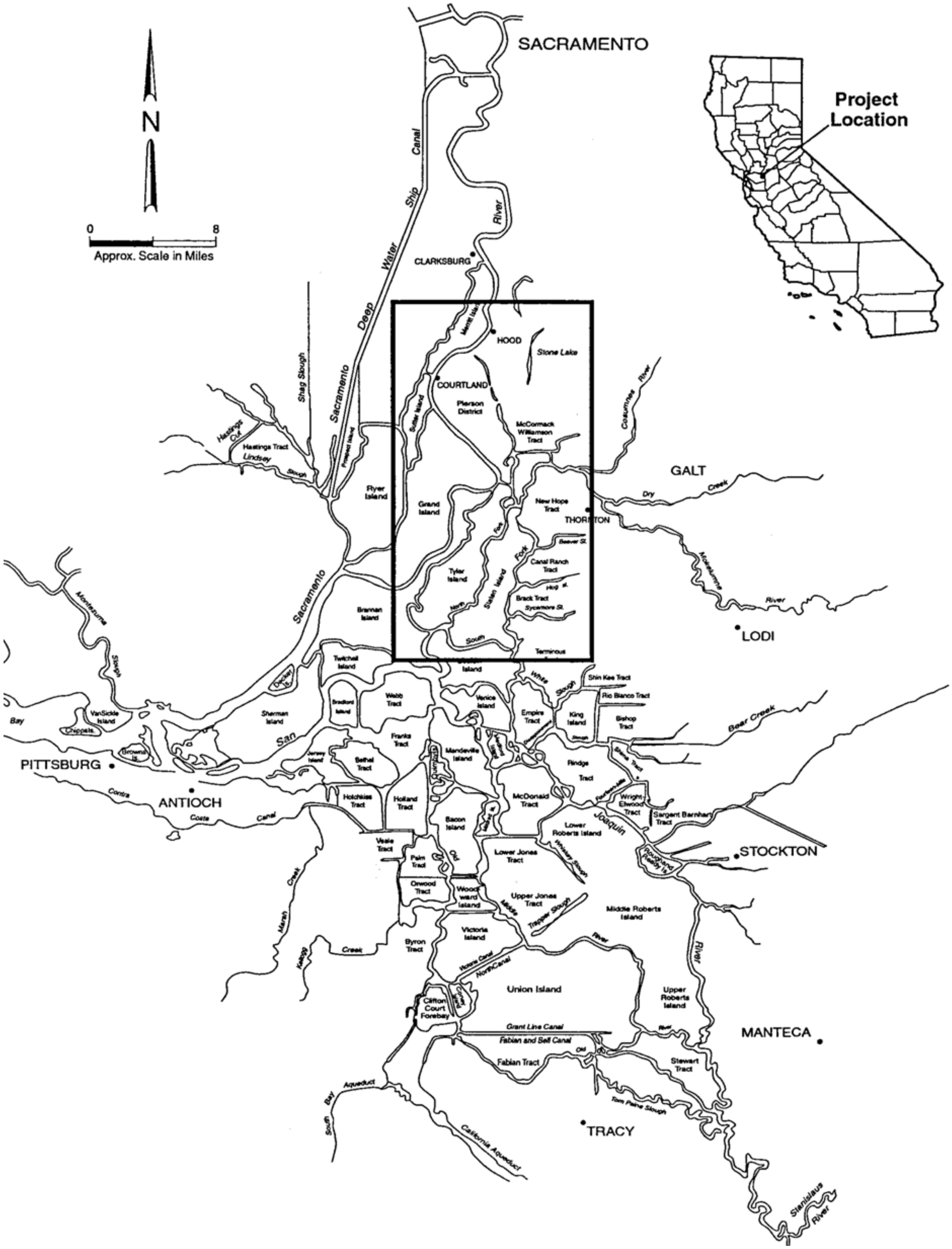


Figure 1. The Sacramento-San Joaquin Delta and general location of the project area

Section 2.0
Geology of the Delta

2.1 Geology

The Sacramento-San Joaquin Delta is located along the western margin of an immense sediment-filled structural trough that forms the Central Valley of California. In the vicinity of the Delta, these sedimentary deposits can be distinguished into discrete layers. Several kilometers beneath the Delta surface, basement rocks are composed of marine sedimentary rocks dating from the pre-Cretaceous Period (before 144 m.y.a., million years ago) to the early Tertiary Period (66.4 m.y.a. to about 40 m.y.a.) (USACE, 1974; DWR, 1986). Basement rocks are overlain by 5 km to 10 km of sedimentary deposits, most of which accumulated in marine environments between 175 m.y.a. and 25 m.y.a. (Atwater, 1982). These marine sediments are capped by late Tertiary (about 25 m.y.a. to 1.6 m.y.a.) and Quaternary (1.6 m.y.a. to present) non-marine sediments ranging from 720 m to 900 m in thickness (Burroughs, 1967; DWR, 1980a). Lastly, non-marine sediments are overlain by a layer of peat and peaty sediments between 0 and about 20 m feet thick interbedded with fluvial and tidal deposits of marine clay, silt, and sand. These sediments form the modern Delta and decrease in thickness with distance toward the Delta margins.

The Delta evolved as a result of millions of years of gradual infilling of the Sacramento Sea, an inland sea that once occupied a large part of Central California during the Oligocene Epoch (39 m.y.a.). During this time, the Sierra Nevada Mountains were much lower than they are today, as was the ancestral Coast Range. Over the next 35 million years an active subduction zone along the California coastline contributed to uplift of the Sierra Nevada and Coast Range and, as the mountains rose, eroded material gradually filled the Sacramento Sea. Prehistoric delta environments occupied large tracts of land along the vast inland shoreline that, as sedimentation progressed, migrated westward to converge in the vicinity of the modern Delta. By about 5 to 3 m.y.a., the Sacramento Sea had largely filled in with sediment, forming the Central Valley (Hickman, 1993).

The modern Delta is the most recent of several deltas that formed during a sequence of depositional and erosional cycles in the Quaternary Period, the period from 1.6 m.y.a. to present (Shlemon and Begg, 1975; Shlemon, 1971). These cycles resulted from fluctuations in climate and sea level related to the advance and retreat of glacial ice. The most recent cycle is one of deposition, resulting from a rise in sea level initiated by deglaciation following the height of the last (Tioga) glaciation approximately 20,000 years ago, a time when sea level was approximately 390 ft lower than it is today (USACE, 1974; Hickman, 1993). As glacial ice retreated, sea level rose more rapidly at first then slowed to a rate of about 0.04 to 0.08 inches per year, a rate that has persisted from about 6,000 years BP (Before Present) to the present time (Atwater et al., 1977).

Unlike most deltas, the modern Delta formed in the inland direction as rising sea levels intruded upstream and flooded a pre-Holocene valley, creating a broad tidal marsh. Rising sea levels gradually submerged the marsh over time, creating anaerobic conditions that greatly reduced the rate of plant decomposition. As a result, the accumulation of decomposing plant material kept pace with rising sea levels over approximately 7,000 to 11,000 years, resulting in the formation of thick peat deposits (Prokopovich, 1988; Shlemon and Begg, 1975). These deposits are thickest in the west and central parts of the Delta and grade to thinner accumulations inland toward the Delta margins (DWR, 1995a).

2.2 Seismicity

The Delta borders the eastern margin of the San Francisco Bay area, a region characterized by several major faults and high seismic activity (Figure 2). There have been numerous large (M>5) earthquakes in the region during the historical period of record, many of which produced seismic shaking in the Delta (USACE, 1995). The Midland Fault Zone, the Tracy-Stockton Fault, the Antioch Fault, the Rio Vista-Sherman Island Fault, and the Montezuma Hills Fault are all located near or within the limits of the Delta (Atwater, 1982; Jennings, 1994; USACE, 1995). Of these five faults, several have shown historical activity since 1800. The proximity of the Delta to major active fault systems in the San Francisco Bay area, most notably the Calaveras Fault and the Hayward and San Andreas Fault Zones, make it susceptible to strong seismic shaking events.

Although the Delta has been subjected to moderate seismic shaking during historical earthquake events, there has been no recorded observation of levee failure directly caused by an earthquake (Kearney, 1980; USACE, 1995). Nevertheless, the risk of liquefaction of protection levees is present given the potential for strong earthquakes in the region and the poor geotechnical characteristics of the peat deposits on which most Delta levees are constructed.

2.3 Land Subsidence

Almost all islands and tracts in the Delta lie below sea level. Land elevations decrease toward the west and center of the Delta to as much as 25 ft below sea level (USGS, 2000). Land surface elevations have been declining throughout the Delta due to widespread land subsidence, initiated when land reclamation began in the middle 1800's. Land subsidence is due largely to the decomposition of organic carbon in the Delta’s predominantly peat soils (Deverel and Rojstaczer, 1996). Prior to land reclamation, peat soils were saturated under anaerobic conditions and decomposed at a much slower rate, a rate exceeded by the rate of accumulation of dead organic matter. Exposure to aerobic conditions following land reclamation in the mid-1800s resulted in a dramatic increase in the rate of peat decomposition.

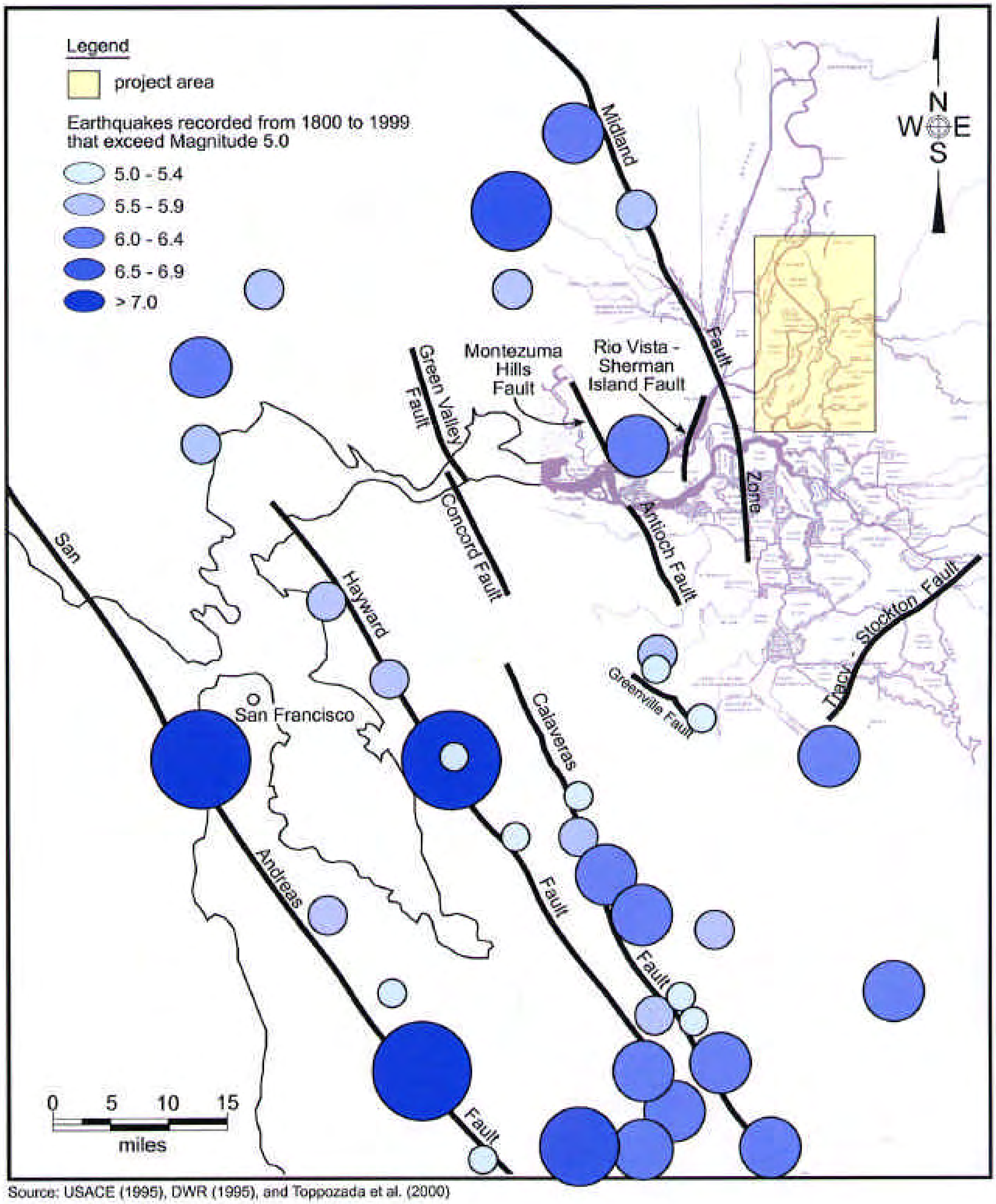


Figure 2. Historical earthquakes (magnitude > 5.0) in the San Francisco Bay region

Many studies have been conducted to accurately measure the rate and amount of land subsidence on Delta islands over time (Weir, 1950; Davis, 1963; Lao, 1965; Newmarch, 1980; DWR, 1986; Rojstaczer et al., 1991; Deverel and Rojstaczer, 1996; Deverel et al., 1998; Kerr and Leighton, 1999). These studies show that land subsidence is greatest in areas where peat deposits are thickest, namely the western and central parts of the Delta. In addition, land subsidence is typically greatest toward the center of islands and least along the levees around the island perimeter. Because the levees act as a protective cap, peat deposits underneath are not exposed to oxygen and therefore do not subside as rapidly as open areas of soil adjacent to levees (Davis, 1963).

Where long-term data are available, a gradual trend toward declining rates of land subsidence over time has been observed (DWR, 1986; Rojstaczer et al., 1991). Short-term data (1992-1994) also support this apparent trend (Deverel and Rojstaczer, 1996). The cause of this decline is attributed to a decrease in the proportion of organic carbon available for decomposition in the near surface (Galloway et al., 1999).

Historical land subsidence in the project area generally increases in a southwest direction. At McCormack-Williamson Tract, thicknesses of organic soils are negligible whereas organic soils are between 30 and 40 feet thick in the southwestern corner of Tyler Island (DWR, 1995a). For the most part, islands and tracts in the project area have experienced less than 10 feet of historical land subsidence, except Tyler and Staten Islands, where the extent of land subsidence may exceed 20 feet (DWR, 1980b).

Section 3.0
Geomorphology of the Delta

3.1 Geomorphic Setting

The Delta covers approximately 738,000 acres (1,153 mi^2) of land area, and forms a roughly triangular shape that broadens with distance inland. Most of the Delta is occupied by about 60 large islands or tracts separated by waterways (DWR, 1995a). Almost all of these areas have been reclaimed for agricultural purposes and lie at or below sea level. Islands and tracts are kept dry by approximately 1,100 miles of levees, and lift pumps are commonly used to lower the local ground water table to levels acceptable for farming. An overview of Delta geography is provided in the Delta Atlas (DWR, 1995a).

Rivers flowing into the Delta convey approximately 50% of the state's annual runoff (DWR, 1995a). The main rivers include the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras Rivers. All the major rivers are regulated by dams, except for the Cosumnes River. The Sacramento River is the dominant source of fresh water and sediment to the Delta, accounting for approximately 80% of annual fresh water inflows (Anderson, 1994). The San Joaquin River is the second largest contributor, accounting for about 10% of annual fresh water inflows. Similarly, most of the sediment supplied to the Delta is carried by the Sacramento River, between 80% and 85% in an average year, whereas the San Joaquin River and the Mokelumne-Cosumnes River supply only about 10% and 4%, respectively (NHC, 2003). The remaining sediment enters the system from the Yolo Bypass and from several other smaller streams and sloughs. A detailed discussion of the Delta sediment budget, past and present, is provided by NHC (2003).

Water and sediment movement in the Delta involves a complex interaction between tidal fluctuations, inflowing river discharges, and topography. The Delta exhibits mixed semi-diurnal tides with two high and two low tides each day. Tidal fluctuations result in changes in water surface elevation and the direction and volume of water and sediment flow in the Delta (NHC, 2003). Tidal effects are most significant in low freshwater flow conditions whereas during floods, tidal fluctuations are largely washed out by inflowing freshwater discharges.

Rivers flowing into the Delta exhibit a decline in stream power due to the combination of decreasing slope and tidal effects. Historically, prior to agricultural development and levee construction, annual flooding would regularly overtop existing low-lying natural levees and flood vast areas of tidal marsh lands. This resulted in sediment deposition and general aggradation of the Delta surface over time. In some cases, flows would concentrate through natural levee breaks and scour new channels through the tidal marsh. This led to a cycle of ongoing change in the alignment and location of channel bifurcations in the Delta. Today, channel alignments are largely fixed by artificial levees and erosion control measures. Flooding, except when artificial levees break, no longer occurs on most islands and tracts. Instead, flow and sediment remain confined to the existing channel network.

3.2 Historical Geomorphology

The geomorphology of the North and South Forks of the Mokelumne River is characteristic of Delta waterways. Both channels are bordered by levees that protect agricultural land uses. Channel alignments are preserved by ongoing levee maintenance and instream dredging. The North Fork is generally deeper and has a higher flow capacity than the South Fork. Combined, the North and South Forks have a maximum flow capacity of approximately 40,000 cfs whereas the 100-year flood requires a capacity of approximately 90,000 cfs (DWR, 2004). As a result, islands and tracts in the region are susceptible to flooding during high flows.

This section summarizes key historical events that have affected geomorphology in the North Delta since land reclamation began in the 1850s. Historical events are divided into the following subject areas: land reclamation and dredging, water diversions, and historical flooding. Summaries of key historical events in the Delta relating to water resources and geomorphology are provided by Prokopovich (1985), Anderson (1994), and DWR (1995a). Historical information regarding early settlement in the Delta is provided by Thompson (1957).

3.2.1 Land Reclamation and Dredging

Before European settlement, the Delta was described as a low-lying area covered by tidal marshes, backwater sloughs, and meandering river courses bordered by natural levees (LTMS, 1996). Much of the land area was at or near mean sea level (MSL) with highest elevations 10 ft to 15 ft above MSL (LTMS, 1996). As a result, much of the area was flooded regularly during high tides and/or high river flows. Natural spring floods annually inundated about 70% of delta lands (USACE, 1982).

The first period of land reclamation, from 1852 to 1875, occurred prior to the use of dredges in the Delta. Levees during this period were constructed largely by Chinese laborers. Reclaimed areas were drained and leveled by filling in the many sloughs and backwater areas of the natural tidal marsh lands. Levees during this period typically ranged from 4 ft to 6 ft in height (Thompson, 1982). Because levees were built atop and from soils with a high organic content, they were prone to settling, dessication shrinkage, and cracking.

The first recorded use of dredged material for levee construction in the Delta was on Jersey Island in 1875 (Thompson, 1982). Early dredges were steam powered and used throughout the Delta to improve existing levees and construct new ones for land reclamation (LTMS, 1996). Once leveed, arable lands were cultivated for farming and irrigated using tide gates that allowed water to flow into the leveed tract at high tide and flow out of the tract at low tide (DWR, 1980c; Prokopovich, 1985). No pumps were needed until the 1880's when land subsidence had become too great for the gravity based tide gate system to function properly (Thompson, 1982).

Hydraulic mining for gold in the Sierra Nevada Mountains from 1853 to 1884 created vast changes in the Delta (Gilbert, 1917). Hydraulic mining reached its apex in the 1870's and early 1880's and introduced huge sediment loads that were transported down major rivers to the Delta, causing river aggradation and the partial infilling of San Pablo and Suisun Bays (Gilbert, 1917; Ogden Beeman & Associates and Ray B. Krone & Associates, 1992; Krone, 1996; Galloway et al., 1999). An estimated 600 million cubic meters of sediment was introduced into the Delta during the period of hydraulic mining (Prokopovich, 1985). Divided over the 32 years of hydraulic mining operation, this value equates to a fivefold to sixfold increase in average annual sediment load over current levels (Prokopovich, 1985; Ogden Beeman & Associates and Ray B. Krone & Associates, 1992). As a result, delta channels became clogged with sediment and aggraded as much as 15 ft, interfering with navigation and increasing the incidence of flooding (LTMS, 1996). Following litigation, hydraulic mining was banned in California in 1884 (DWR, 1980c). Although banned, hydraulic mining continued sporadically until around 1915 (Gilbert, 1917).

A new generation of dredges, called clamshell dredges, was applied to clear the accumulated sediments from Delta channels following the end of hydraulic mining in 1884 (Galloway et al., 1999). The same style of dredge remains in use today. Clamshell dredges were also instrumental in constructing new levees and in improving existing ones to offset the effects of land subsidence. Ongoing reclamation work continued and by 1900 about half of the Delta had been reclaimed for agricultural use. In 1911 a Reclamation Board was established to manage and regulate private levee construction (DWR, 1980c) and by 1916 almost the entire Delta had been reclaimed (DWR, 1980c; Thompson, 1982). In addition to levee construction and land reclamation, many existing sloughs were straightened and new cuts dug through islands and tracts in the Delta (DWR, 1995a). By the 1930's, reclamation of the Delta was largely completed and in the configuration currently observed today (Thompson, 1957; Prokopovich, 1985). Over the period from 1852 to 1930, land reclamation resulted in the loss of approximately 97% of the total original tidal marsh in the Delta (Atwater and Belknap, 1980).

As development in the Delta and the Central Valley continued, Congress authorized the Sacramento Flood Control Project in 1917, resulting in the construction of improved levees along the Sacramento River and its distributary channels in the northern Delta (DWR, 1995a). Completed in 1960, the levee system, referred to as project levees, includes Georgiana Slough just south of the Delta Cross-Channel. The remaining levees in the project area are locally funded non-project levees maintained by local reclamation districts with support from the State.

In 1933, the Stockton Deep Water Ship Channel (DWSC) was dredged along the San Joaquin River from Suisun Bay to the city of Stockton (USACE, 1934). The project included channel dredging as well as the excavation of cuts through a meandering portion of the San Joaquin River in the east Delta. In 1935, dredging work on the Sacramento River was also conducted to improve navigation (Anderson, 1994). In 1963 the Sacramento DWSC was constructed along the Sacramento River from Sherman Island to West Sacramento. In 1983, both the Stockton DWSC and Sacramento DWSC were deepened to 35 ft to allow for the passage of larger ships (DWR, 1995a). Both the Sacramento DWSC and the Stockton DWSC fall under the jurisdiction of the Corps and are subject to maintenance dredging each year to maintain depths for ship passage (Valentine, 2000). Dredging in the Delta is also conducted by State agencies, reclamation boards and private companies for levee repair, marina maintenance, and other channel improvements.

Traditionally, the U.S. Army Corps of Engineers has been responsible for large dredging projects in the Delta for improving navigation. According to their records, the Corps has not been involved in any dredging projects along the Mokelumne River (Mirakomi, 2002). However, the river has been dredged in the past to supply local landowners and reclamation districts with material for levee construction and maintenance. A summary of recent dredging activities in the project area is provided by NHC (2002).

3.2.2 Water Diversions

California is home to the largest water distribution system in the world and its primary source of water is the Delta. In 1933, Congress authorized the Central Valley Project to distribute water from the Delta to the San Francisco Bay area, the San Joaquin Valley, and southern California (DWR, 1980c). The first component of the project, the Contra Costa Canal, was completed in 1940 and began exporting water from the Delta that same year. In 1951, the Delta Mendota Canal and the Delta Cross Channel were completed, greatly increasing the rate of annual water exports from the Delta. The final stage of the CVP was completed in 1973 when the California Aqueduct was constructed from the Delta to southern California.

Because fresh water was needed at the newly constructed pumping plants year round, dams were constructed in upper basins of the Delta watershed to regulate flow in winter and provide flow releases in summer, supplying adequate water for pumping and limiting the upstream transgression of saline sea water into the Delta. Today, all major rivers draining into the Delta, except the Cosumnes, are regulated by dams. Some of the most notable reservoirs are Lake Almanor on the North Fork of the Feather River completed in 1924, Millerton Lake on the San Joaquin River in 1942, Lake Shasta (1944) on the Sacramento River, Lake Oroville (1967) on the Feather River, Folsom Lake on the American River (1955), Lake Berryessa on Putah Creek (1956), Camanche Reservoir on the Mokelumne River (1963), Don Pedro Reservoir on the Tuolumne River (1970), and New Melones Reservoir on the Stanislaus River (1978).

As a result of these water projects, salinity intrusion in the Delta has been greatly diminished (DWR, 1993, 1995b). Historically, before Shasta Dam was completed, the maximum extent of salinity intrusion in dry years extended over more than 80% of the Delta. Today, salinity intrusion, even in very dry years, is limited to the area west of Oulton Point on Twitchell Island. In addition to changes in salinity intrusion, state and federal water projects also affected general flow patterns in the Delta. Historically, fresh water from the Sacramento River was once concentrated in a more westerly direction toward Sherman Island and Suisun Bay. Today, fresh water from the Sacramento River flows in a more southerly direction, leaving the Sacramento River through the Delta Cross-Channel and flowing south toward the Tracy and Harvey Banks Pumping Plants that supply water to the Delta-Mendota Canal and California Aqueduct, respectively (DWR, 1995a).

3.2.3 Historical Flooding

Historically, major floods in the Delta occurred in the following water years: 1878, 1881, 1890, 1893, 1902, 1904, 1907, 1909, 1938, 1950, 1955, 1958, 1969, 1980, 1982, 1983, 1986, 1995, 1997, and 2004 (DWR, 1995; Thompson, 1996). In each water year, one or more large islands or tracts were flooded and required draining and levee repair. Although flooding in the Delta typically occurs during flood flows on either the Sacramento or San Joaquin River systems, levees have also failed during low flow summer or early fall conditions (DWR, 1995a). Delta levees are subject to wave erosion, seepage, overtopping by floods, and structural failure due to underlying soil type (DWR, 1980c, Thompson, 1982). In addition, as ongoing land subsidence continues, levees are subject to increasingly greater pressure as the difference between water surface and land surface elevation increases.

Levees on McCormack-Williamson Tract and Dead Horse Island have frequently been overtopped during large floods. Aside from frequent flooding in the late 1800s, McCormack-Williamson Tract experienced flooding in 1955, 1958, 1964, 1986, and 1997. Dead Horse Island has also experienced frequent flooding, in 1950, 1955, 1958, 1980, 1986, and in 1997. Staten Island has not flooded for almost 100 years, last flooding in 1904 and again in 1907.

3.3 Channel Morphology

3.3.1 Planform Comparison

Historical maps of the Walnut Grove area and vicinity are shown in Figure 3. Maps shown in Figure 3 date from the 1910-1916 period and the 1978-1993 period. Several significant changes during this time period are noted. First, the area of McCormack-Williamson Tract appears as marshland in 1910-1916 era maps with some small lakes bordering the tract. McCormack-Williamson Tract was one of the last remaining areas of marshland in the North Delta to be converted to agriculture. Also notable are the numerous sloughs that partially dissect many of the tracts and islands in the North Delta. Broad Slough, near the southern end of Tyler Island, is particularly extensive. A slough appears to connect Snodgrass Slough and Georgiana Slough at the west end of Deadhorse Island in 1910-16 mapping, but has been filled in by 1978-93. Construction of the Delta Cross-Channel in 1951 from the Sacramento River to Snodgrass Slough is also a notable change from 1910-16 to 1978-93.

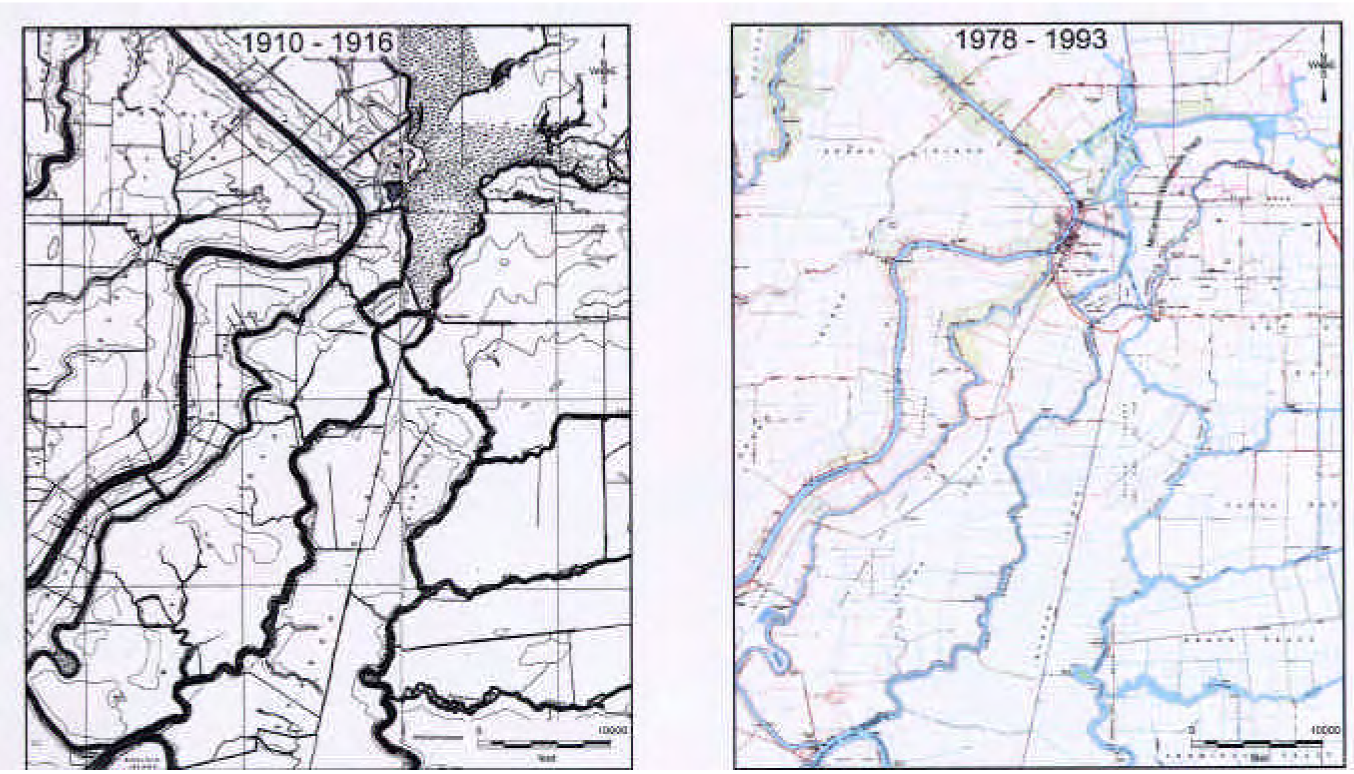


Figure 3. Historical map comparison of Walnut Grove and vicinity

In contrast to observed changes, much of the islands, tracts, and channel alignments in the North Delta still appear as they did in the early 1900s. Major river alignments have not changed significantly over the last several decades although levee heights have increased by several feet to improve flood control. The most significant changes to flow and sediment transport in North Delta waterways are not expressed in terms of channel alignments but rather in the land subsidence of islands, grading and filling of farm land, increases in levee heights and channel flow capacities, and water regulation by the State Water Project.

3.3.2 Cross-Section Comparison

Historical cross-section data for the North Delta were available from the State Department of Water Resources (DWR) for two time periods, namely: bathymetric data from 1934 and annual cross-section data from 1994 to 2001. Bathymetric data are available from the Cross Section Development Program (CSDP), a software application that develops stream cross-sections by drawing from bathymetric points upstream and downstream of the desired section line. The bathymetric data are not sufficiently dense to produce accurate cross-sections but do provide a general sense of channel morphology. In contrast, detailed annual cross-section data are available from the North Delta Scour Monitoring Program (DWR, 1998, 2000). Initiated in 1994, the program has collected cross-section data for the last 10 years, although released data are only available through 2001.

Cross-section data from 1994 through 2001 were available at 32 locations on waterways adjacent to McCormack-Williamson Tract, Dead Horse Island and Staten Island. Cross-section locations and a summary of historical changes at each site are shown in Figure 4 and discussed below. Where available, the channel invert from 1934 bathymetric data is also shown in the figure.

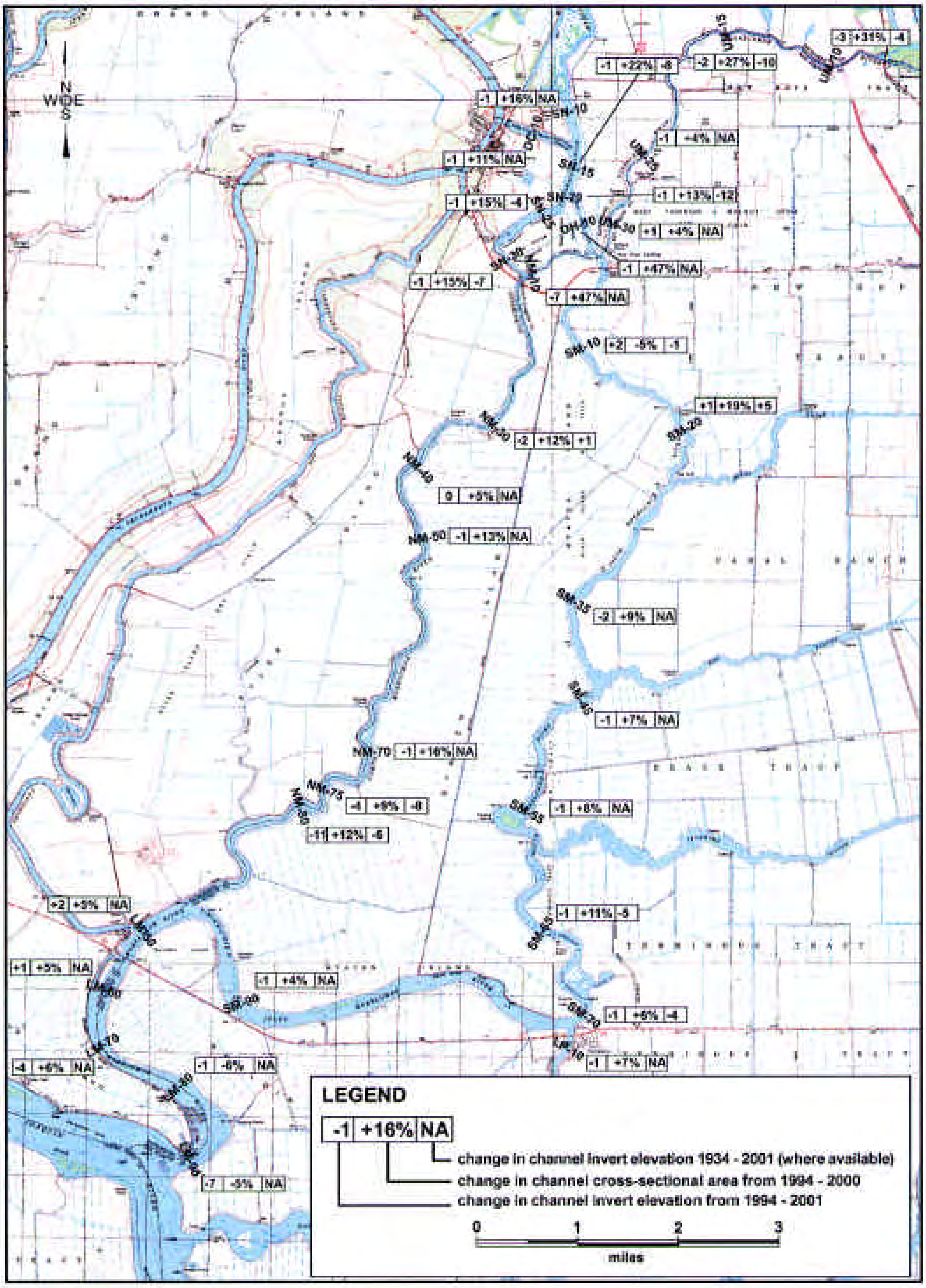


Figure 4. Summary of historical cross section changes (feet) in study area

At most locations in Figure 4, the 1934 – 2001 and 1994 – 2001 cross-section data show declines in channel invert elevation as well as increases in cross-section area for the 1994 – 2000 period. Note that, due to the lack of density of data points, estimates of the 1934 channel invert could be made at only 13 of the 32 cross-section locations and are estimated to be accurate to within +/- 5 feet. This made it impossible to identify long term changes in bed elevation with confidence; however, almost all the data (11 of 13 sites) show an apparent decline in invert elevation from 1934 to 2001. Only two sites indicate a possible channel invert rise, NM-30 (+1 feet) and SM-20 (+5 feet). The change at NM-30 is well within the range of error whereas the change at SM-20 is possibly significant and corroborates an observed trend of aggradation on some parts of the South Fork Mokelumne River in recent years (Fleenor, 2002).

A summary of historical cross-section data from 1994 – 2001 is shown by stream segment in (Table 1). Similar to the 1934 – 2001 data, a general decline in channel invert elevation is observed in the project area. In addition, the average cross-section area for each stream segment shows an increase for the period, reflecting an increase in channel capacity.

Table 1. 1994 - 2001 Cross section changes in North Delta project area

Stream Segment	Average Invert Change 1994 – 2001 (ft)	Average Cross-Section Area Change (1994 – 2000)
South Fork Mokelumne	-0.5 ft	+7%*
North Fork Mokelumne	-3 ft**	+16%*
Upper Mokelumne	-1 ft	+17%*
Lower Mokelumne	-2 ft	+1%
Snodgrass Slough	-1 ft	+16%
Dead Horse Slough	-1 ft	+47%*

* dredging occurred in this reach during the period of change

**excluding NM-80 where the invert lowered by 11 feet, this reach would have had an average invert change of -1.5 ft

Dredging was conducted between 1994 and 2001 on the North and South forks of the Mokelumne River, the Lower Mokelumne River and Dead Horse Slough (Darcie, 2002). Clearly, dredging has affected channel invert elevation and may have contributed to the observed net channel incision from 1994 to 2001. In addition to dredging, major floods in 1995 and 1997 may have scoured some channels in the North Delta (NHC, 2003). Due to incomplete records, the quantities and locations of historical dredging in the project area are not well documented. Thus, the extent to which dredging has contributed to the observed sediment loss in project area is not known.

3.4 Historical Trends

Historical changes in the North Delta that have affected channel morphology include land reclamation, levee construction, dredging, hydraulic mining, impoundment of water and sediment by upstream dams and other diversions, as well as the construction of water diversion facilities and consequent alteration of flow and sedimentation patterns in the Delta. The effects of these changes on channel morphology in the project area are summarized below:

- Waterways in the project area are largely confined by levees and able to convey significantly greater flow and sediment discharges than during historic times.

- Historical cross-section data indicate that the majority of waterways in the project area have experienced some channel incision over the several decades and may be experiencing a net sediment loss over time.

- Water regulation, diversions, and the impoundment of water and sediment by dams has resulted in a decline in the total annual water and sediment outflows to the Delta from the Central Valley, a trend that is expected to continue into the future (NHC, 2003).

- The construction of large water diversion facilities such as the Delta-Mendota Canal and Delta Cross Channel in 1951, and California Aqueduct in 1973 have altered the traditional flow patterns in the Delta that affect sedimentation. Water and sediment exhibit a more southerly flow in the Delta, somewhat reducing deposition of sediment in the North and Central Delta and increasing deposition of sediment in the South Delta (NHC, 2003).

- The combination of overgrazing, deforestation, floodplain reclamation, river channelization, and, most importantly, hydraulic mining for gold caused huge increases in sediment loads in the Delta system. The historic trend demonstrates a rapid decline of sediment loads in the Delta streams at the beginning of the 20th century, followed by a gradual steady reduction of sediment loads over the last half a century (NHC, 2003).

Section 4.0
Extensions and Modifications Made to the MIKE11 Hydraulic Model

4.1 Model Description

Northwest Hydraulic Consultants obtained a MIKE11 hydrodynamic model of the North Delta from the University of California at Davis (UCD). The model was developed at UCD to evaluate flooding scenarios in the project area and to assist in the design of flood control and ecological restoration alternatives. Figure 5 presents the domain of the model and significant boundary conditions.

A thorough review of the original MIKE11 model developed by UCD, as well as its documentation (Chris Hammersmark, MS Thesis, UCD, 2002) (Stephen Blake, MS Thesis, UCD, 2001), was undertaken. Sources for the geometry and input parameters were verified. An unsteady HEC-RAS model of the project area was also obtained from MBK engineering and used to extend the original MIKE11 boundaries and to evaluate its results. Both models were developed with respect to the NGVD 29 vertical datum, although the MIKE11 model used SI units and the MBK model English units.

Once acquired, the original MIKE11 hydrodynamic model was updated to extend the domain of the model and to improve the accuracy of the results. Important changes were made to both the model's channel geometry and boundary conditions.

4.2 Channel Geometry Improvements

As depicted in Figure 5, various geometric improvements and extensions were made to the channels in the MIKE11 hydrodynamic model. These included:

Cosumnes River and Deer Creek: Additional cross sections were added along the Cosumnes River and Deer Creek to improve their alignments and increase the overall length of the branches. The resulting total length was 56240 m (about 35 miles) for the Cosumnes River and 10108 m (about 6.3 miles) for Deer Creek. Existing maps and aerial photographs published by the U.S. Geological Survey (http://terraserver-usa.com) were used to during the process. Surveys provided by Candice Fehr from year the 2000 at 31 locations along the reaches were also integrated into the model.

Dry Creek, Grizzly Slough, and Bear Slough: The original cross-sections along Dry Creek, Grizzly Slough, and Bear Sloughs in the original MIKE11 model were somewhat inconsistent. Therefore, they were replaced with those from the HEC-RAS model. Raw cross-section data was converted from HEC-RAS format into MIKE11 format by UCD. The HEC-RAS cross-sections did not extend as far upstream as the present Dry Creek branch in the MIKE11 model. Therefore, the upstream most section was duplicated multiple times to extend the total reach length. Although most cross-sections along Grizzly and Bear Sloughs compare more favorably between the models, the HEC-

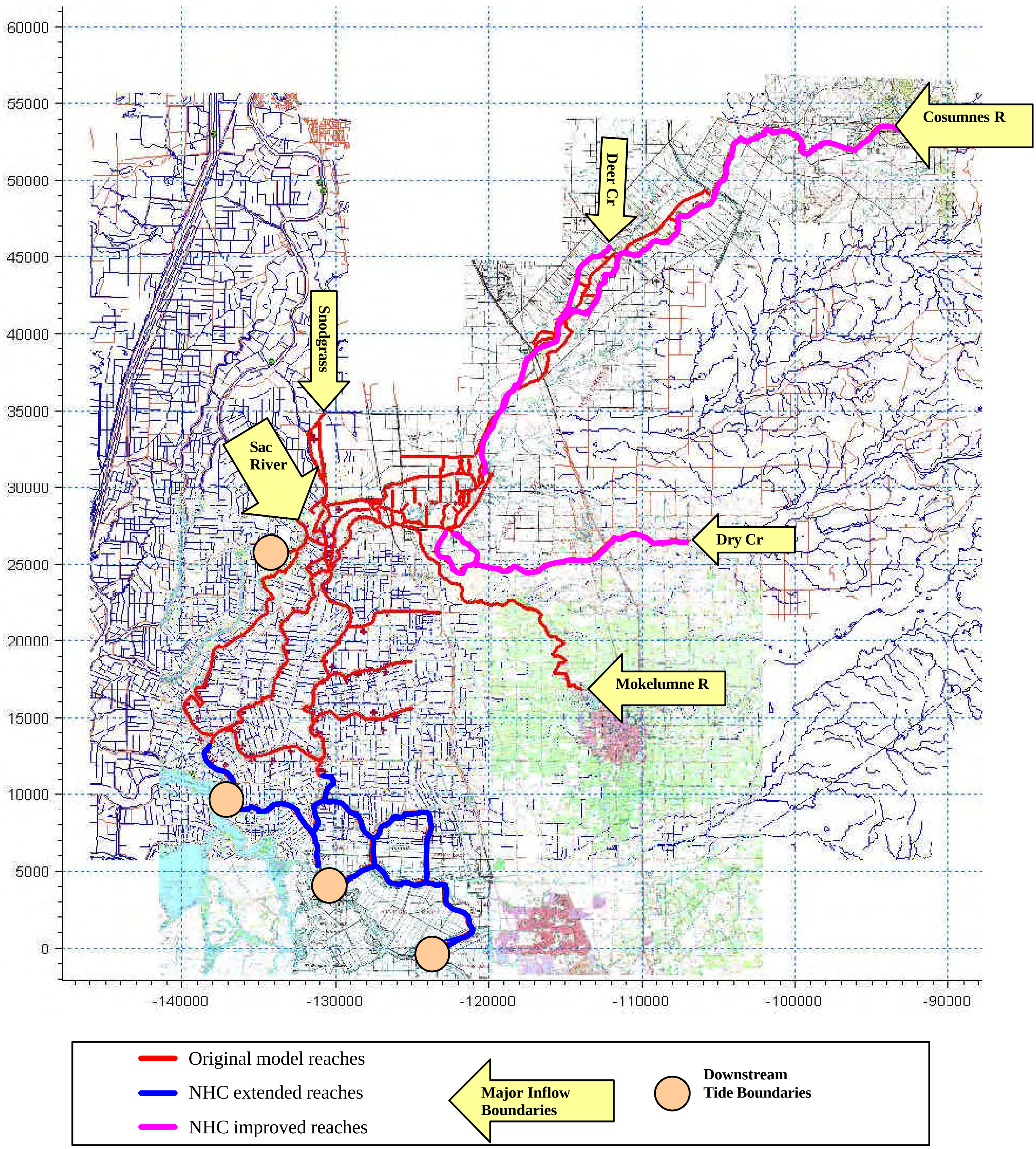


Figure 5. Modeling domain and branch layout for MIKE11 model of the North Delta

RAS sections for the Cosumnes tended to be higher than those originally in the MIKE11 model.

Lower Mokelumne and Sloughs: In parallel to NHC's work, UCD continued to make its own improvements to the MIKE11 model, which have also been integrated into the present model. UCD updated channel geometries in the region below Benson's Ferry near the McCormack-Williamson Tract using recent cross-sections obtained from the North Delta Scour Monitoring Program and by redigitizing existing branches to elongate and improve channel alignments. This helped capture actual channel sinuosity and improved model representations of tidal oscillations. Additional improvements implemented by UCD include:

- *Channel Redigitization*. Branches for the following streams were redigitized and lengthened, with cross-sections repositioned as necessary to represent proper location based upon their coordinates: Middle Mokelumne (below Cosumnes), South Mokelumne, North Mokelumne, Lower Mokelumne (above Georgiana), Georgiana Slough, Hog Slough, Sycamore Slough, Beaver Slough, Snodgrass Slough, Dead Horse Cut, Delta Cross Channel, Meadow Slough, Lambert Slough, and Middle Slough.

- *Cross-sections Additions*. Cross-sections were added to the following branches using data from the North Delta Scour Monitoring (NDSM) 2000 survey: Middle Mokelumne (below Cosumnes), South Mokelumne, North Mokelumne, Lower Mokelumne (above Georgiana Slough), Little Potato Slough (north of White Slough), Hog Slough, Sycamore Slough, Beaver Slough, Snodgrass Slough, Dead Horse Cut, and Delta Cross Channel.

- *Branch Additions*. The North of Twin Cities Road (NofTCR) floodplain branch was added to the current model, improving the performance of the model at the Twin Cities Road bridges under high flows.

Bridge Crossings: Except for the Highway 99 bridge over the Cosumnes River, no other bridges were initially incorporated into the UCD MIKE11 model. To remedy this, NHC attempted to add bridge structures to the model at the following locations: Wilton Road on Deer Creek and Cosumnes River, Dillard Road on Cosumnes, Highway 99 on Cosumnes, Twin Cities Road on Cosumnes and overflow branch, Thornton/Franklin Road (J8) on Mokelumne River, and New Hope Bridges (J11) on the North and South Mokelumne. Unfortunately, results were generally quite unsatisfactory, as to the model overestimated headloss under a variety of hydraulic conditions. The bridges were subsequently removed and replaced by simple pier structures in the channel. Bridges at the Twin Cities Road on the Cosumnes, Thornton/Franklin Road (J8) on the Mokelumne, and the New Hope Bridges (J11) on both the North and South Mokelumne Rivers were added to the model in this manner. After analyzing the results of several model runs, it was evident that the Twin Cities Road Bridge could become submerged during a large flood event. Under this scenario, the model might not accurately predict local flow conditions since the deck of the bridge is not included in the model geometry.

4.3 Downstream Boundary Improvements

The downstream boundaries in the original MIKE11 model consisted of the Lower Mokelumne River just below its confluence with Georgiana Slough and Little Potato Slough at the confluence with White Slough, approximately 2 miles downstream of Highway 12. These were extended by NHC to the San Joaquin River using channel geometry data from the HEC-RAS model. Likewise, Little Potato Slough was extended downstream past White Slough about 1.5 miles. At this point, Little Potato Slough joins with Connection Slough, which splits off the San Joaquin, to become Potato Slough and then rejoins the San Joaquin. Connection, Potato, and White Sloughs were all added to the model, along with Honker Cut, Bishop Cut, Disappointment Slough, and Fourteenmile Slough.

The resulting extended model has five downstream boundaries, all along the San Joaquin River. Stage data for the boundaries was readily available through the California Department of Water Resources and the Interagency Ecological Program. The data sets include (1) Rindge Pump at the confluence between the San Joaquin Riverand Fourteen Mile Slough, (2) Venice Island at the outlet of Disappointment Slough, and (3) San Andreas Landing located on the San Joaquin River just downstream of the confluence with the Mokelumne.

4.4 Upstream Boundary Improvements

For the simulation events modeled by MBK, in 1995 and 1997, in most cases the upstream boundary data used for the MIKE11 model were chosen to match the HEC-RAS modeling. For both the Dry Creek and Cosumnes River inflow boundaries, adjustments had been made by MBK to fill in missing data and account for rating curve shifts. In order to allow direct comparison with the MBK results, these adjusted data were also used in the MIKE11 model. Laguna Creek was also added to the MIKE11 model as a lateral inflow to the Cosumnes, using the MBK inflow data. For Deer Creek at Wilton Road and Stone Lake outlet at Lambert Road (Snodgrass Slough), these are exterior stage boundary conditions in the MIKE11 model. However, these locations are interior within the MBK model. Therefore, HEC-RAS stage output was extracted from the model for the 1995 and 1997 floods, and used as the MIKE11 boundary conditions at these two locations. Realtime (www.sacflood.org) and historic data are also available at these locations from Sacramento County.

4.5 Model Verification and Results

The UCD MIKE11 model was extensively reviewed, and determined to be appropriately developed and applied. Details of the model calibration and setup can be found in a UCD Master’s Thesis (Hammersmark, 2002). The model appears to have been reasonably well-calibrated to historical events in 1998 and 2000, and remains well-calibrated with the nhc-modified model (as described herein) – although the results are somewhat different, in most cases improved. Simulations were also carried out and comparisons made for events in 1995 and 1997 that were simulated by MBK with HEC-RAS.

2000 results: The latest 2000 MIKE11 model compares closely to the original 2000 UCD model, prior to all the improvements. Those bridges with significant piers were modeled by modifying the cross-section geometries, and yield reasonable results. In the area of Cosumnes River at Twin Cities Road, the new results are significantly lower due to the addition of new flow paths by UCD from their 1986 model. These should be more accurate. The Dry Creek branch profile is significantly different due to the new cross-sections which replace the sparse cross-section definition of the previous MIKE11 model. At Benson's Ferry and New Hope Landing, where stage gages are maintained (Figure 6), the calibration is still good if not even better. At Benson’s Ferry, particular improvement is noted during the lower stages of the event, while the peak results remain about the same (Figure 7). At New Hope Landing, the previous model tended to over predict water levels. The new model very closely captures the high tide levels and also more closely captures the lower tide (although still too high), resulting in an overall more accurate tidal fluctuation (Figure 8).

1999 results: At the time of the analysis, we had yet to obtain data for the Rindge Pump downstream boundary (Fourteenmile Slough). This data may now be available from the IEP or other website. Boundary conditions elsewhere have been set up for 1999, and the model is otherwise ready to simulate that event.

1998 results: The trends and conclusions for the 1998 simulation are similar to 2000, although the improvement is even more pronounced. At Benson’s Ferry, with a few exceptions, the refined model more closely replicates the measured data throughout the simulation (Figure 9). At New Hope Landing, the previous model over predicted water levels by up to more than a meter. The refined model both lowers the computed water levels and also increases the tidal fluctuation, resulting in a very close prediction to the measured levels (Figure 10). Some of the improvement here can be attributed to Chris Hammersmark’s recent improvements to the lower part of the model, as discussed previously.

1997 results: The model has been set up and even run for the 1997 flood event, with all the appropriate boundary conditions. However, none of the numerous levee breaches have yet to be added to the MIKE11 model, so the results are not valid for replicating historic 1997 conditions or for comparing with the MBK HEC-RAS model.

1995 results: The MIKE11 and HEC-RAS results generally compare reasonably well. One exception seems to be in the area of the lower Cosumnes, around Twin Cities Road and downstream to Grizzly and Bear Sloughs and the adjacent. MIKE11 results are as much as 2.5m higher (Cosumnes at Grizzly/Bear) than HEC-RAS. The HEC-RAS model, outside of the main channels, consists of many inter-connected storage areas, whereas the MIKE11 model includes more linked branches but is missing some floodplain areas that do become inundated. Measured data is lacking within this area, although adding these missing floodplains to the MIKE11 model would add storage (and possibly conveyance) and likely lower the predicted water levels somewhat closer to the HEC-RAS results. There was also one levee breach simulated in the HEC-RAS model along Grizzly Slough, which was not included in the MIKE11 simulation. From this area continuing downstream towards the west and south, however, the results improve. At Benson's Ferry as well as New Hope Landing, both models replicate the measured data reasonably well, with the HEC-RAS model slightly under predicting the stage and the MIKE11 model slightly over predicting (Figures 11 and 12). Continuing downstream the results between the two models compare even better.

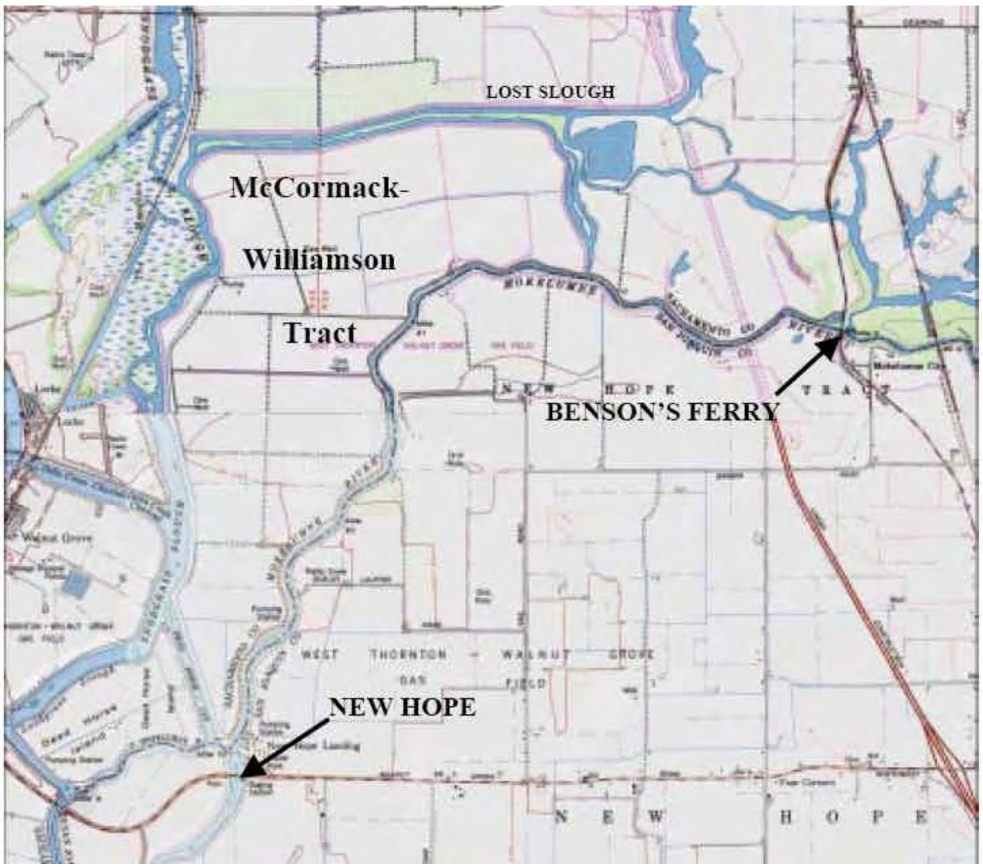


Figure 6. Water surface elevation gage locations within the project area

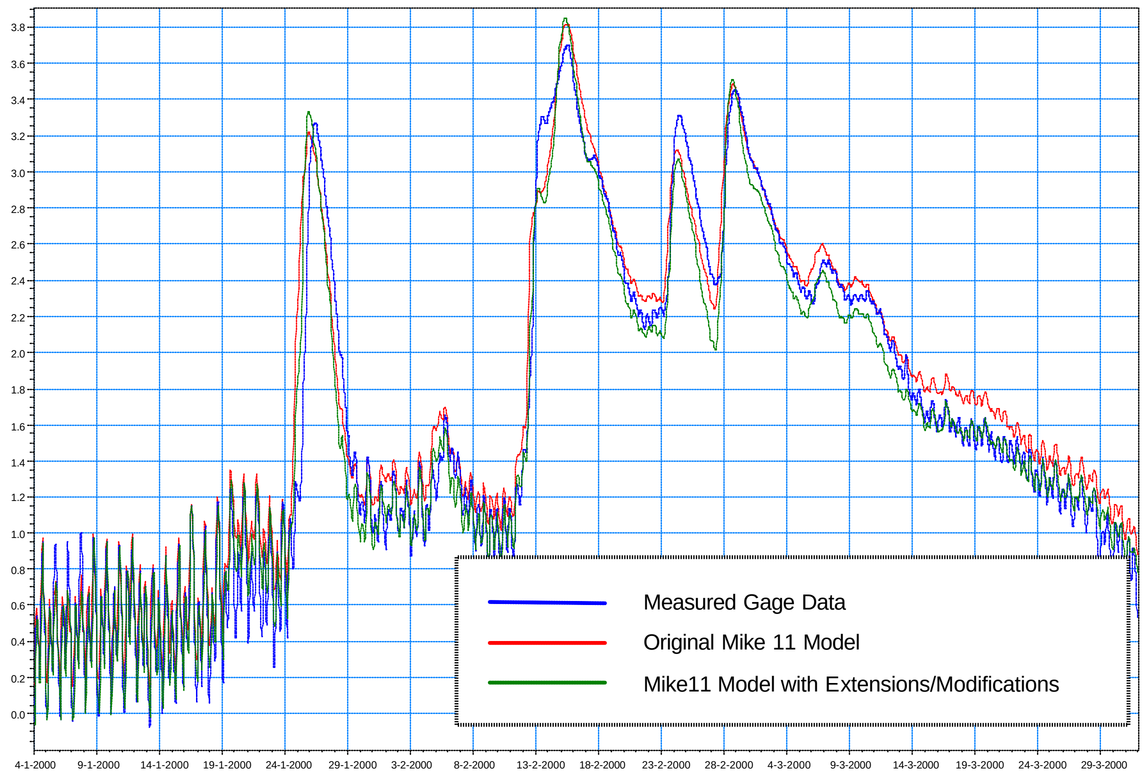


Figure 7. Benson's Ferry water level comparisons (meters NGVD29) for Jan-Mar 2000.

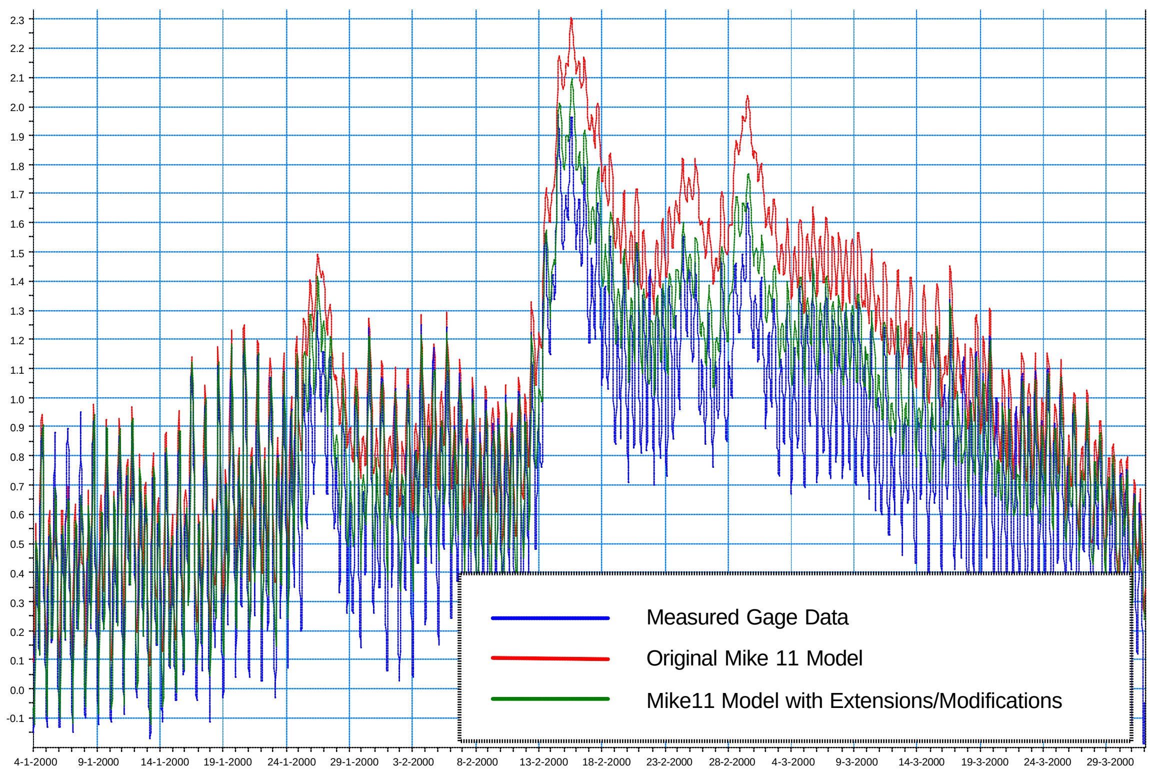


Figure 8. New Hope Landing water level comparisons (meters NGVD29) for Jan-Mar 2000.

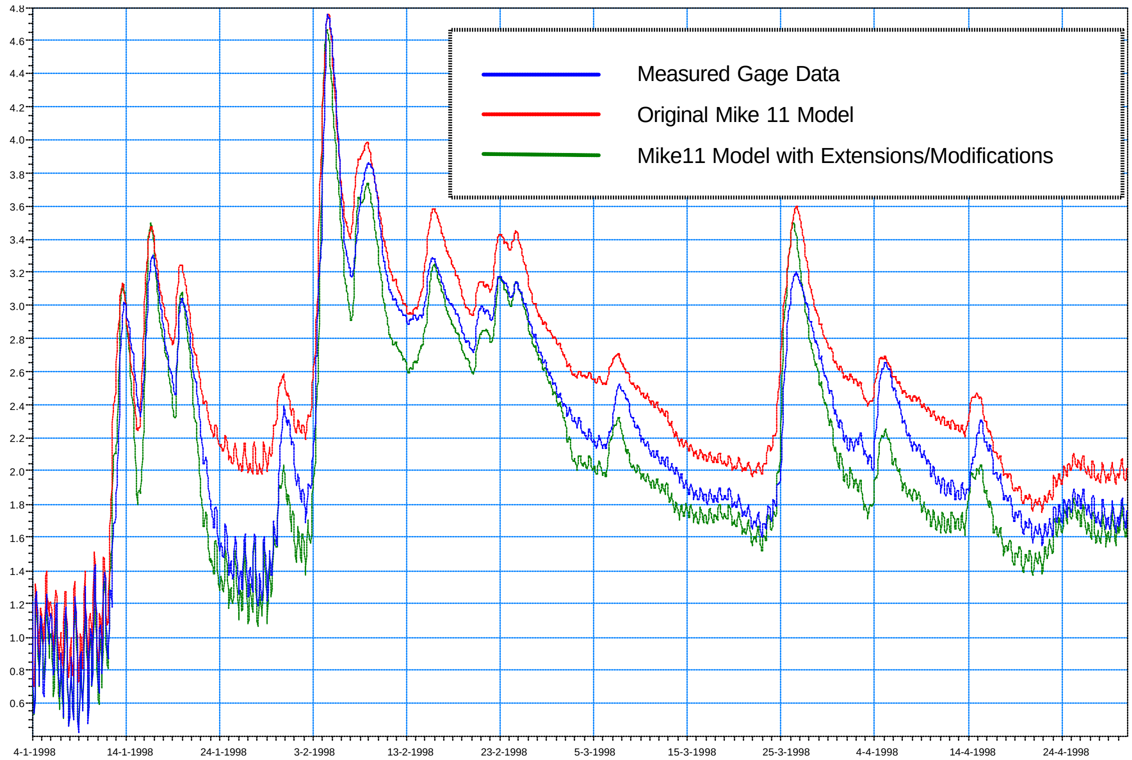


Figure 9. Benson's Ferry water level comparisons (meters NGVD29) for Jan-Apr 1998

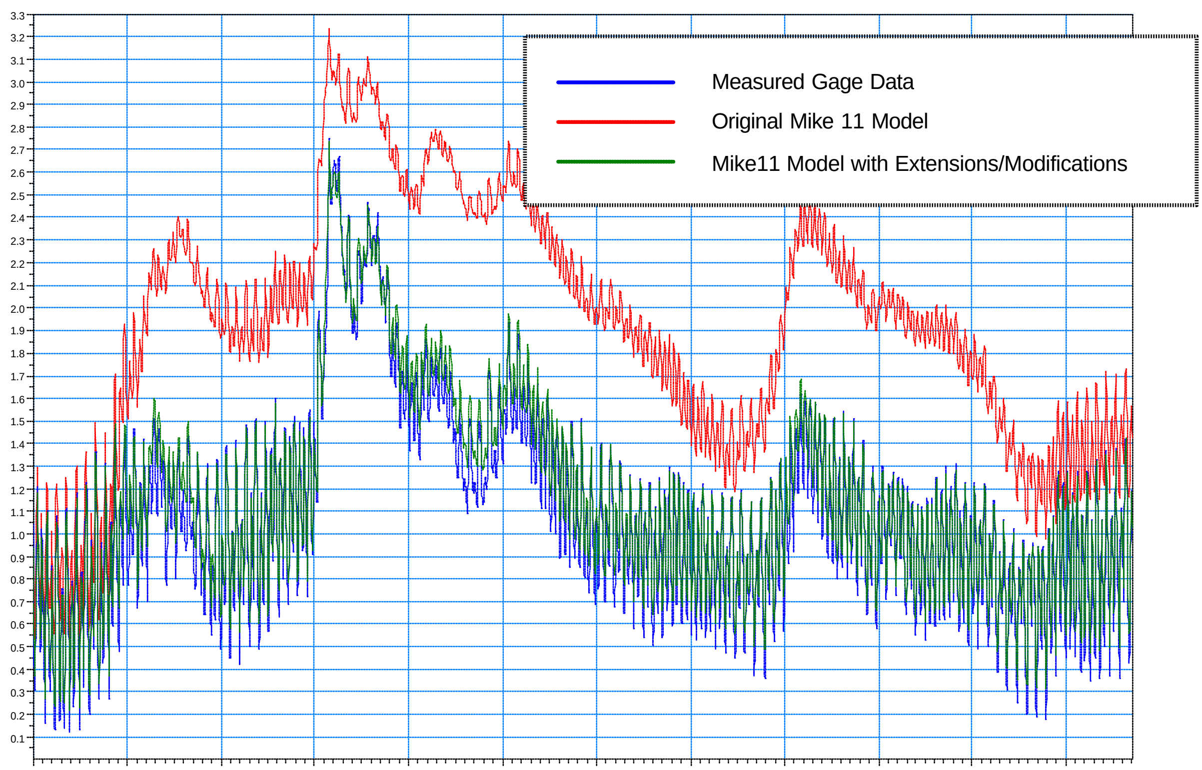


Figure 10. New Hope Landing water level comparisons (meters NGVD29) for Jan-Apr 1998

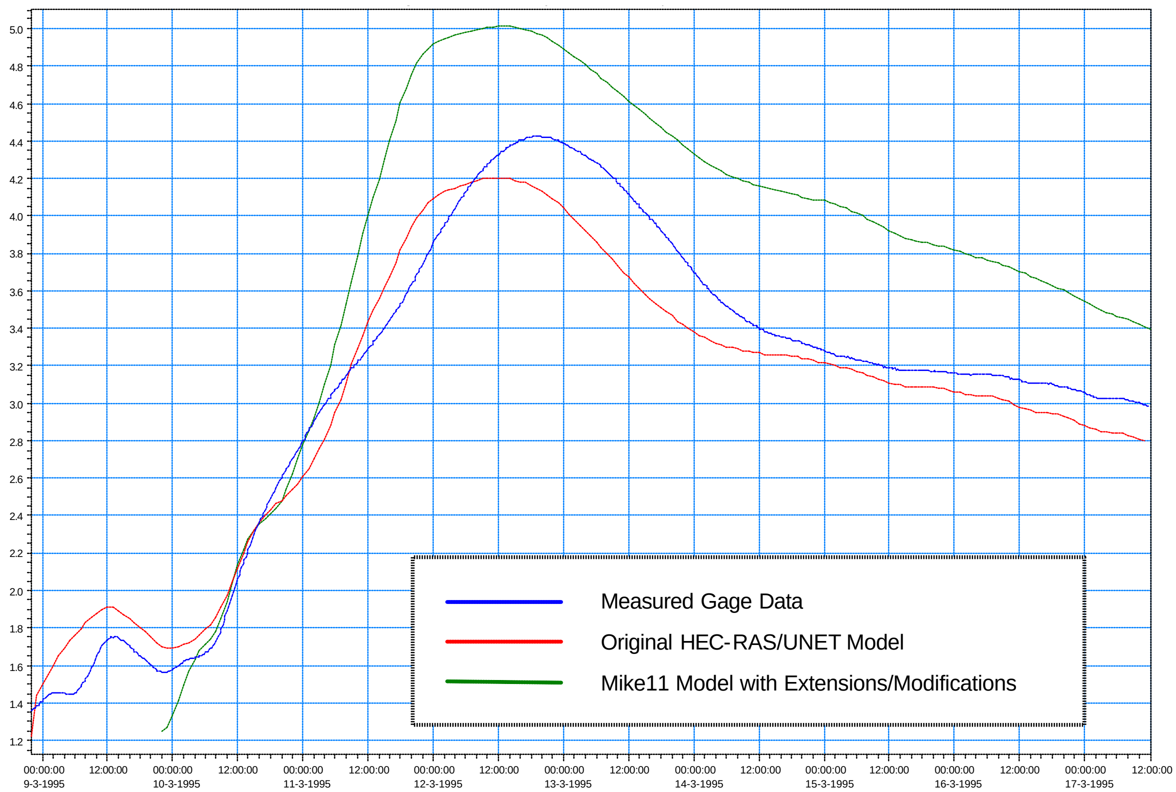


Figure 11. Benson's Ferry water level comparisons (meters NGVD29) for Mar 1995

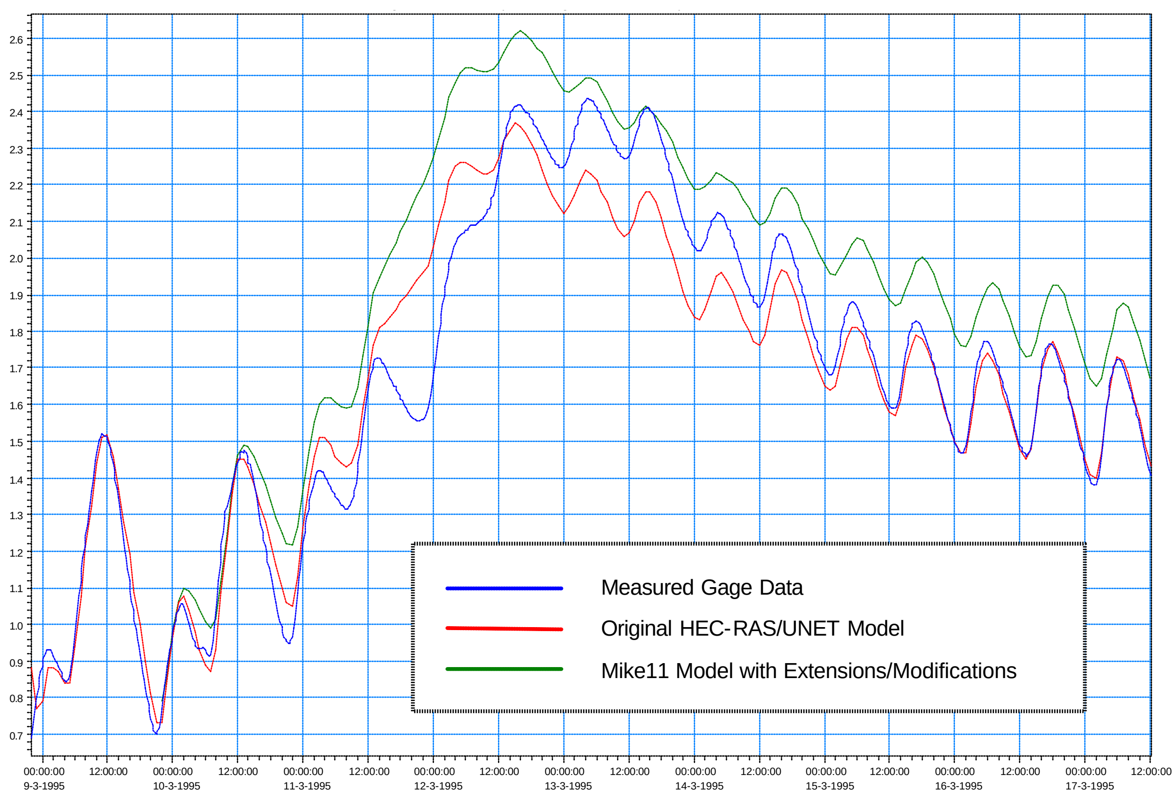


Figure 12. New Hope Landing water level comparisons (meters NGVD29) for Mar 1995

Section 5.0
North Delta Data Collection

Bed samples and flow measurements were taken from the North Delta study area prior to the development of the sediment transport model to verify the existing data set and to fill-in data gaps. The following section describes the nature of the data collected and summarizes its implications with respect to calibration of the transport model.

5.1 Existing Sediment Data

Bed material samples had been collected previously near the study area by the USGS (2002) and the University of California, Davis (Constantine, 2001). According to the results of this sampling, the bed material in the Sacramento River near Sacramento consisted of fine to coarse sand with small amounts of fine gravel. The bed material of the lower Cosumnes River was composed of fine to medium gravels. The grain size distributions for the Sacramento and Cosumnes Rivers are presented in Figure 13.

Systematic measurements of suspended load at selected locations on streams tributary to the Sacramento-San Joaquin Delta was initiated by the USGS in the late 1950's. Daily suspended load data are available for the Sacramento River at Sacramento (1956-1979) and at Freeport (1979-2000), Yolo Bypass near Woodland (1979-1980), San Joaquin River near Vernalis (1959-2000), and Cosumnes River at Michigan Bar (1962-1970). Episodic measurements of suspended load are available for Yolo Bypass near Woodland (1957-1961), Cosumnes River at McConnell (1965-1967), and Mokelumne River at Woodbridge (1974-1994). Suspended sediment composition data found for the Sacramento and Cosumnes Rivers are presented in Figure 14. As is apparent from the figure, suspended sediments in the Delta streams are mostly composed of clay, silt, and fine sand.

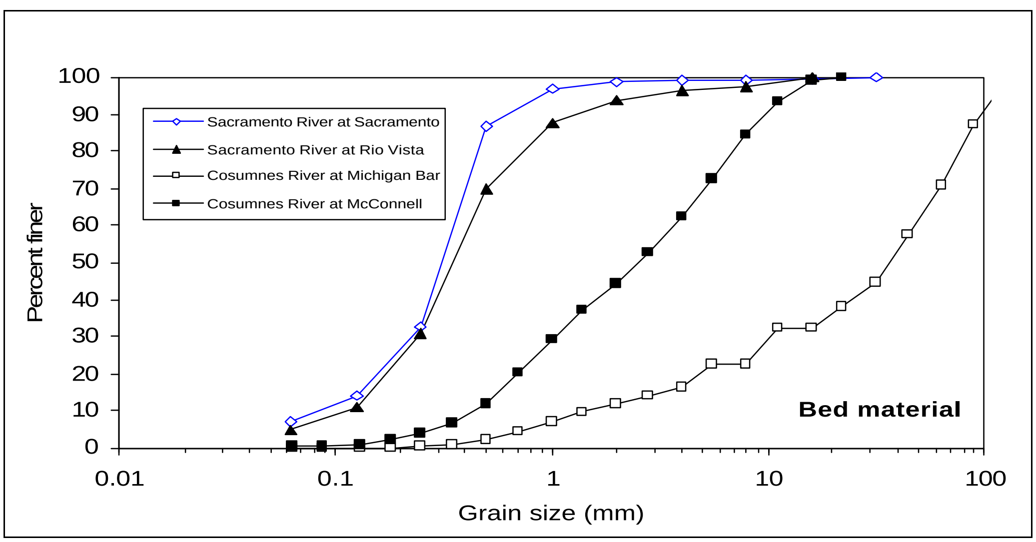


Figure 13. Grain size distribution of bed material from the Sacramento and Cosumnes Rivers

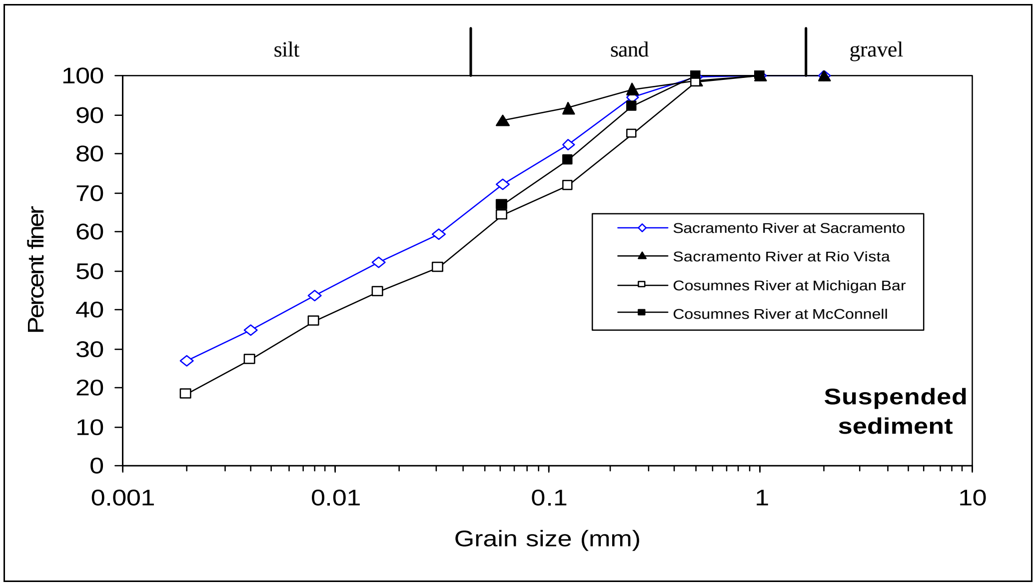


Figure 14. Grain size distribution of suspended sediment from the Sacramento and Cosumnes Rivers

5.2 Sediment Sampling by NHC

Northwest Hydraulic Consultants collected bed material samples from within the study area in October of 2003 and September of 2004. The material collected during 2003 was taken from the network of channels surrounding Dead Horse Island north of Staten Island. Analysis of the sediment was performed by Raney Geotechnical in order to develop grain size distribution curves. The samples collected in 2004 were not quantified by sizing, but rather evaluated qualitatively in the field. The main goal of this sampling was to determine the general composition of the sediments in the North and South Forks of the Mokelumne.

5.2.1 2003 Sediment Sampling

NHC collected bed material samples in the North Delta near Dead Horse Island for sieve analysis in 2003. The locations of sampling sites are presented in Figure 15, and the resulting cumulative grading curves of the analyses are presented in Figure 16. As shown in the figure, the bed material samples consisted mainly of medium to fine sands with silt and organic material deposited in low energy areas, such as Dead Horse Cut, portions of Snodgrass Slough, and the North Mokelumne River above Snodgrass Slough. No sediment samples were taken from Snodgrass Slough at North Mokelumne River due to a thick layer of cockle-shells that exists there.

5.2.2 2004 Sediment Sampling

Bed samples were collected in the lower reaches of Georgiana Slough and from the North and South Forks of the Mokelumne River in 2004 to determine the general composition of the sediments in those regions. The sampling indicated that the lower ends of these rivers contain mostly silt with a little fine sand that formed a foamy mud on the bottom of the rivers. Samples taken just downstream of the Walnut Grove Road Bridge from the

North and South Forks of the Mokelumne, however, consisted of medium and fine sands with a little silt, indicating that a significant sediment interface exists in these reaches. The transition zone occurred approximately 1.5 miles south of the bridge on the North Mokelumne and near Beaver Slough on the South Mokelumne.

5.3 Flow Measurement Sampling

Discharge measurements were taken at ten locations within the North Delta study area on June 9th and 10th, 2004. Flowrates in each channel reach were measured using an acoustic doppler channel profiler (ADCP) attached to the bow of a small boat. Most measurements of flow into a junction were taken within a few minutes of each other, so that tidal effects were minimized. The locations of the flow sampling sites are also presented in Figure 15. The results of the discharges measurements at the four junctions

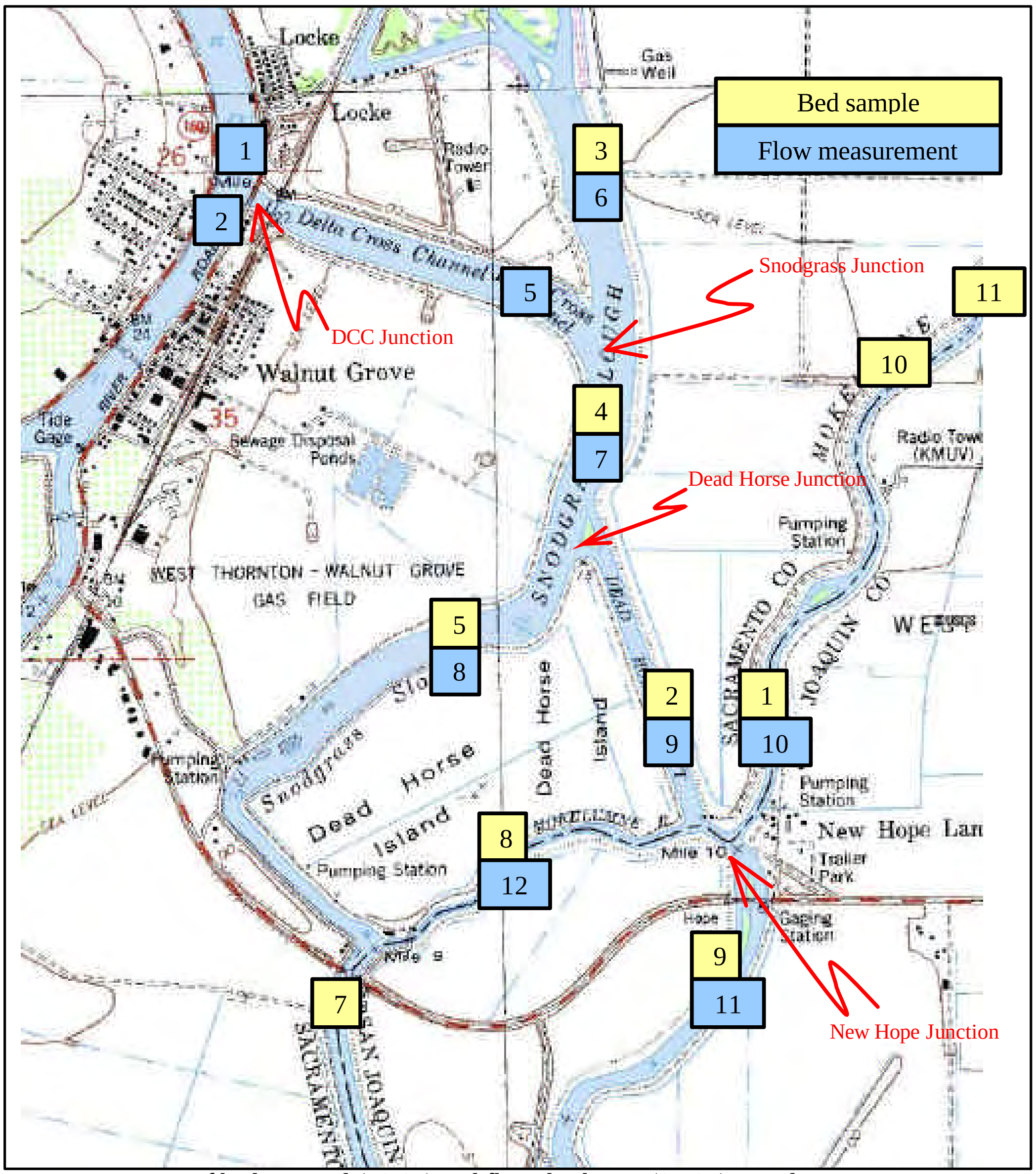


Figure 15. Location of bed material (10/03) and flow discharge (06/04) sampling sites in project area

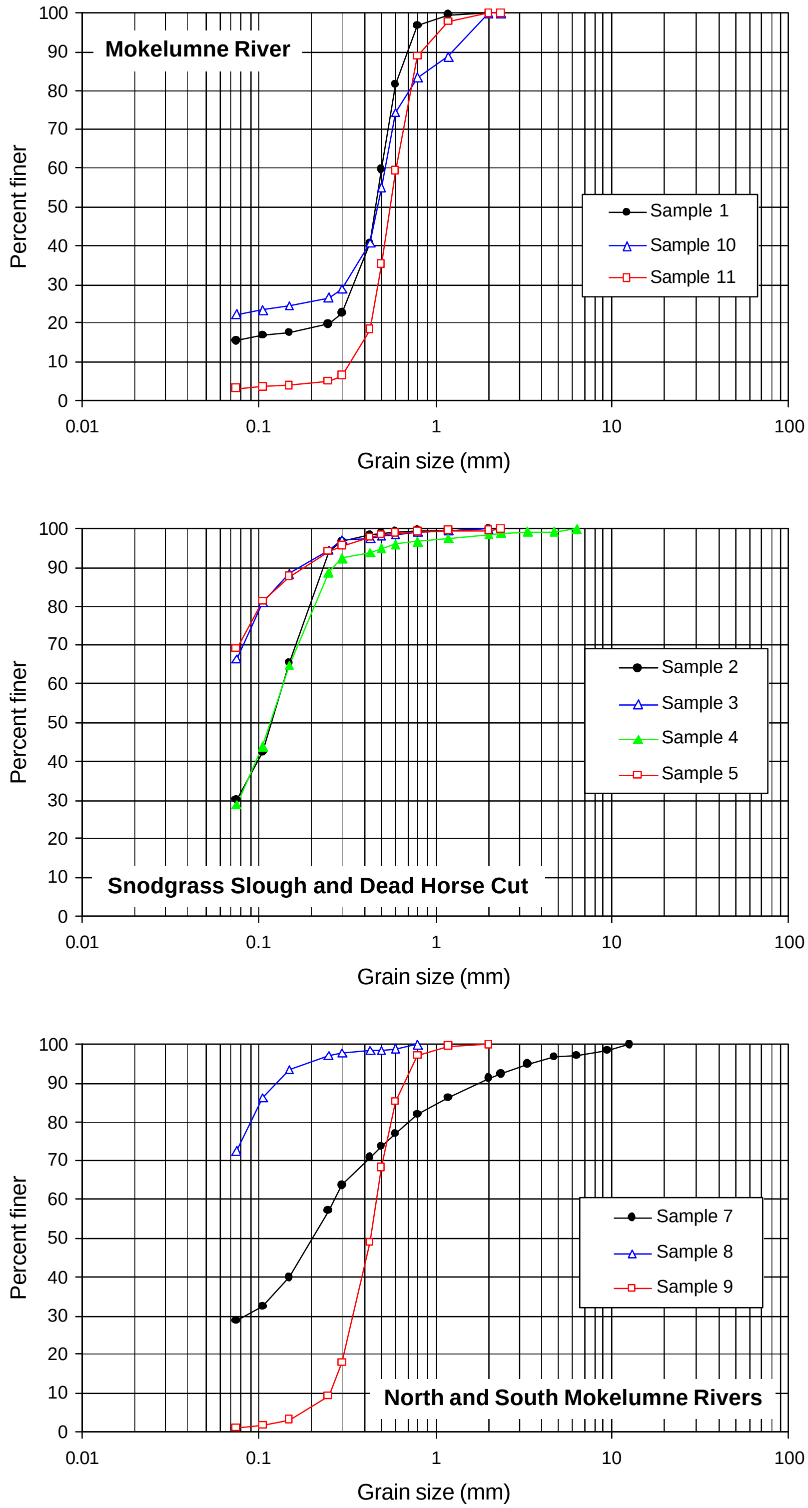


Figure 16. Bed material composition from North Delta sites shown in previously in Figure 15

are presented in Tables 2a through 2d. The column *diff Q* in the tables represents the net sum of flow into and out of a junction. This residual flow is due mainly to tidal fluctuations in the Delta that strongly affected both stage and discharge at each junction. Additional differences may also be attributed to instrument precision.

Table 2a. Measured discharges near the Delta Cross Channel Junction†

Junction: **Delta Cross Channel**					
Day	Sampling Time	Reach 1 (cfs)	Reach 2 (cfs)	Reach 5 (cfs)	diff Q (cfs)
Jun 09	11:13-11:36	9500	-	-3900	-
Jun 10	11:06-11:24	8400	-1400	-7300	-300
Jun 10	13:02-13:28	10700	-8800	-3100	-1200
Jun 10	15:17-15:55	13500	-11500	-2200	-200

Table 2b. Measured discharges at Snodgrass Slough Junction†

Junction: **Snodgrass**					
Day	Sampling Time	Reach 5 (cfs)	Reach 6 (cfs)	Reach 7 (cfs)	diff Q (cfs)
Jun 09	12:09-12:48	1200	2200	-3000	400
Jun 10	11:06-11:57	7300	-2600	-4600	100
Jun 10	12:24-13:07	3100	-800	-3100	-800
Jun 10	15:12-15:37	2200	2100	-4300	0

Table 2c. Measured discharges at near Dead Horse Island†

Junction: **Dead Horse**					
Day	Sampling Time	Reach 7 (cfs)	Reach 8 (cfs)	Reach 9 (cfs)	diff Q (cfs)
Jun 09	10:08-10:40	3300	-2300	-1200	-200
Jun 10	10:29-10:48	4600	-3000	-1600	0
Jun 10	12:04-12:29	3300	-2500	-1200	-400
Jun 10	14:52-15:15	4300	-3400	-1000	-100

Table 2d. Measured discharges at near New Hope Landing†

Junction: **New Hope Landing**						
Day	Sampling Time	Reach 9 (cfs)	Reach 10 (cfs)	Reach 11 (cfs)	Reach 12 (cfs)	diff Q (cfs)
Jun 09	9:31-10:12	1200	-1100	-500	200	-200
Jun 10	10:01-10:31	1600	-1000	-1000	300	-100
Jun 10	11:38-12:07	1200	-600	-700	-40	-140
Jun 10	14:29-14:54	1000	1000	-1300	-600	100

†*Measured discharges at channel junctions presented in Figure 15 (positive signifies flow into junction)*

Section 6.0

Sediment Budget of the Delta

A preliminary sediment budget for the Sacramento-San Joaquin Delta was estimated by Northwest Hydraulic Consultants using available sediment data, rating curves, and established sediment transport equations. Annual suspended sediment loads were determined using USGS suspended sediment data collected in 1998 (high-flow year) and 1999 (average-flow year) from the Sacramento, San Joaquin, Mokelumne, and Cosumnes Rivers, and from the Yolo Bypass, Delta-Mendota Canal, and Suisun Bay. Annual bed loads were established indirectly using the *Levi* sediment transport equation.

It is worthwhile noting that the estimation of a sediment budget for a system as large and complex as the Delta is subject to high degrees of uncertainty, and the results presented here should be viewed accordingly.

6.1 Suspended Sediment

The annual suspended sediment contribution of the Sacramento River was calculated using daily time series data collected at the Freeport sediment gauge. Annual suspended sediment yields in the San Joaquin River were calculated using daily data available from the Vernalis gauge. Suspended loads passing through the Sacramento Weir to the Yolo Bypass were calculated using daily flow data for the weir and daily suspended sediment concentrations from the Sacramento and Freeport gauges. Suspended sediment concentration at the weir was assumed to be 0.78 of the concentrations at Sacramento and Freeport (Porterfield, 1980).

Annual suspended loads in Yolo Bypass near Woodland, Cosumnes River at Michigan Bar, Mokelumne River at Woodbridge, and Delta-Mendota Canal near Tracy were estimated using daily flow time series data and sediment rating curves developed from episodic measurements of suspended load. Suspended sediment outflow from the Delta to the Clifton Court Forebay and further to the California Aqueduct was estimated using daily flow data for the Banks Delta Pumping Plant and a suspended load rating curve obtained for the Delta-Mendota Canal. It was assumed that the suspended sediment concentration at the water intakes was the same for both water export facilities.

6.2 Bed Load

The bed load data collected by the USGS in the Sacramento River and in Threemile Slough (Dinehart, 2000) are limited in volume and range, which prevents accurate estimation of the bed load yield using the measured data alone. However, these data provide a useful basis for selection of a bed load transport formula most appropriate for the conditions of Delta streams. Since hydraulic data from Delta streams usually contains both flow and stage information at a station, and due to the complex and highly sensitive flow behaviors exhibited in the tidally influenced Delta, six bed load transport formulas based on the flow-velocity concept were considered. Of the six, the Levi (1957) formula proved to be most accurate at predicting the bed load of the Sacramento River at Freeport. Using metric units, the formula can be expressed by:

$$q_b = 2\left(\frac{V}{\sqrt{g\,D}}\right)^3 D\left(V - V_c\right)\left(\frac{D}{h}\right)^{0.25} \tag{1}$$

where q_b is the bed load transport rate per unit channel width (kg/s/m); V is the average flow velocity (m/s); V_c is the critical average flow velocity at which bed load transport begins (m/s), defined as

$$V_c = 1.4\sqrt{g\,D}\,\log\frac{12h}{D_{90}}\left(\frac{D}{D_{max}}\right)^{0.1} \text{ for } \frac{h}{D_{90}} > 60\text{, and}$$

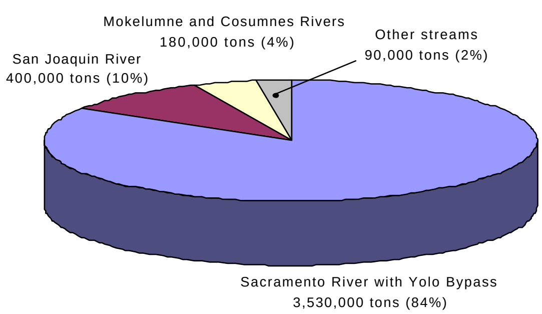
$$V_c = 1.4\sqrt{g\,D}\left(0.8 + 0.67\log\frac{10h}{D_{90}}\right)\left(\frac{D}{D_{max}}\right)^{0.1} \text{ for } 10 \le \frac{h}{D_{90}} \le 60 \tag{2}$$

where g is gravitational acceleration (9.81 m/s^2); D is the median grain size (m); D_{max} is the maximum grain size (usually D_{95}) of the bed material (m); D_{90} and D_{95} are the grain sizes for which 90 and 95% of sediment is finer (m); and h is the flow depth (m).

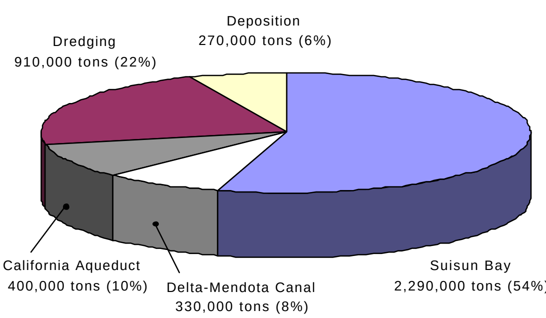
Equation (1) was used together with flow and stage data downloaded from the USGS and DWR databases, and bathymetry data from NOAA, USCOE, USGS, and DWR. Discrete bed load volumes were calculated at 15-minute to 24-hour intervals, depending on the resolution of the available flow and stage data, and then summed together to obtain annual yields.

6.3 Annual Sediment Budget Estimate

Figure 17 presents the results of the sediment budget estimate developed for various discrete locations in the Sacramento-San Joaquin Delta. The figure demonstrates that the Sacramento River system including the Yolo bypass is the primary supplier of sediment to the Delta. The average annual sediment inflow from the Sacramento River system is



(A)



(B)

Figure 17. Average annual inflow (A) and outflow/dredging (B) of sediments in Delta

about 3,530,000 tons, or 84% of the total sediment inflow to the Delta. The San Joaquin River system supplies about 400,000 tons of sediment and the Mokelumne River system supplies 180,000 tons of sediment. An allowance of 90,000 tons per year was added for other streams and creeks not covered by the present analysis (Porterfield, 1980). Bed load supply is 151,000 tons for the Sacramento River, 79,000 tons for the San Joaquin River, and about 8,000 tons for the Mokelumne River. For these calculations, bed load outflow through the Delta-Mendota Canal and California Aqueduct was ignored. Although bed load constitutes only 4% to 20% of the total sediment load in the Sacramento, San Joaquin, Mokelumne, and Cosumnes Rivers, bed load transport is believed to be the main factor determining channel evolution (fill and scour of the channel bed) in the Delta.

On average, an estimated 2,290,000 tons (54%) of the average annual sediment supply to the Delta is transported to Suisun Bay and 730,000 tons (18%) is exported through water export facilities to Delta-Mendota Canal and California Aqueduct. An estimated 1,180,000 tons (28%) of the sediment supplied is deposited in the Delta each year. About 910,000 tons (22%) is dredged for navigation and levee maintenance purposes. Figure 18 presents the findings geographically.

Using the estimates above, a remainder of approximately 270,000 tons (6%) of sediment per year on average would be deposited in the Delta. Based on analyses of cross sections and data published in DWR’s Scour Monitoring Programs (DWR, 1993 and DWR, 2000), it appears that the majority of this deposition is occurring in the South Delta rather than in the north. However, additional analysis and data collection are necessary to confirm this apparent trend.

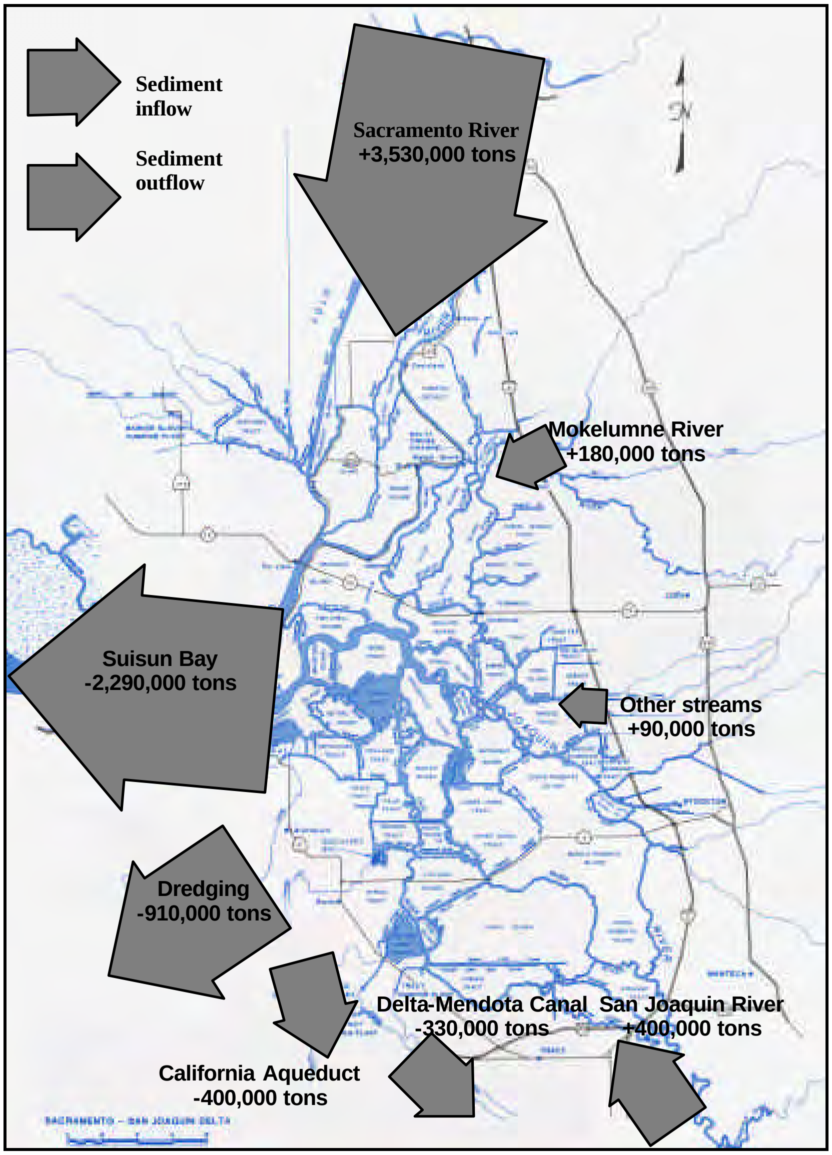


Figure 18. Estimated annual sediment budget for Sacramento-San Joaquin Delta

Section 7.0
Sediment Assessment for 1995 and 1997 Floods

The sediment assessment conducted for streams and sloughs within the North Delta Improvement Project study area was performed as a part of the Task 2 "Sediment Assessment." The work included initial estimation of sediment transport capacities of the channels comprising the NDIP area under a range of flow conditions, using results from the existing conditions HEC-RAS model of the North Delta developed and provided by MBK Engineers.

7.1 Background

The study area for which sediment assessment was conducted is shown in Figure 19. Sediment transport was calculated for two flood events lasting from 8 March 1995 to 17 March 1995 and from 29 December 1996 to 9 January 1997. Calculations were performed for selected representative cross sections of the streams comprising the study area including the Mokelumne River, North Mokelumne River, South Mokelumne River, Dead Horse Cut, Snodgrass Slough, Lost Slough, and Georgiana Slough. The cross sections at which sediment transport was calculated were selected on straight river reaches in the vicinity of the main stream junctions. A few additional cross sections were selected on the streams upstream and downstream of the study area to estimate sediment transport variability along the streams. Cross section geometry and flow hydraulic data were obtained from the HEC-RAS model.

7.2 Assumptions

The transport calculations were performed using the Ackers-White (1973) transport function as modified by Ackers (1993). This transport function predicts total sediment load, which includes sediment transported both in suspension and as bed load. The function is based on a large set of experimental data and is often used for calculation of sand material transport. A mean sediment grain size of D_{50}=0.5mm was established using Bed Sample 1 (see Figure 16) to represent the parent bed material and section-average hydraulic parameters were used in the calculations to estimate sediment transport capacity of different channels.

7.3 Results

Calculated sediment yields for the 1995 and 1997 flood events are also summarized in Figure 19. Cross section geometry, maximum water surface elevations during the two flood events, and calculated relationships between sediment load and flow velocity are shown in Figure 5. According to the calculations, net sediment transport capacities in the tidally affected North Delta channels varied from practically zero (Dead Horse Cut) to 25,000 metric tons (Georgiana Slough) during the 1995 flood and up to 56,000 metric tons (North Mokelumne River) during the 1997 flood. Transport capacities vary

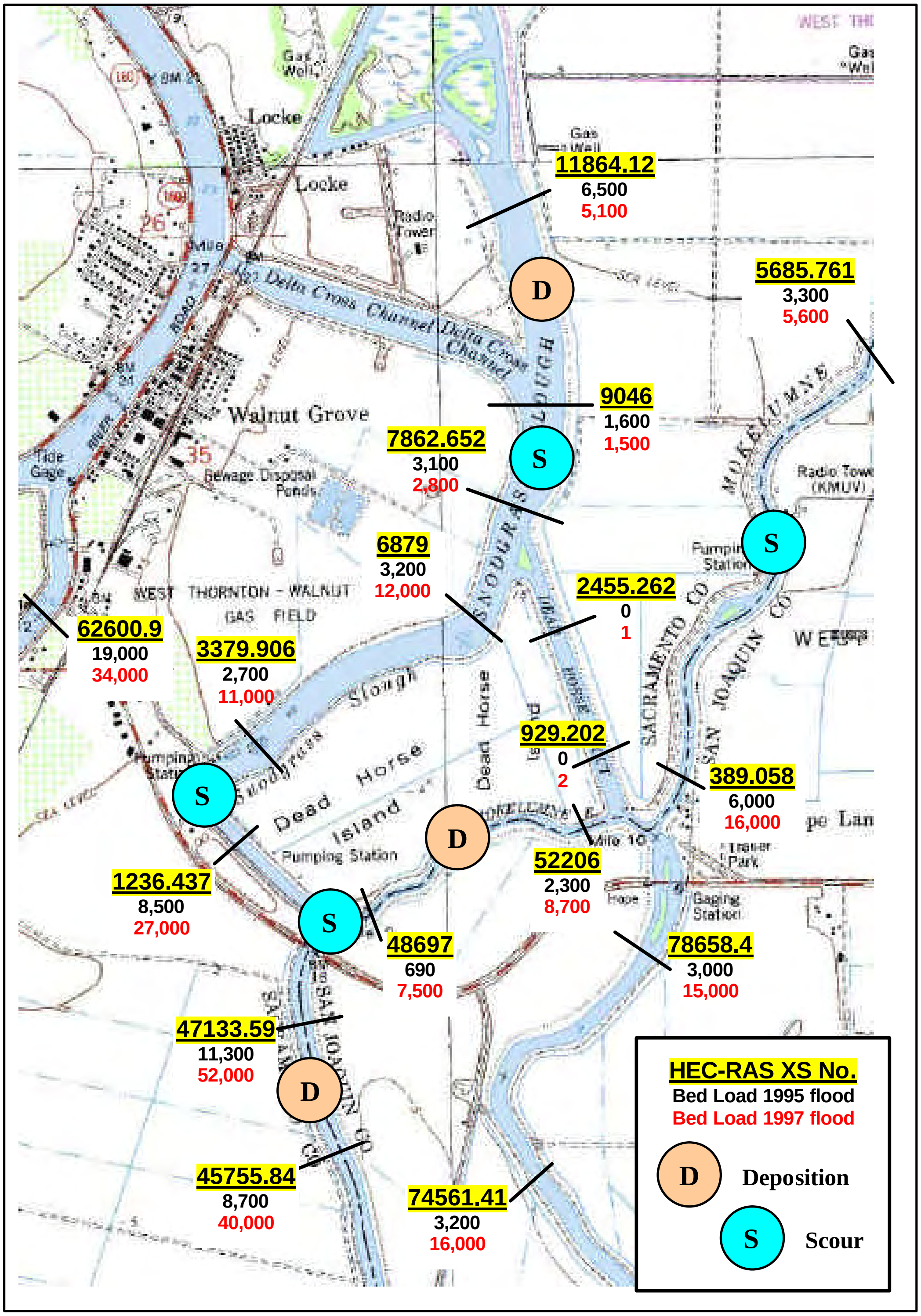


Figure 19. Calculated potential sediment yields (in metric tons) during 1995 and 1997 flood events, including reach tendencies to deposit or scour sediment

significantly along the streams, depending on local channel conditions and tributaries supplying or diverting water and sediment. In the Mokelumne River, sediment transport capacity generally increases in the downstream direction. In the North Mokelumne River, transport capacity increases abruptly below Snodgrass Slough. Fairly uniform longitudinal distribution of transport capacity is obtained for the South Mokelumne River and Georgiana Slough. Although some sediment can be transported by tidal flows up and down Dead Horse Cut, net sediment transport here is practically zero. In Snodgrass Slough, transport capacity reduces in the vicinity of Dead Horse Cut and increased at North Mokelumne River. Variable capacity is obtained along Lost Slough.

In most of the channels higher transport capacities are obtained for the extremely high 1997 flood. During this flood levees were overtopped in some reaches, which resulted in significant volumes of water entering inside areas of islands and tracts. Filling and draining of the floodplain storage areas resulted in complex, atypical streamflow and sediment transport conditions through the North Delta channel network during the 1997 flood event. Therefore, the 1997 flood data are not suitable for sediment budget assessment within some of the North Delta channels. The sediment transport data calculated for the 1995 flood, which was conveyed within the channel boundaries, were primarily used here to identify reaches where significant scour or deposition during high flow events is likely. Potentially depositional/scour reaches of the North Delta are shown in Figure 19. Potential streambed scour is obtained for the lower Mokelumne River at New Hope Landing, Snodgrass Slough between Delta Cross Channel and Dead Horse Cut, narrow channel of Snodgrass Slough at North Mokelumne River, and at confluence of Snodgrass Slough and North Mokelumne River. Potential sediment deposition is obtained for Snodgrass Slough above Delta Cross Channel, North Mokelumne River between Dead Horse Cut and confluence with Snodgrass Slough, and North Mokelumne River below Snodgrass Slough.

Section 8.0
Long-Term Sediment Transport and Channel Morphology Modeling

Sedimentation in the streams and channels of the North Delta is controlled by a complex sequence of events and physical processes that occur over vast distances and on a wide range of time scales. Modeling such a system over the long-term, in a deterministic sense with confidence, is simply not possible. However, it is possible to develop a simplified model of sediment transport in the Delta by identifying and quantifying some of the significant variables affecting sedimentation, so that trends can be revealed and ultimately predicted.

Northwest Hydraulic Consultants investigated the long-term sediment dynamics of the study area associated with the North Delta Flood Control and Ecosystem Restoration Project to better understand the existing system conditions and to evaluate the effects of proposed flood control and restoration alternatives. The analyses were performed using an enhanced MIKE11 model originally developed by researchers at the University of California, Davis. The sediment transport modeling capability was added to the MIKE11 model using DHI’s ST module. The goal of the investigation was to develop a sediment transport model extending from upper MWT to the San Joaquin River that could identify sedimentation rates and changes to those rates due to proposed flood control and restoration alternatives for the region. All modeling described in this report was performed using the 2003 version of DHI’s MIKE11 model.

8.1 Sediment Transport Modeling Background

Engineering analysis of erosion and sedimentation is based on Newtonian mechanics applied to moving fluids and sediment particles. Non-cohesive sediment transport assumes that the sediment in a channel is made up of individual particles or grains that do not interact chemically or electromagnetically. Only mechanical forces are assumed to affect the particles, which include the force of moving water, particle collisions, and gravity.

Sediment transport of non-cohesive particles is often categorized using three transport modes: bed load, suspended load, and wash load. The bed load is that portion of sediment transported by bumping and rolling along the bed of the channel. This typically includes coarser sands, rocks, and gravels. Suspended load is transported within the mean flow above the bed and is usually made up of finer sands and silts. Wash load is the term used to describe the fraction of the suspended load that is made up of very fine material, such as fine silts and clays. This sediment is so fine that it tends not to settle out even under low flow conditions, and it usually transported all the way through the system. Each of these sediment loads and their relative position within the water column are depicted in Figure 20.

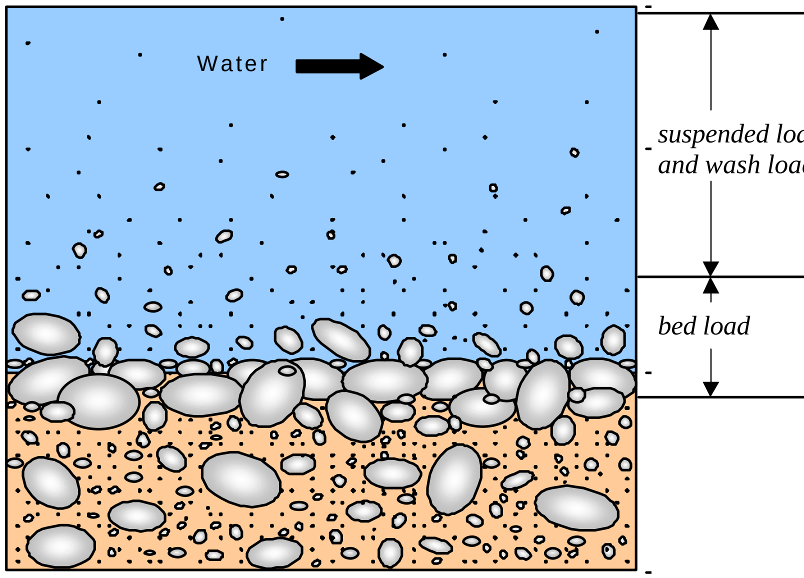


Figure 20. Non-cohesive sediment transport classification

Sediment transport in rivers is modeled using a variety of equations, techniques, and rules of thumb that have been proposed by various researchers over the years. Due to the extremely complex nature of sediment transport, commercially available software packages typically employ simplified empirical and semi-empirical formulas to estimate transport rate based on grain size and local flow conditions. Specific inputs and levels of sophistication vary among the methods, but the output is generally sediment flow rate at a station, with units such as tons per day or liters per second. Because most sediment transport equations provide a deterministic answer to a chaotic and probabilistic event, it is always important to ruthlessly review the results and make sure that the solution makes physical sense.

8.2 MIKE11 Model Setup

The MIKE11 modeling package includes a non-cohesive sediment transport module (ST) which tracks the movement, erosion, and deposition of sediment in river channels. The program allows the user to choose from several standard sediment transport equations that estimate the local rate of scour/deposition based on sediment properties and other hydraulic parameters. The ST module also includes a morphological component that updates the geometry of local cross sections at each time step to simulate deposition and erosion within the system. Sediment transport at a station can be calculated either separately as bed load and suspended load, or together as total load. The model also allows the definition of multiple grain sizes within a reach, to better describe grain-size distributions and to more accurately model mobilization of the bed. The ST module of MIKE11 is appropriate for tracking bed material loads consisting of fine sands and larger particles. Wash load transport and deposition rates were, therefore, calculated separately as described in Section 9 of this report.

8.2.1 North Delta Model Description and Limitations

The North Delta sediment transport model was developed to identify and evaluate changes in sedimentation due to proposed flood control and habitat restoration alternatives. It was operated as an add-on to the existing MIKE11 hydraulic model of the North Delta, which contained all of the channel geometry and network connections for the system. Due to the sheer size of the modeling domain, the resolution of the geometry in the original hydraulic model was rather coarse, especially for sediment transport modeling. However, since the primary goal of the investigation was to evaluate relative differences between alternatives and not to predict exact sediment transport quantities, the resolution was deemed sufficient.

8.2.2 Modeling Domain

The modeling domain of the North Delta sediment transport model is smaller than that of the MIKE11 hydrodynamic model (see Figure 21). It was reduced because of numerous numerical problems that arose in the upstream sections near bridges and around link channels commonly used in MIKE11 to simulate levee breaches and levee overtoppings. Due to a programming flaw, MIKE11 sometimes assumes a cross sectional area of $1m^2$ for link channels when calculating sediment flow splits at a junction. This forces most of the sediment to flow directly past the link channel and to be deposited immediately downstream due to a decrease in flowrate. The sediment deposits quickly grow to unreasonable heights and eventually cause the model to crash. Since it was noted that the link channels were an integral part of the North Delta hydraulic model developed by

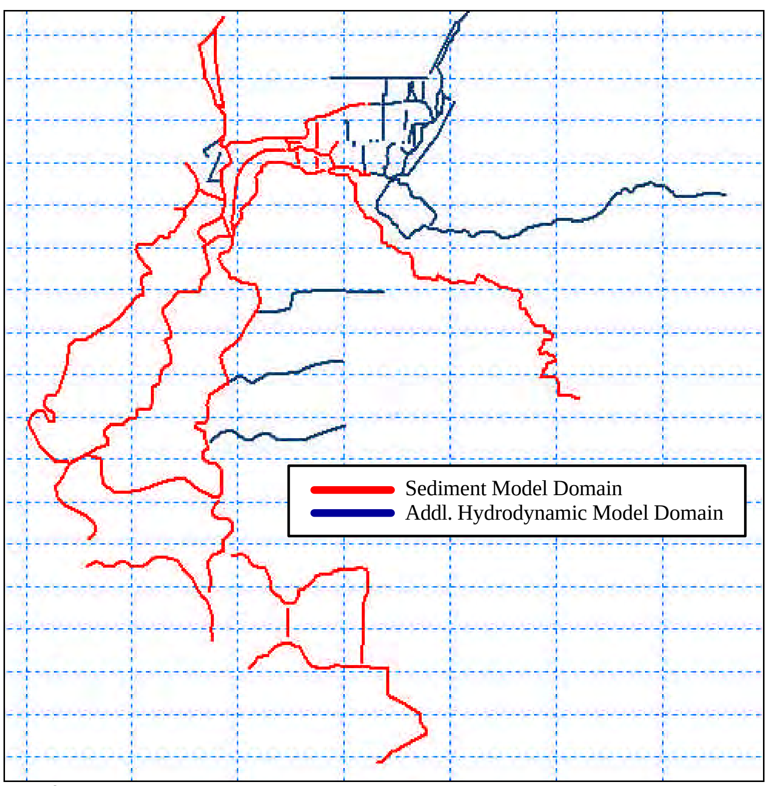


Figure 21. Domain of sediment transport and hydrodynamic models (upper Cosumnes reaches not shown)

UCD and could not be simply removed, the domain of the sediment transport model was reduced instead by excluding some channels near and to the east of Highway 5.

8.2.3 Representative Grain Sizes

Due to the size of the study area and the resolution of the model, it was deemed practical to use a single sediment grain size per channel to represent the local bed material for the base model. However, a multiple grain size model which used three grain sizes per channel was also developed. The multiple grain size model proved to be highly unstable and cumbersome to operate, and the results did not differ substantially from those of the single grain model.

Figure 16 in Section 5 presented the grain size distributions of bed samples taken by NHC around the project area. Different representative grain sizes were used in the model, depending on the location of a particular reach. A relatively large grain size of D_{50}=100mm was used on all the Cosumnes reaches upstream of Grizzly Slough to avoid numerical instabilities that commonly occurred in these steeper sections. Preliminary modeling results demonstrated that the exclusion of the upstream channels from the sediment calculations did not significantly affect the transport rates calculated around MWT and below. The Mokelumne and Sacramento Rivers were modeled using a medium sand of D_{50}=0.4mm. Snodgrass Slough and Dead Horse Cut were modeled using D_{50}=0.25mm, and all other channels downstream and to the west of MWT were modeled using a finer sand of D_{50}=0.1mm. The standard deviations of the grain size distributions in each channel were assumed to be equal to the grain sizes themselves.

8.2.4 Transport Equations

The ST module in MIKE11 provides the user with the option to calculate bed load and suspended load separately, or together as total load using a single equation. Due to the size and hydraulic complexity of the North Delta model, a single total load approach was used. The Ackers and White transport formula was used in the calculations due to its applicability to sand bed rivers. The sensitivity of model to the Ackers and White equation was evaluated by also running the model using Engelund and Hansen's formula.

8.2.5 Passive channels

Many of the channels that were defined as having over-sized bed material (D_{50}=100mm) were defined as passive channels within the model. This sped up the calculation process and reduced total run times. According to MIKE11 literature, this setting essentially causes the channel to be eliminated from sediment transport calculations. Sediment is allowed to enter the reach, but disappears and never reenters the system. Passive channels may be though of as sediment traps. However, despite the insistence by Danish Hydraulic Institute representatives that this option functions normally in the most recent model version, sediment was observed to be transporting through and exiting out of passive reaches in the North Delta model. However, the fact that the passive channel option did not appear to be functioning properly did not affect the general results of the model.

8.2.6 Boundary Conditions

The sediment transport module of MIKE11 requires sediment boundary conditions at all flow boundaries. Since all of the model's hydraulic inflow boundaries are far from the sediment transport model's area of interest, it was deemed acceptable to define each sediment boundary as flowing at the channel's full sediment transport capacity. For the Cosumnes River, Deer Creek, and Dry Creek, this implied an input of almost zero since the bed material was defined as very large to avoid sediment transport calculations there. The Mokelumne and Sacramento Rivers, however, do exhibit sediment transport at their inflow boundaries.

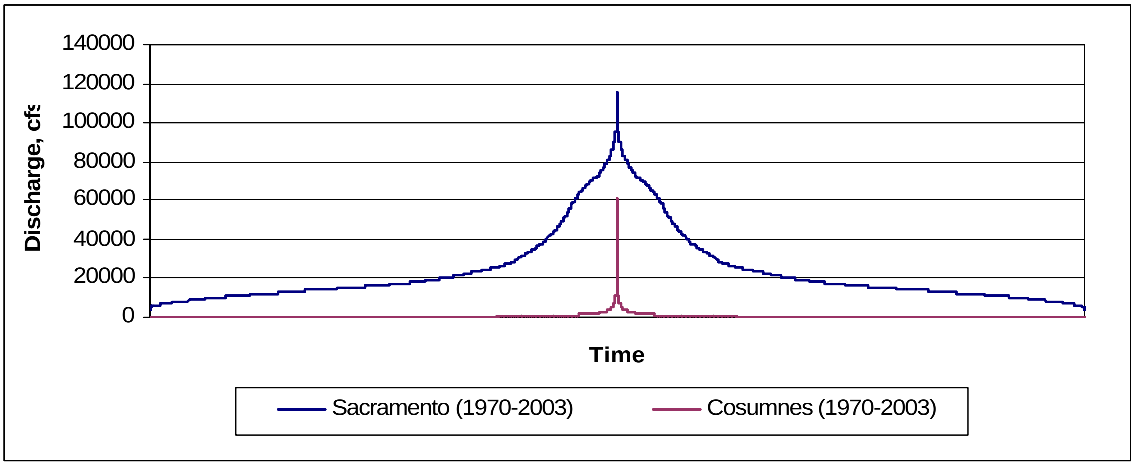
8.2.7 Hydrodynamics

The principal objective of the sediment transport modeling was to investigate existing conditions in the project area and to compare differences in sedimentation due to the implementation of the proposed project alternatives. It was, therefore, necessary to develop a model that could evaluate the sedimentation patterns and geometric evolution of the project area over the long-term. To achieve this, synthetic flow hydrographs were developed for each of the five major hydraulic inputs into the North Delta: the Sacramento, Cosumnes, and Mokelumne Rivers, and Deer and Dry Creeks. The representative synthetic hydrographs were created from flow duration curves that used daily mean flow data collected by the U.S. Geological Survey. Table 3 presents the various periods of record used to develop the flow duration curves and associated representative synthetic hydrographs, which are shown in Figure 22.

In order to be sure that the representative synthetic hydrographs adequately described flow conditions for sediment transport modeling purposes, a comparison was performed of the sediment transport rate predicted by the model using actual annual hydrographs verses using the synthetic hydrographs based on the same data. The actual hydrographs were developed using hourly flow and stage data obtained from websites operated by the California Department of Water Resources. Hydrographs that best represented a typical water year were arbitrarily chosen for each upstream boundary, such that the water years of inflows do not necessarily match. Data from the same water year (1999) was used to model all of the downstream tide boundary conditions. Table 4 presents the data used for each boundary in the model. Figure 23 presents each real hydrograph together with the associated synthetic hydrograph developed using the same data set.

Table 3. USGS stage data used to develop flow duration curve hydrographs for long-term modeling

Upstream Boundary	*USGS Station No.*	*Period of Record*
Sacramento River at Freeport	11447650	1970-2003
Cosumnes River at Michigan Bar	11335000	1970-2003
Mokelumne River at Woodbridge	11325500	1970-2003
Dry Creek near Galt	11329500	1960-1997
Deer Creek near Sloughhouse	11335700	1960-1977



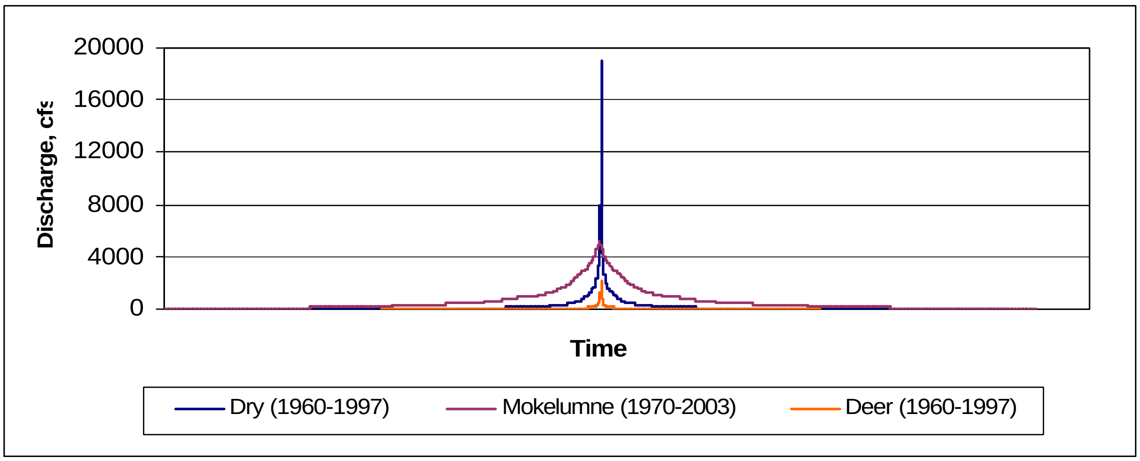


Figure 22. Representative synthetic hydrographs developed for Dry Creek, Mokelumne River, and Deer Creek using data from the period of record specified

Table 4. One-year flow and stage data sets used to validate similarity of sediment transport predictions between modeling based on actual hydrographs and representative synthetic flow hydrographs

Boundary Name	*B.C. Type*	*Source*	*Name*	*Data Year*
Sacramento R. u.s. of Delta CC	u.s.	IEP† (DWR)	RSAC128	1999
Cosumnes R. at Michigan Bar	u.s.	CDEC‡ (DWR)	MHB	2000
Mokelumne R. at Woodbridge	u.s.	USGS*	11325500	2000
Dry Creek near Galt	u.s.	USGS*	11329500	1980
Deer Creek at Highway 32	u.s.	CDEC‡ (DWR)	DCH	1970
Sacramento d.s. of Georgiana Sl.	d.s.	IEP† (DWR)	RSAC123	1999
San Joaquin at Rindge Pump	d.s.	IEP† (DWR)	RSAN052	1999
San Joaquin River at Venice Island	d.s.	IEP† (DWR)	RSAN043	1999
San Joaquin R. at San Andreas	d.s.	IEP† (DWR)	RSAN032	1999

†Interagency Ecological Program, http://iep.water.ca.gov
‡California Data Exchange Center, http://cdec.water.ca.gov/
*U.S. Geological Survey, http://water.usgs.gov/

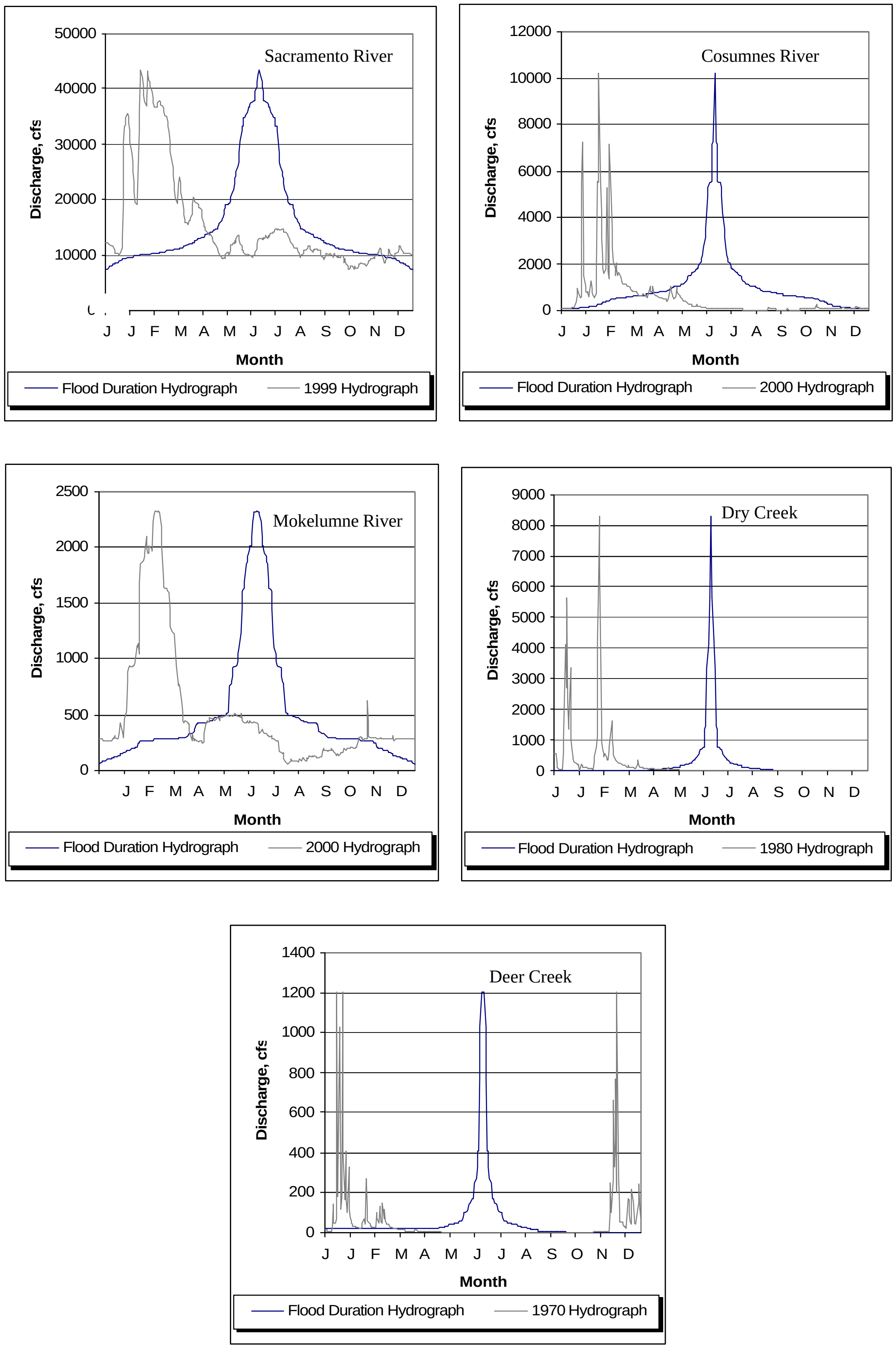


Figure 23. Comparison of actual annual hydrographs and representative synthetic hydrographs used to validate the simplification of inflow hydrology in MIKE11 sediment models

A direct comparison of the sediment transport results obtained using the actual hydrographs for the North Delta and the representative synthetic hydrographs revealed only minor differences. In addition, since nearly all the sediment transport occurred during the top 10% of annual discharges, the results indicated that it would be necessary to model just the peak 10% of the flood duration curve to obtain the effective transport results.

8.2.8 Specific Geometry Changes Made to MIKE11

Several specific changes were made to the North Delta geometry files to make the MIKE11 model better suited for sedimentation modeling. Due to problems that MIKE11 had when routing sediment past bridges, all bridge structures were removed from the model. Although this affects the local hydraulics of the flow in the model, such minor alterations in geometry should not have a wide-ranging effect on general reach averaged sedimentation patterns over the long-term simulations completed for this analysis.

Additionally, since sediment transport was shown to occur almost entirely in the highest 10% of annual discharges, it was deduced that the Delta Cross Channel gates would be closed during all sediment modeling scenarios.

8.3 Baseline Model and Initial Results

A baseline sediment transport model was originally developed to test the sensitivity of the model setup and to verify the model's results against observed data. A ten-year time interval was chosen as a simulation period for the baseline model so that the length of its results would be of the same order of magnitude as the seven years of cross section scour data available through DWR. Because the period of record for the DWR scour data is short, it can not be used to define long-term erosion or accurately describe depositional trends in the system. However, a reasonable qualitative assessment of the model's performance was made by comparing its predictions to the observed data set. Because the model must calculate sediment transport in the system over a period of years, the run time was shortened considerably by ignoring the lower 90% of flows from the flood duration curve hydrographs since these flows were shown to have little or no effect on sediment transport in the MIKE11 model.

Figures 24a and 24b present the mean elevations of specific scour cross sections surveyed by DWR from 1994 to 2001 combined with the mean channel elevations predicted by the model for 2002 to 2012. The location of each cross section in the North Delta study area can be found in Figure 4 (Section 3). The figures demonstrate the reasonable agreement that exists between the observed data and elevations predicted by MIKE11 for channel reaches to the west of Highway 5. Sediment transport in the channels east of Highway 5 was not evaluated due to instabilities in the model.

Examination of the figures reveals a rapid initial change in bed elevation in some cross sections at the beginning of the simulation. This is mainly due start up instabilities in the sedimentation routine as the model establishes an equilibrium state. Near junctions, these exaggerations can be profound, sometimes resulting in large sediment deposits or deep scour holes. However, over time, these initial shocks generally subside.

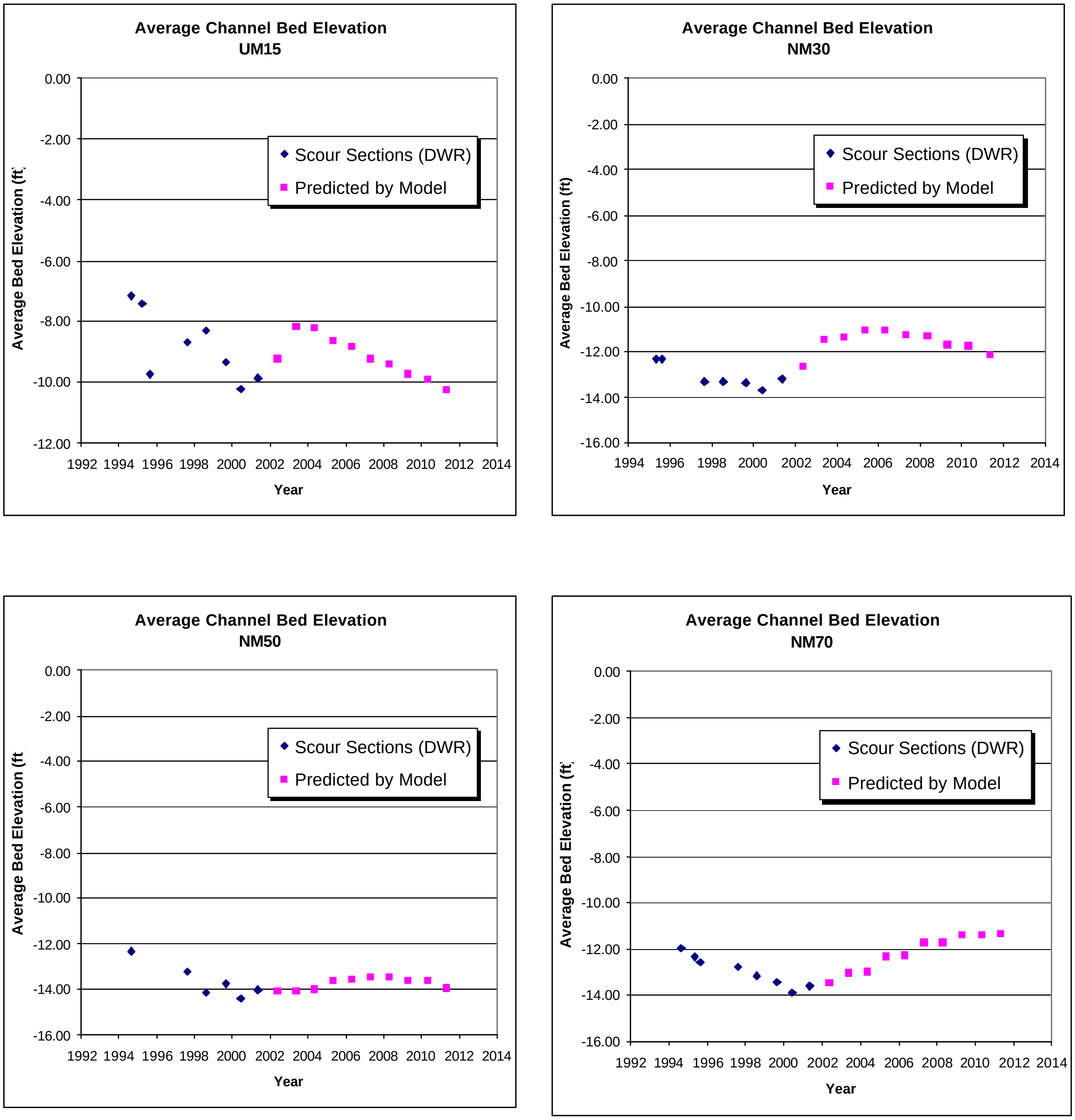


Figure 24a. Historical mean elevations of channels (DWR) combined with elevations predicted by model (cross section locations shown in Figure 4)

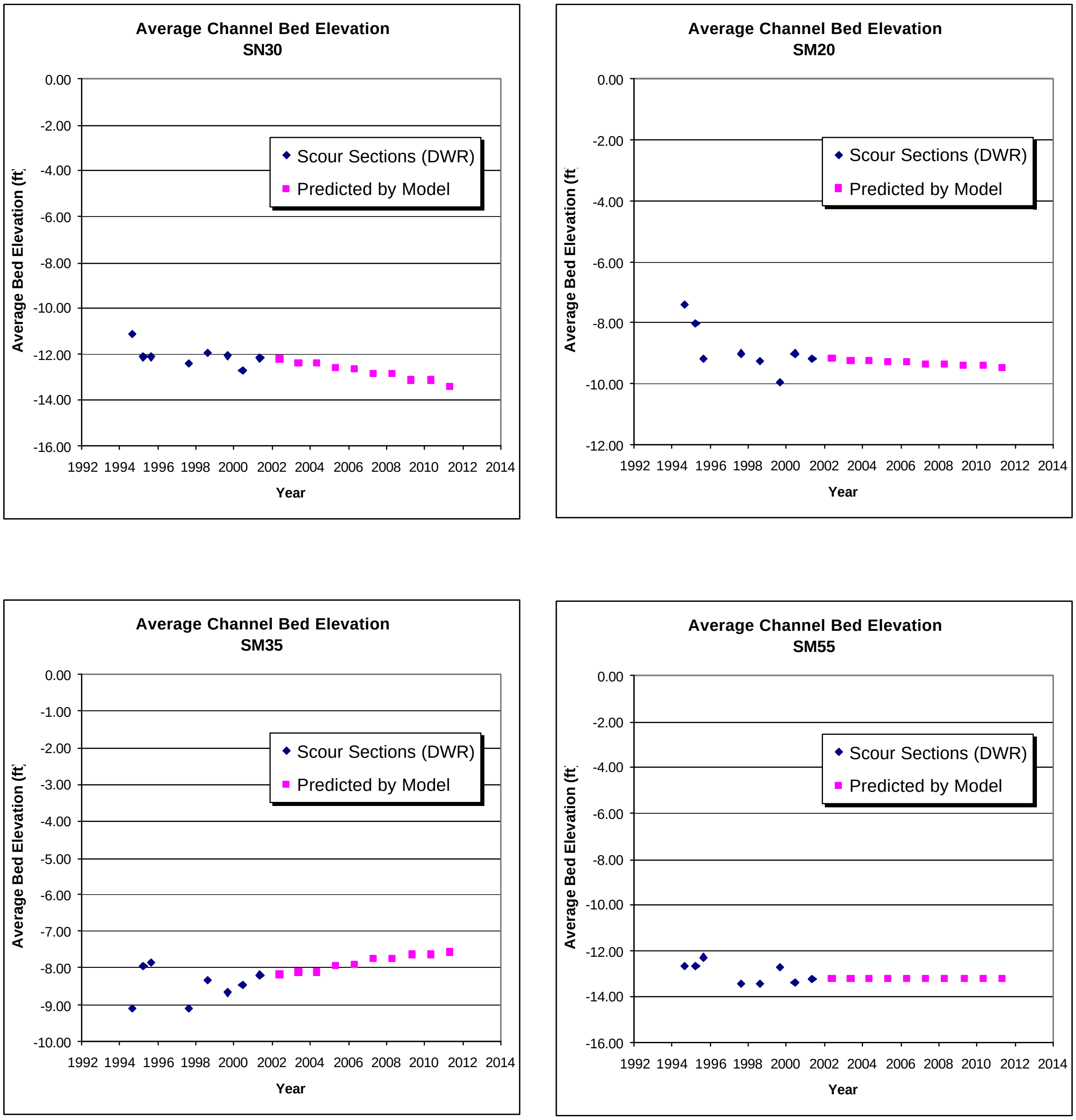


Figure 24b. Historical mean elevations of channels (DWR) combined with elevations predicted by model (cross section locations shown in Figure 4)

8.4 Sensitivity Runs for Baseline Model

To evaluate the sensitivity of the baseline model to various parameters, additional model runs were conducted. These included runs designed to determine the model's sensitivity to particle size per reach, the use of multiple grain sizes, and the application of different transport equations. Additional runs were also conducted using the highest 5% and 20% of the representative flood duration curve hydrographs to confirm that sediment transport in the MIKE11 model occurred only within the upper 10% of flows recorded in the historical record. Table 5 lists some of the sensitivity runs performed and comments on the differences noted when comparing the results to the baseline model.

Table 5. Summary of sensitivity runs for sediment transport modeling

Modeling Scenario	*Sensitivity Parameter Invesigated*	*Major Differences Noted*	*General Comments*
Base model 10-yr simulation using top 10% of historical flows	n/a	n/a	n/a
10-yr simulation using top 20% of historical flows	Effect of applying lower flows on sediment transport predictions	none	Exact same sediment transport results as base model
10-yr simulation using top 5% of historical flows	Effect of only using very high flows on sediment transport predictions	negligible	Very similar sediment transport results as base model
50-yr simulation using top 10% of historical flows	Long-term modeling	Some development of scour holes; additional sediment movement through system evident	System continues to evolve dynamically and tends toward a more stable geometric configuration
Increase of channel bed material	Doubling of grain size in every reach	Large decrease in transport everywhere	Model is very sensitive to grain size, though relative transport between reaches observed to be similar
Use of multiple grain sizes in reaches	More accurate representation of bed using three representative grain sizes	Lower sediment transport, especially in upper N and S forks	General sedimentation patterns similar though magnitudes are different; model is very unstable
Use of Engelund and Hansen's transport formula in model	Ackers and White's Total load equation	Slightly lower transport volumes predicted (between 10-50%)	Model is sensitive to equation choice

8.5 Sediment Transport Modeling of North Delta Project Alternatives

Sediment transport models were developed for five different flood control and ecosystem restoration alternatives proposed by DWR for the North Delta. Each of the models was created by altering the geometry of the baseline model to reflect changes proposed by a particular project option. The goal of the modeling was to identify large-scale and long-term sedimentation trends in the study area under existing conditions and to note significant changes in these trends due to implementation of each proposed alternative.

8.5.1 Description of Project Alternatives

Table 6 presents a brief description of the proposed North Delta alternatives included in the scope of this analysis. The first two alternatives, Eco-Options 1 and 2, involve modifications to the levee system around MWT. Flood Control Options 2 and 3 propose the establishment of channel setbacks and a large flood detention pond on Staten Island. The final alternative, Flood Control Option 4, proposes significant dredging of the channels around MWT and Staten Island, as well as plans to lay back channel banks and levee slopes.

Table 6. Summary of project alternatives considered and modeled in the sedimentation study.

Project Alternative	Description
Baseline	• No change condition of existing North Delta system
Eco-Option 1 (EO1)	• Installation of a weir set at 8.5' NGVD on the upstream northwestern side of MWT to capture high flows and reduce flood peaks. • Degradation of downstream levee along Dead Horse Cut to -2.5' NGVD allowing tidal exchange into island. • 300' notch cut into levee on the upstream end of the island to allow water from the Mokelumne to pass onto the island
Eco-Option 2 (EO2)	• Installation of a weir set at 8.5' NGVD on the upstream northwestern side of MWT to capture high flows and reduce flood peaks. • Degradation of downstream levee along Dead Horse Cut to 5.5' NGVD • Installation of multiple box culverts on downstream end to facilitate draining of the island after flooding
Flood Control Option 2 (FO2)	• Widening of North Fork of the Mokelumne by setting back levees on Staten Island • Construction of a flood detention pond with inlet weir set at 9' NGVD on Staten Island to capture peak flood flows
Flood Control Option 3 (FO3)	• Widening of South Fork of the Mokelumne by setting back levees on Staten Island • Construction of a flood detention pond with inlet weir set at 9' NGVD on Staten Island to capture peak flood flows
Flood Control Option 4 (FO4)	• Dredging of channels around MWT and in the South Fork of the Mokelumne by Staten Island • Channel bank set backs and reduction of levee side slopes to 1:5

8.5.2 Model Setups

The original baseline MIKE11 sediment transport model was updated using revised network and geometry files created by UCD in mid 2005. Special attention was paid to changes made to channel reaches near the study area, which included the Mid Mokelumne, Snodgrass Slough, Dead Horse Cut, and the North and South Forks of the Mokelumne. Once a stable baseline model had been created and tested, it was used as a basis for developing the sediment transport models of the five alternative project configurations. Changes to the baseline model that reflected the proposed alternative geometries were copied from UCD's MIKE11 files.

The same boundary conditions and upstream hydrology were applied to each sediment transport model. A 20-year simulation period was adopted using a representative flood duration curve as described in Section 8.2 of this report. The resulting synthetic inflow hydrograph had 10 peaks distributed over a two-year run time period, using only the highest 10% of recorded mean daily flows. The downstream boundaries were modeled using a repeating annual tide series. A 15-second time step was used for hydraulic and sediment transport calculations, with output recorded every six hours model time.

8.5.3 Reach-Averaged Analysis of Sedimentation Results

The results from the sediment transport simulations were analyzed at a reach-wide level by defining eleven study reaches (Figure 25) near MWT, Dead Horse Island, and Staten Island. The sediment volume captured in a study reach was calculated by subtracting the

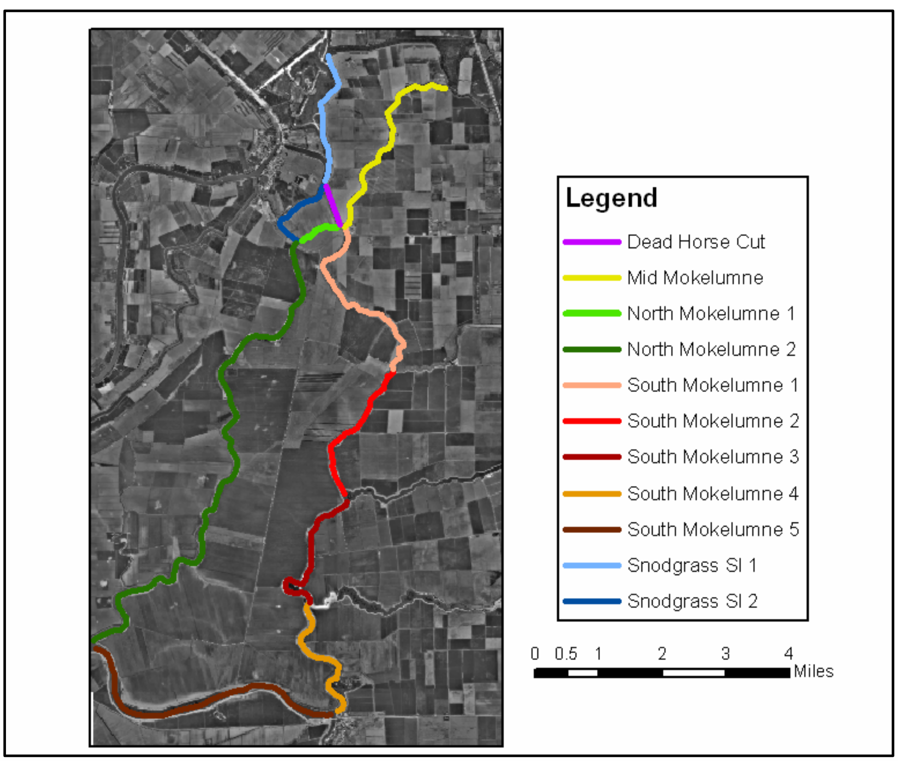


Figure 25. Location of study reaches used to calculate changes in sediment volume.

Table 7. Net changes in study reach sediment volumes over 20-year simulation period.

	Net sediment volume (cubic meters)					
Reach	*Baseline*	*EO1*	*EO2*	*FO2*	*FO3*	*FO4*
DH Cut	45,841	-49,610	49,511	77,731	74,036	28,925
Mid Mok	-72,522	205,474	-123,468	-130,555	-134,561	-28,277
North Mok 1	13,389	-14,888	8,173	8,801	14,516	58,123
North Mok 2	51,120	43,983	50,195	-21,713	50,148	47,923
South Mok 1	61,558	-1,341	79,620	103,141	125,669	183,991
South Mok 2	2,289	-20,846	-2,624	13,681	-50,398	-22,352
South Mok 3	20,497	49,333	25,152	11,932	62,408	41,040
South Mok 4	1,192	1,679	1,244	894	2,207	9,747
South Mok 5	9	9	7	6	4	-1
Snodgrass Sl 1	102,235	5	181	72,232	77,250	56,961
Snodgrass Sl 2	-52,467	-31,864	-41,380	-56,249	-46,281	-9,342

volume of sediment leaving a reach during the simulation from the total volume entering. A positive result indicated a net increase in sediment volume (deposition) within the reach, while a negative result indicated a net export of sediment volume (scour). This approach is useful for assessing sedimentation impacts of project alternatives and provides a measure of quantifying the change in sedimentation patterns and the potential requirements for dredging and/or scour protection measures. The reach averaged analysis is also preferred over the analysis of bed level changes at individual cross sections since sedimentation trends in the sub-reaches are more likely to stand out and are less likely to be affected by local instabilities and minor disturbances which may occur at individual cross sections in a sedimentation model.

Table 7 presents the raw data from the results of the numerical simulations. Each of the reaches shown in Figure 25 is listed in the first column of the table. The table describes the total volume of sediment captured in a reach over the 20-year simulation period for the baseline conditions model and the five project alternatives. Although the results presented in Table 7 may appear definitive and accurate, it is important to bear in mind that sediment transport is an extremely complex phenomenon that is not easily quantified. Therefore, the raw data results should be used only to identify general trends in the system and for comparative purposes between project alternatives. Individual results should not be taken out of context nor accepted as a true prediction of future sedimentation.

8.5.4 Verification of Baseline Results

The results from the baseline sediment transport simulation can be qualitatively verified by comparing the model predictions outlined in Table 7 to the potential sediment yield calculations described in Section 7 and presented in Figure 19 of this report. In general, the two approaches for estimating reach-wide sedimentation agree. Both predict deposition in Snodgrass 1, North Mokelumne 1, and North Mokelumne 2. Both also predict scour in Snodgrass 2 and Mid Mokelumne. The two reaches showing dissimilarity between the techniques are Dead Horse Cut and South Mokelumne 1. In both cases, the MIKE11 model predicted deposition in these reaches, while the results from the sediment yield calculations predicted no significant sedimentation at all.

8.5.5 Analysis of Simulation Results

The results presented in Table 7 were compared and analyzed to identify changes in trends between the baseline model and the five alternative project configurations proposed by DWR. In general, a change in a channel's sedimentation pattern was perceived as significant if it increased or decreased the net sediment volume of a specific reach changed by a factor of two from existing conditions. The following subsections discuss the results of the simulations and describe observed sediment transport trends associated with each project alternative.

<u>Baseline Condition</u>
The results from baseline model predict a general trend of sediment deposition near Staten Island, especially in the upper reaches of the North and South Forks of the Mokelumne. Deposition is also predicted in upper Snodgrass Slough and in Dead Horse Cut. The model shows general scour in the Mid Mokelumne reach adjacent to MWT and in lower Snodgrass Slough around Dead Horse Island. These sedimentation trends seem reasonable, with erosion occurring in the Mid Mokelumne reach until the channel trifurcates, increasing the conveyance and encouraging deposition mainly in the South Fork of the Mokelumne. Farther downstream, in South Mokelumne 4 and 5, sediment transport is very small, and net sediment storage is minor.

<u>Eco-Option 1</u>
Eco-Option 1 calls for substantial modifications to the flood control system around MWT. The lowering of the northeastern levee allows flood flows to spill onto the island and reduces the peak flow in Lost Slough and Snodgrass Slough by one half. The reduction of flow in Lost Slough causes most sediment to drop out early and reduces the deposition predicted to occur in Snodgrass Slough. The levee cut at the upstream end of the Mid Mokelumne also encourages a substantial amount of flow to leave the channel and enter the island. The resulting reduction in velocity in the Mid Mokelumne causes most of the sediment load to drop out in the channel before it reaches the trifurcation. Flow exits the MWT Island through Dead Horse Cut, which experiences a great increase in scour. The upper sections of both the North Fork and South Fork of the Mokelumne also show increased scour as sediment-starved water from the island reenters the channel system and velocities increase. In the case of the South Fork, the increase in scour continues south through Canal Ranch. Some of this additional sediment load is then deposited in the Brack Tract reach of the Mokelumne. Figure 26 presents a schematic representation of the changes in sedimentation trends due to implementation of Eco-Option 1. Sediment transport onto MWT was not evaluated in this study because sedimentation there would be very small and consist of wash load deposits and some suspended sediments rather than bed load.

<u>Eco-Option 2</u>
The sedimentation trends associated with Eco-Option 2 were fairly similar to those observed in the baseline model. Because this option would merely capture a portion of the hydrograph peak during very large flood events, the hydraulics of the system would not be significantly altered. The notable exception is the reduction of sediment

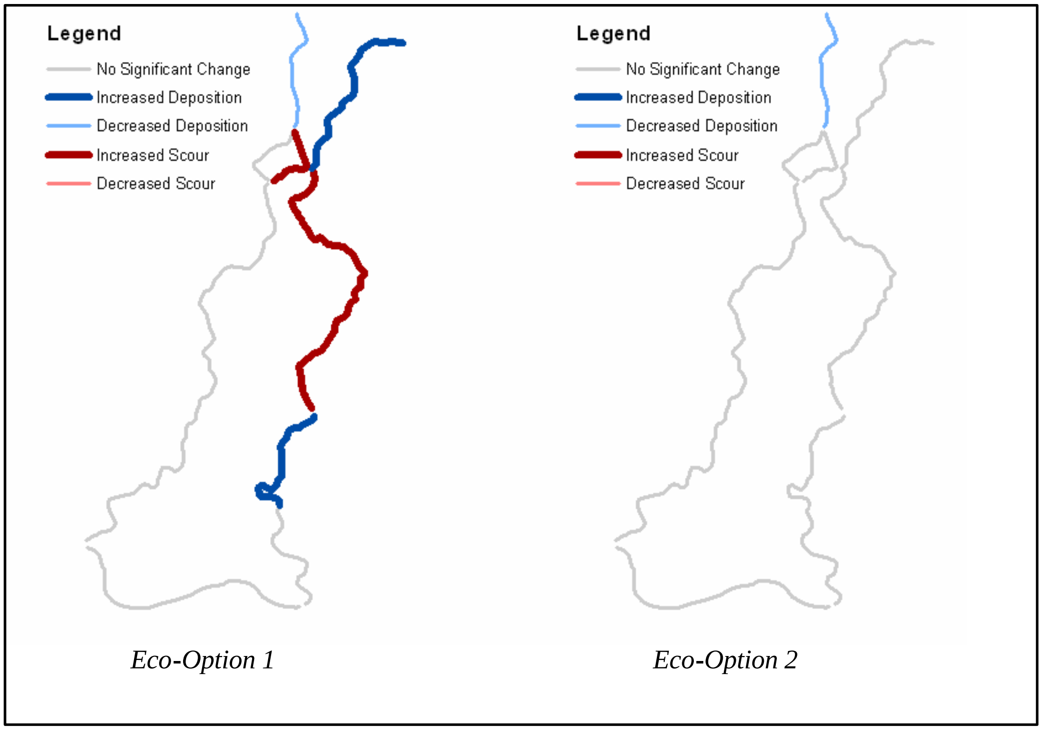


Figure 26. Changes in sedimentation trends between baseline conditions and Eco-Options 1 and 2.

deposition observed in upper Snodgrass Slough (Figure 26). This is due to increased sediment capture in Lost Slough upstream of Snodgrass Slough as a portion of the peak discharges are routed through MWT and slough velocities are reduced.

Flood Option 2

Proposed levee setbacks in Flood Option 2 would increase flood flows in the North Fork of the Mokelumne by widening the upstream section of the channel. The model predicts that, in general, the North Fork would experience additional scour from this increased in flow (Figure 27). Conversely, the reduction of flow into the South Fork would encourage additional deposition in its upper reaches. Water levels in the North Fork did not reach the elevation of the inlet weir of the flood detention pond, so its effects on sedimentation could not be evaluated.

Flood Option 3

In Flood Option 3, levee setbacks proposed on Staten Island across from New Hope Tract would encourage additional flow to pass through the South Fork of the Mokelumne. The levee setbacks would decrease local channel velocities near New Hope enough to increase deposition in the upper reach (Figure 27). However, downstream of the setbacks, the increased flows and sediment-starved water would encourage scour of the Canal Ranch reach. The additional sediment load picked up along Canal Ranch would then be deposited near Brack Tract as the river velocities decreased with increasing channel area. Similar to Flood Option 2, the Flood Option 3 simulation did not predict significant flooding of the flood detention pond, and its effects on sedimentation could not be evaluated.

<u>Flood Option 4</u>
In Flood Option 4, dredging is proposed for lower Snodgrass Slough, Dead Horse Cut, Mid Mokelumne, the upper reach of the North Fork of the Mokelumne near Dead Horse Island, and the upper and mid reaches of the South Fork. It is expected, therefore, that the general trend in these areas would be an increase in deposition or a decrease in scour due to lower velocities. This is exactly what the model predicted (Figure 27). Lower Snodgrass and the Mid Mokelumne reaches show significant reductions in scour over the baseline model. An increase in deposition follows downstream in the upstream reaches of the North and South Forks of the Mokelumne. However, the downstream reach of the South Fork along Canal Ranch shows a significant increase in scour. This is mainly due to the depositional trend observed upstream, which is responsible for sediment-starved water entering the reach and picking up material. The sediment load collected near Canal Ranch is then deposited just downstream near Brack Tract.

8.6 Summary and Conclusions

All of the proposed alternatives affect the sediment storage and export characteristics of the North Delta project area. In general, with the exception of the Mid-Mokelumne adjacent to the MWT, the region is a zone of sediment storage, which is to be expected given the reduction of stream gradient from the upper Mokelumne and Cosumnes River systems to the North Delta project area. The term "Delta" in the region's place name implies a zone of deposition. All of the many procedures utilized to understand sediment dynamics in this study all indicate net sediment storage within the region.

At first glance, the sediment modeling results may appear to contradict observed channel changes based on the CSDP scour surveys. However, it should be kept in mind that historical data, including the CSDP sections, show an extremely high level of data scatter when considering trends of aggradation or scour in North Delta reaches. Many cross sectional area and invert elevation trends can be reversed by choosing years other than 1994 and 2000 to compare. The CSDP record is not long enough to demonstrate long-term trends, only what was observed between 1994-2001. The sediment transport modeling, on the other hand, uses current cross section data and the entire historical discharge record to reveal future trends in the system based on relative channel morphology. Generally speaking, it should not be directly applied to predict absolute changes in particular cross sections based on one system configuration. It should also be noted that any dredging that may have occurred in the study area would be reflected in the scour surveys only and not in the sediment modeling results.

The computed changes in reach-averaged sediment characteristics for each alternative is an expected response of the river system's sediment balance. If an alternative results in sediment deposition within a reach, in general the adjacent downstream reach then adjusts to the lower inflowing sediment load through decreased deposition, or potentially scour, occurring in the downstream reach. Conversely, if an alternative results in scour within a reach, in general the adjacent downstream reach then adjusts to the increased inflowing sediment load through decreased scour, or potentially deposition, occurring in the downstream reach.

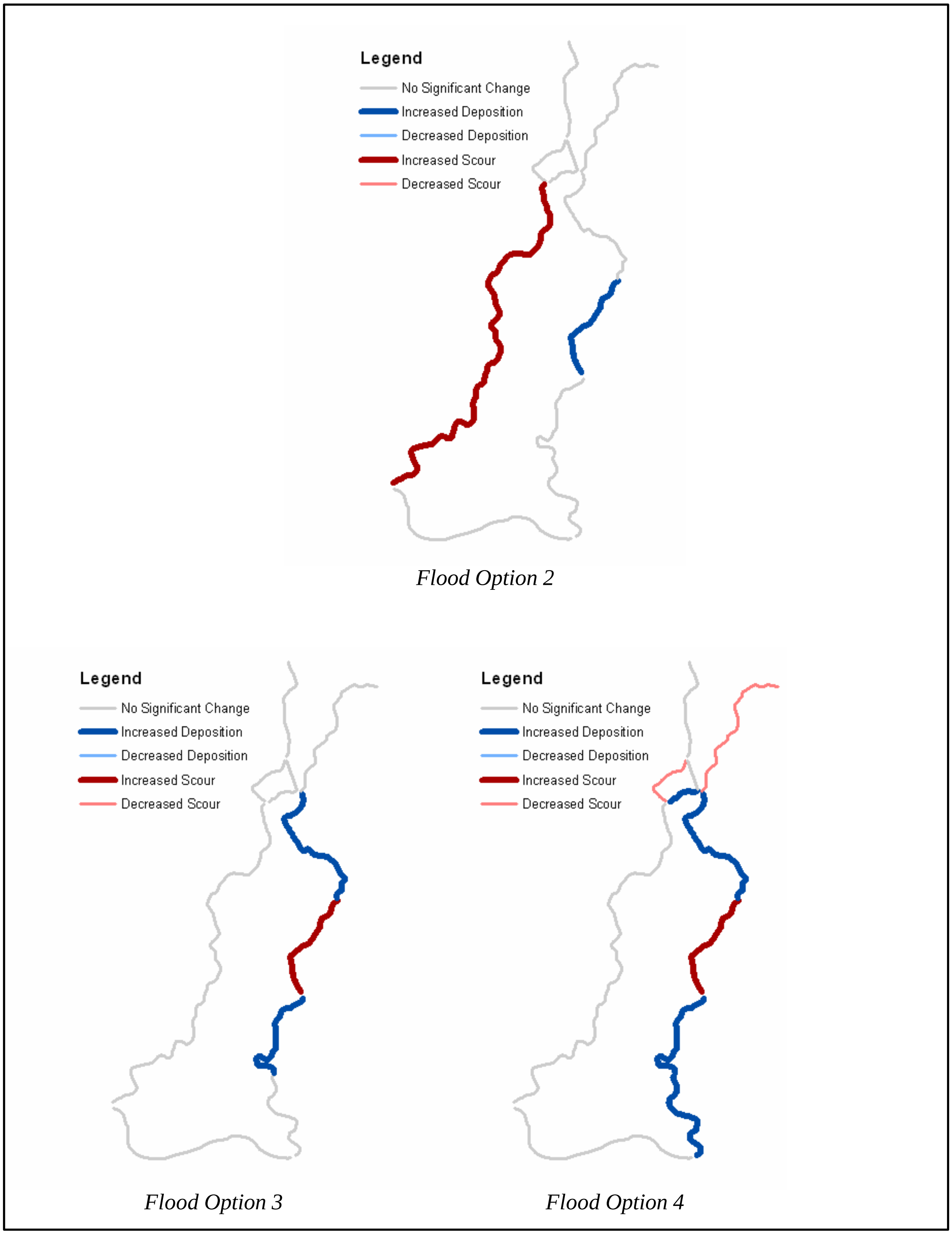


Figure 27. Changes in sedimentation trends between baseline conditions and Flood Options 2, 3 and 4.

Eco-Option 2 has the least impact on changes to the sediment regime of any of the project alternatives. This alternative has the least impact on the hydrodynamics of flood conditions, and hence the least impact on the resultant sedimentation dynamics. The other 4 alternatives entail a greater degree of channel and floodplain modification, and thus change to a greater extent the flood and sedimentation characteristics of the project reaches. None of the proposed alternatives are projected to drastically change the sediment characteristics of the project area to the point that management activities beyond those already implemented in the region would require significant modification. Site specific bank erosion control activities will likely be required in the future in response to continuing bank and bed scour. Limited dredging activity has been reported on some of the reaches in the project area, and such activity would likely continue in response to continued sediment deposition within the area.

Section 9.0
Long-Term Fine Sediment Deposition Rates in MWT

In addition to the modeling of bed material load transport and delta channel morphology using MIKE11, fine suspended sediment deposition rates in McCormack-Williamson Tract were estimated based on the proposed levee reconfigurations outlined in *Ecosystem Restoration Option 1* by the DWR. This particular configuration calls for the degradation of the southern-most levee to restore tidal action to the island, as well as the establishment of a 300-foot breach at the upper end of the island along the Mokelumne River to provide an inlet for river flow. In addition, the northwestern levee would be degraded to an elevation of 8.5 feet NGVD to capture flood peaks on the island during high flows in the Mokelumne. As described in Section 8, MIKE11 is not an appropriate tool for estimating fine sediment deposition rates in the Delta because they consist mainly of wash load. Therefore, the results presented here were developed from a spreadsheet model that utilized the hydrodynamic output from the MIKE11 model.

9.1 Description of Approach

Fine suspended sediment deposition rates on MWT were estimated by tracking the mass of sediment particles entering and leaving the island over time and calculating the deposition flux based on average sediment concentrations. Flow rates into and out of the island were established from hydraulic modeling results developed by **nhc** for DWR's *Ecosystem Restoration Option 1*. Inflow boundary conditions for the hydraulic model were based on synthetic hydrographs developed from flow-duration curves for the Sacramento, Cosumnes, and Mokelumne rivers.

Sediment calculations on MWT were performed at six-hour intervals using the results from the hydraulic model. Suspended sediment concentrations in the Mokelumne River near MWT were assumed equal to concentrations calculated for both the Cosumnes River and the Sacramento River during each time step. Suspended sediment concentrations in these rivers were determined by fitting a power-function regression curve to suspended sediment discharge and flow rate data collected by the USGS and **nhc** (see Table 8). The regression curve relationships developed for this study are described by:

Cosumnes River: $$Qs_{cms} = 1.64 \times 10^{-7} \left(Q_{cms}\right)^{2.31} \qquad (3)$$

Sacramento River: $$Qs_{cms} = 1.10 \times 10^{-8} \left(Q_{cms}\right)^{2.11} \qquad (4)$$

where Qs is suspended sediment discharge and Q is flow rate in SI units of m^3/s. Equations (3) and (4) predict total suspended sediment discharge throughout the water column, including fine sands that are transported in suspension during high flows. Therefore, the sediment discharges estimated by Equations (3) and (4) were adjusted to account for only the silt and clay fraction transported in the flow based on sediment grading analyses of suspended sediment samples taken at various flow rates on the Cosumnes River (Jones and Stokes, 2003).

Table 8. Suspended sediment data sets for the Sacramento River and Cosumnes River.

Station Location	*Data Start Date*	*Data End Date*	*Data Collected by*
Sacramento R at Freeport	Oct 1979	Sep 1989	USGS
Sacramento R at Freeport	Oct 1991	Sep 1992	USGS
Sacramento R at Freeport	Oct 1993	Sep 1994	USGS
Cosumnes River at Michigan Bar	Nov 1965	Sep 1974	USGS
Cosumnes River at Michigan Bar	Feb 2003	May 2003	**nhc**
Cosumnes River at McConnell	Nov 1965	Aug 1967	USGS
Cosumnes River at Plymouth	Aug 1957	Apr 1960	USGS

Suspended sediment concentration and deposition rates were calculated in MWT during each six hour time step. A sediment mass balance was developed by adding incremental water and sediment inflow volumes from the Mokelumne River and subtracting sediment deposition volumes. The rate of sediment deposition in the island was calculated using a fine sediment deposition and marsh plain accretion model developed by Krone (1987) at the University of California, Davis. Krone's model is widely used for estimating fine sediment deposition within the Sacramento-San Joaquin Delta and San Francisco Bay Estuary.

9.2 Summary and Conclusions

The results of the sediment deposition simulations are summarized in Table 9. Average accretion rates of 0.1 and 0.2 cm per year were calculated in MWT assuming sediment concentrations in the Mokelumne were equal to those estimated for the Sacramento River and Cosumnes River, respectively. In reality, suspended sediment concentrations near MWT would be lower than those used in the study due to inflows from the upper Mokelumne River and other local drainages that contain lower concentrations of suspended sediment. The accretion rates for MWT presented in Table 9 show reasonable agreement with suspended sediment deposition rates both observed and estimated around the Sacramento-San Joaquin Delta by **nhc** (2003), Reed (2002), and DWR (1984). These observed and estimated rates, which are all based on total suspended sediment deposition, vary between the orders of 0.1 and 1 cm/year.

Table 9. Fine suspended sediment deposition and accreting rates calculated for MWT based on concentrations developed from the Cosumnes River and Sacramento River.

Sediment Concentration Source	*Average Sediment Entering Island (m^3/yr)*	*Average Sediment Deposition (m^3/yr)*	*Average Accretion Rate (cm/yr)*
Cosumnes River	18,000	12,000	0.2
Sacramento River	10,000	4,000	0.1

REFERENCES

Ackers, P. (1993). Sediment Transport in Open Channels: Ackers and White Update. Proc. Instn Civ. Engrs Wat., Marit. & Energy, 101, pp. 247-249.

Ackers, P., and White, W.R. (1973). Sediment Transport: New Approach and Analysis. J. Hydraul. Div., ASCE, v. 99, no. HY11, pp. 2041-2060.

Anderson, M. L. Historic sediment loads in the Sacramento-San Joaquin Delta. 1994. Report to Delta Planning Branch of Department of Water Resources of State of California, University of California, Davis, 27 p.

Atwater, B.F. and Belknap, D.F. 1980. 'Tidal wetland deposits of the Sacramento-San Joaquin Delta, California', in M.E. Field, A.H. Bouma, I.P. Colburn, R.G. Douglas, and J.C. Ingle (eds.), Quaternary Depositional Environments of the Pacific Coast, Pacific Coast Paleogeography Symposium 4.

Atwater, B.F., 1982. "Geologic maps of the Sacramento-San Joaquin Delta, California", U.S. Geological Survey MF-1401, 15 p + 21 plates.

Atwater, B.F., Hedel, C.W., and Helley, E.J. 1977. "Late Quaternary depositional history, Holocene sea-level changes, and vertical crustal movement, southern San Francisco Bay, California", Geological Survey Professional Paper 1014, 15 p.

Blake, Stephen 2001. MS Thesis, Civil and Environmental Engineering, University of California at Davis, 73 p.

Burroughs, E. 1967. 'Rio Vista gas field: summary of operations, California oil fields', Sacramento, California Division of Oil and Gas, v. 53, pp. 25-33.

Constantine, C.R. 2001. 'The effects of substrate variability and incision on the downstream-fining pattern in the Cosumnes River, Central Valley, California', M.S. Thesis, University of California at Davis, 132 p.

Darcie, Bill 2002. Personal communication. KSN Engineering, Stockton, California.

Davis, G.H. 1963. 'Formation of ridges through differential subsidence of peatlands, article 101 in USGS prof paper 475C, c162-C165.

Deverel, S.J. and Rojstaczer, S. 1996. 'Subsidence of agricultural lands in the Sacramento-San Joaquin Delta, California: Role of aqueous and gaseous carbon fluxes', Water Resources Research, vol. 32, no. 8, pp. 2359-2367.

Deverel, S.J., Wang, B, and Rojstaczer, S. 1998. ‘Subsidence of organic soils, Sacramento-San Joaquin Delta, California’, in Borchers, J.W.,(ed.), Land Subsidence Histories and Current Research: Proceedings of the Dr. Joseph F. Poland Symposium, Association of Engineering Geologist Special Publication No. 8: Belmont, Star Publishing Co., pp 489-502.

Dinehart, R. L. Bedform movement in Threemile Slough near San Joaquin River. CalFed Bay-Delta Program Science Conference Abstracts, October 3-5, 2000, Sacramento, California, p.234, 2000.

DWR (California Department of Water Resources), 1993. Southern Delta Scour Monitoring: 1991 and 1992, Sacramento, California, 52 p.

DWR (California Department of Water Resources), 1995b. Sacramento-San Joaquin Delta Atlas, Sacramento, California, 121 p.

DWR (California Department of Water Resources), 1998. North Delta Scour Monitoring Program: 1995-1997, Sacramento, California, 39 p.

DWR (California Department of Water Resources), 2000. North Delta Scour Monitoring Program: 1998-2000, Sacramento, California, 39 p.

DWR (California Department of Water Resources). Cross Section Development Program (CSDP), version 2.23, available via the Internet at http://modeling.water.ca.gov/delta/models, 2000.

DWR (California Department of Water Resources), 1984. Materials for Delta levee Reconstruction. Memorandum Report. Sacramento, California, October. 35p.

DWR (California State Department of Water Resources), 1980a. ‘Seismicity hazards in the Sacramento-San Joaquin Delta’, California Department of Water Resources Central District, 26p.

DWR (California State Department of Water Resources), 1980b. Subsidence of organic soils in the Sacramento – San Joaquin Delta, Central District, Sacramento, California, 26 p.

DWR (California State Department of Water Resources), 1980c. “Report on causes of subsidence in the Sacramento-San Joaquin delta and a strategy for controlling its rate”, 63p.

DWR (California State Department of Water Resources), 1986. “Delta subsidence investigation progress report”, Central District.

DWR (California State Department of Water Resources), 1995a. Sacramento-San Joaquin Delta Atlas, July, 121 p.

DWR (California State Department of Water Resources), 2004. North Delta Flood Control and Ecosystem Restoration Project, web site: http://baydeltaoffice.water.ca.gov/ndelta/northdelta/background.htm

Fleenor, Bill. 2002, Personal communication. Research Engineer, University of California at Davis, Department of Civil Engineering.

Galloway, D., et. al., 1999, "Land subsidence in the United States", U.S. Geological Survey Circular 1182, 177 p.

Gilbert, G. K. 1917. Hydraulic-Mining Debris in the Sierra Nevada. USGS Professional Paper 105, Government Printing Office, Washington, D.C., 154 p.

Hammersmark, Chris. 2002. MS Thesis, Hydrologic Sciences, University of California at Davis, 99 p.

Hickman, J. (ed.), 1993. The Jepson Manual: Higher Plants of California, University of California Press, 1400 p.

Jennings, C.W. 1994. 'Fault activity map of California and adjacent areas with locations and ages of recent volcanic eruptions', California Division of Mines and Geology, Geologic Data Map No. 6.

Jones and Stokes and Northwest Hydraulic Consultants, 2003. *Cosumnes River watershed inventory and assessment: Phase II Final Report*. A report submitted to the Sloughhouse Resource Conservation District and Cosumnes River Task Force, September.

Kearney, C., 1980. "Seismicity hazards in the Sacramento-San Joaquin Delta", California Department of Water Resources, Central District.

Kerr, B.D. and Leighton, D.A. 1999. "Extensometer, water-level, and lithologic data from Bacon and Bethel Islands in Sacramento-San Joaquin Delta, California, September 1987 to August 1993, U.S. Geological Survey Open-File Report 98-631, 12 p.

Krone, R.B., 1987. *A method for simulating historic marsh elevations*. Proceedings of ASCE Conference, Coastal Sediments 87, New Orleans, 317-323.

Lao, C. 1965. Land subsidence study, California Department of Water Resource, Central District Office Report.

Levi, I. I. Dynamics of fluvial streams. Gosenergoizdat, Moscow-Leningrad, Russia, 1957 (in Russian).

LTMS (Long Term Management Strategy) Mult-Agency Writing Team, April 1996. "Long-term management strategy (LTMS) for the placement of dredged material in the San Francisco Bay region", Vol. 1, Draft, prepared for LTMS Management Committee.

Mirakomi, Robert. July 2002. Personal communication. U.S. Army Corps of Engineers, Dredging Regulation Branch, Sacramento, California.

Newmarch, G., 1980. “Subsidence of organic soils in the Sacramento-San Joaquin Delta”, California Department of Water Resources, Sacramento, CA.

NHC (Northwest Hydraulic Consultants), 2002. NDIP Preliminary Sedimentation Investigation Memorandum, 14 p.

NHC (Northwest Hydraulic Consultants), 2003. Assessment of Sediment Budget of Sacramento – San Joaquin Delta, 36 p.

Porterfield, G. Sediment transport of streams tributary to San Francisco, San Pablo, and Suisun Bays, California, 1909-66. Water-Resources Investigations 80-64, U.S. Geological Survey, Water Resources Division, Menlo Park, California, 92 p., 1980.

Prokopovich, N.P., 1985, “Subsidence of peat in California and Florida”, In: Bulletin of the Association of Engineering Geologists, November, Vol. 22, no. 4, p. 395-420.

Prokopovich, Nikola P., 1988, “ Tectonic subsidence in California's Sacramento-San Joaquin Delta", Bulletin of the Association of Engineering Geologists, Vol. 25, no. 1, p. 140-144.

Reed, D.J. (2002). *Understanding tidal marsh sedimentation in the Sacramento-San Joaquin Delta, California*. Journal of Coastal Research, 36, 605-611.

Rojstaczer, S.A., Hamon, R.E., Deverel, S.J., Massey, C.A., 1991, “Evaluation of selected data to assess the causes of subsidence in the Sacramento-San Joaquin Delta, California” U.S. Geological Survey Open-File Report 91-193, 16 p.

Sacramento-San Joaquin Delta’, California Department of Water Resources Central District, 26p.

Shlemon, R.J. 1971. “The Quaternary deltaic and channel system in the Central Great Valley, California”, Annals of the Association of American Geographers, vol. 61, no. 3, 427-440.

Shlemon, R.J. and Begg, E.L., 1975. “Late Quaternary evolution of the Sacramento-San Joaquin Delta, California”, in: Suggate, R.P. and Cresswell, M.M. (eds), Quaternary Studies: The Royal Society of New Zealand, Wellington, New Zealand, pp. 259-266.

Thompson, J. 1957. ‘The settlement geography of the Sacramento-San Joaquin Delta, California’, Doctoral Dissertation, Stanford University, 551 p.

Thompson, J. 1996. Flood chronologies and aftermaths affecting the lower Sacramento River, 1878 – 1909, Department of Geography, University Of Illinois, 74 p.

Thompson, J.,1982, “Discovering and rediscovering the fragility of levees and land in the Sacramento-San Joaquin Delta, 1870-1879 and today”, Research Paper, California Department of Water Resources Central District, March, 30 p.

USACE, 1934. ‘San Joaquin River and Suisun Bay, California, 30 Foot Channel Project, From Carquinez Straits to Stockton’, U.S. Army Corps of Engineers, Sacramento District, Scale 1" = 400 ft, 21 sheets.

USACE, 1974. “Port of Stockton to Point Edith, San Francisco Bay to Stockton, California (John F. Baldwin and Stockton Ship Channels), Environmental Working Paper, Sacramento District.

USACE, 1982. “Sacramento-San Joaquin Delta, California, draft feasibility report and draft environmental impact statement”, U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA, 128 p., 59 p., 11 p., 55 p., 277 p.

USACE, 1995. “Reconnaissance investigation, western delta islands, Sacramento-San Joaquin Delta, California”, Geology and Soil Design Sections, Geotechnical Branch, Sacramento District, 10p +plates.

USGS, 2000. ‘Delta subsidence in California, the sinking heart of the state’, Fact Sheet, FS-005-00, April. 4 p.

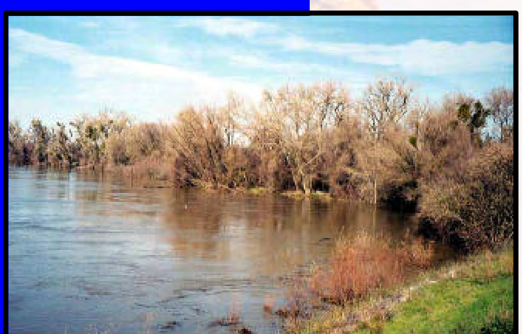
USGS, 2002. Water database, available via the Internet at http://water.usgs.gov.

Valentine, P. 2000. ‘Annual maintenance dredging, Stockton DWSC’, U.S. Army Corps of Engineers, Sacramento District, excel spreadsheet, 1 p.

Weir, W. 1950. “Subsidence of peat lands of the Sacramento - San Joaquin Delta, California, Hilgardia, vol. 20, no. 3, 56 p.

North Delta Improvement Program

Conceptual Designs of Erosion Protection for Hydraulic Elements



March 4, 2006

Prepared for:

California Department of Water Resources

Prepared by:

northwest hydraulic consultants

nhc

TABLE OF CONTENTS

LIST OF FIGURES

North Delta Improvement Program

Conceptual Designs of Erosion Protection for Hydraulic Elements

1. INTRODUCTION

As a part of its North Delta Improvement Program (NDIP), the California Department of Water Resources (DWR) has developed three alternative Ecosystem Restoration Options and four Flood Control Options for McCormack Williamson Tract (MWT) and Staten Island. The alternatives address decreasing wildlife habitat and local flood conveyance issues in the Lower Mokelumne River system. While all seven options call for significant changes to the existing levee system, six propose lowering entire levee sections to promote tidal exchange into the islands or overtopping during flood events. Because the existing flood control levees in the North Delta are not designed to withstand overtopping, it is important that their designs include adequate erosion protection to avoid structural failure.

Northwest Hydraulic Consultants (**nhc**) completed its evaluation of the levee changes proposed by DWR, and developed conceptual design plans that specify erosion protection requirements and provide typical grading dimensions for quantity and cost estimation purposes. This report presents the plans developed by **nhc** for hydraulic elements described by DWR in their Ecosystem Restoration Options 1, 2, and 3, and Flood Control Options 1, 2, and 3 for the North Delta Improvement Program.

2. HYDRAULIC MODELING

The erosion protection designs presented in this report are based on the results of a hydraulic model developed by the University of California at Davis (UCD). MIKE11, an unsteady one-dimensional flow model, was used by UCD to evaluate stage and flow in the North Delta for a variety of hydrologic conditions and project alternatives. As requested by DWR, the levee protection designs were based solely on UCD's modeling of the flood event that occurred in the Delta between December 1996 and January 1997. Six alternative configurations were examined: three Ecosystem Restoration Options modeled without downstream Flood Control Options and the three Flood Control Options combined with Ecosystem Restoration Option 2. Although the results of UCD's MIKE11 model were used in the design of erosion protection for each degraded levee, **nhc** did not participate in the development, evaluation, or application of the model at any time.

3. DESIGN PROCEDURES

3.1 Estimation of Existing Levee Dimensions

The geometries of existing levees in the conceptual design plans were estimated using cross sections from in the MIKE11 hydraulic model and project drawings developed by DWR. Levee dimensions in the Delta can be highly variable, which directly affects the grading and protection required at a particular site. The conceptual design plans presented here show typical or example levee dimensions based on available elevation data and simplifying assumptions (for most levees, the existing top width was assumed to be 14 feet wide with 2:1 side slopes on both the water and landsides). Once the approximate dimensions of the existing levees were established, grading plans were drawn that showed typical plan and cross section views of each structure as well as the location of required erosion protection.

3.2 Erosion Protection Design

The degraded levees that have been proposed for the NDIP will be overtopped more frequently than the existing levees. When a levee overtops, its function is radically altered from a containment structure to a broad-crested weir. The shallow uncontrolled spill over the levee crest is highly turbulent, and velocities become significant as the flow approaches the end of the crest and falls off the levee face. During overtopping, a degraded levee behaves like a spillway on a low-head dam, and the physical processes associated with such a flow must be considered in the erosion protection design.

The design of the rock protection for the degraded levees in the Flood Control and Ecosystem Restoration Options was developed using a combination of MIKE11 results, spillway models, and published empirical design guidelines. In general, the sizing of the rock protection was based on studies performed by Frizell, Ruff, and Mishra (1997, 1998) of overtopping of steep riprap embankments. These values were then checked against independent design equations for steep slope riprap design presented in EM 1110-2-1601 (USACE, 1991). The height and length dimensions for all degraded structures were obtained from conceptual drawings and reports developed by DWR and supplied to **nhc**.

3.3 Box Culvert Design

The box culverts designed for Ecosystem Restoration Options 2 and 3 were sized using MWT stage-volume data supplied to **nhc** by DWR (DWR, 2005) and hourly tide data obtained from the California Data Exchange Center (http://cdec.water.ca.gov/) of the Sacramento River at Georgiana Slough

(RSAC123). A drainage period of between 2 to 4 weeks was considered acceptable for sizing the box culverts.

4. SUMMARY OF CONCEPT DESIGN CONFIGURATIONS

DWR has provided **nhc** with basic dimensions and the locations of each of the hydraulic elements associated with the proposed Flood Control and Ecosystem Restoration Options. Figures 1-3 present the location of the hydraulic elements for Ecosystem Restoration Options 1, 2, and 3, respectively. Figure 4 presents the location of the overflow weirs proposed for Flood Control Options 1, 2 and 3. Each hydraulic element shown is discussed in detail in Section 5 *Description of Hydraulic Elements* of this report.

4.1 Ecosystem Restoration Option 1

The first of the Ecosystem Restoration Options calls for the modification of four levee sites, as shown in Figure 1. The option would provide three points of access for flows to enter MWT. The eastern levee on the upstream end of the island (Levee "A") would be degraded to 8.5 feet NGVD so that larger flood events could overtop the levee and flow into the island. On the downstream end, the southwestern levee (Levee "C") will be completely removed to encourage tidal exchange in the lower half of the island. In addition, a 300-foot breach (Levee "B") will be introduced along the Mokelumne River side of MWT to provide continuous inflow from the river, through the island, and out the southern end through Levee "C." Due to the additional discharges that would flow laterally into Dead Horse Cut through Levee "C", special erosion protection along the waterside of the eastern levee of Dead Horse Island (Levee "D") would be necessary.

4.2 Ecosystem Restoration Option 2

Ecosystem Restoration Option 2 (Figure 2) also proposes the lowering of the upstream levee on MWT (Levee "A") and the addition of waterside protection to the waterside of the eastern Dead Horse Island levee (Levee "D"). In contrast, Option 2 calls for the downstream levee on MWT (Levee "E") to be degraded to 5.5 feet NGVD rather than completely removed. Since the proposed Levee "E" would prevent water trapped on the island from draining into Dead Horse Cut, a system of discharge structures would be necessary to remove the water. Initial modeling results indicate that six 4' by 8' box culverts with inverts at about 0 feet NGVD and tide gates on the outlet side would be capable of draining the island in two to five weeks, depending on tidal cycles.

4.3 Ecosystem Restoration Option 3

The final Ecosystem Restoration Option (Figure 3) is similar to Option 2 and includes the degraded upstream and downstream levees on MWT (Levees “A” and “E”, respectively), and the waterside protection for the Dead Horse Island levee (Levee “D”). In addition, this option calls for the construction of an internal cross levee (Levee “F”) set to elevation 5.5 feet NGVD. Floodwater trapped south of the cross levee would be left to pond to encourage the settling of suspended sediment on the island. Water trapped to the north would be drained using five 4’ by 8’ box culverts set to invert elevation 0 feet NGVD and equipped with tide gates.

4.4 Flood Control Option 1

Flood Control Option 1 (Figure 4) calls for the removal of the northern Staten Island levee adjacent to Dead Horse Island and the construction of a lower levee structure (Levee “G”) that could be overtopped during flood events and divert flows to a large detention basin on the island. Additional perimeter levees would be built on Staten Island to the south of the inlet to contain the diverted flow. **nhc** was only tasked to design the rock protection for the Levee “G” structure for this option.

4.5 Flood Control Options 2 and 3

Flood Control Options 2 and 3 (Figure 4) are similar in concept but different in location. Both options again call for the construction of levees (Levee “H” and “J”, respectively) that could also perform as inlet structures to detention basins on Staten Island. **nhc** was only tasked to design the rock protection for the Levee “H” and Levee “J” structures for these two options.

5. DESCRIPTION OF HYDRAULIC ELEMENTS

The following subsections present descriptions of the various hydraulic elements associated with the Flood Control and Ecosystem Restoration Options mentioned in Section 4 above. The location of each structure can be found on the project location photos presented in Figures 1-4.

5.1 Levee “A”

Levee “A” is located on the eastern side of MWT, about 1000 feet west of Interstate 5. All three Ecosystem Restoration Options include Levee “A”, which calls for about 3000 feet of the existing levee to be lowered to an elevation of 8.5 feet NGVD. During larger events, flood water would overtop the degraded levee, enter MWT, and flow south toward Dead Horse Island. Figure 5 presents the concept design for Levee “A” including the required rock protection designed by **nhc**. The figure shows that the existing levee will need to be lowered from its existing elevation of approximately 17 feet to the design elevation of 8.5 feet NGVD, minus 30 additional inches for the riprap cover. The riprap will consist of 24-inch angular rock according to the riprap standards prescribed by the USACE (1991). The Levee “A” design may also include a paved access road with 1-foot concrete cut-off walls running parallel to the pavement edge to protect against undercutting. Flow velocities over the weir will likely reach a maximum of between 3 and 4 feet per second (fps), which are high enough to merit protection along the crest. Velocities on the downstream levee face will be much higher than this, requiring full erosion protection along the entire landside slope. An additional 10 feet of riprap is to be placed on the waterside of the levee to protect against turbulence in the approach flow. The riprap should be placed to a depth of 30 inches and should be flush with the waterside face. Riprap may be placed directly on the levee surface on the landside face to avoid unnecessary excavation. Figure 5 also shows the required grading for an end sill toe on the land side to help dissipate energy if the island is not fully submerged at the onset of overtopping and to add protection to the levee toe (USACE, 1992). Finally, the ends of the degraded section must also be covered with 24-inch angular rock (USACE, 1991) to protect the interface between grades as well as the adjacent perimeter levee from scour. One or more filter layers will be required under all riprap areas to prevent scour of the underlying soil.

5.2 Levee “B”

The Levee “B” structure is only associated with Ecosystem Restoration Option 1. It consists of a 300-foot breach cut into the MWT levee that borders the Mokelumne River. The goal of this alternative is to establish hydraulic connectivity between the breach and the southwestern end of MWT. However, if the elevation of MWT at the breach location is higher than local tide levels, a pilot channel will need to be excavated in order for the degraded section to function as an inlet. As shown in Figure 6, the cut will broken down into two side tiers at elevation 3.5 feet and one central tier at 0 feet NGVD. The design presented in Figure 6 leaves this lower section unprotected so that it can scour and eventually form into natural channel inlet. The design does call for plantings on the side tiers to protect against erosion and to precipitate colonization of the area by appropriate species. To protect the interface between the breach and the existing levee, 24-inch riprap (USACE, 1991) should be placed to a depth of 30 inches along the exposed 3:1 slope that matches the different grades. A 60-inch launchable riprap toe should be placed in the river channel to prevent undercutting of the rock protection. One or more filter layers will be required under all 24-inch riprap to prevent scour of the underlying soil.

5.3 Levee "C"

Figure 7 presents the conceptual design for Levee "C" located on the southwest side of MWT adjacent to Dead Horse Cut. Levee "C" is only associated with Ecosystem Restoration Option 1. The original concept plans for this structure called for the levee to be degraded to an elevation of -2.5 feet NGVD. However, according to cross section elevation data in the UCD MIKE11 model, the island elevation at this location ranges between about -1 and -2.5 feet NGVD. Therefore, the design presented in Figure 7 assumes that the levee will simply be graded down to the landside elevation. Removal of this levee will open MWT to tidal action, and around 50 percent of the island will become permanently submerged. The threat of scour along the embankment between the untouched levee and the breach requires the placement of 24-inch angular riprap (USACE, 1991) to a depth of 30 inches along the 3:1 grade-matching slope as well as the local levee faces. A 60-inch launchable riprap toe should be placed along the base of the 3:1 grade and in the river channel along the levee toe. Note that the area of protection required will vary with levee geometry, the invert of the Mokelume River, and the local elevation of MWT. One or more filter layers will be required under all placed riprap.

5.4 Levee "D"

Due to the increased lateral inflows and higher velocities, the riverside face of the eastern levee on Dead Horse Island will require additional erosion protection. Figure 8 presents the concept design developed for the levee, which entails the placement of 18-inch riprap to a depth of 24 inches over the entire 3000' levee length. A 48-inch launchable toe should be place in the river channel to prevent scour of the toe. One or more filter layers will be required under all placed riprap.

5.5 Levee "E"

Ecosystem Restoration Options 2 and 3 call for the lowering of the southwest levee on MWT (adjacent to Dead Horse Cut) from about 15 feet to 5.5 feet NGVD. This crest elevation would be high enough to prevent tidal flooding of the island. However, the levee would be regularly overtopped from Dead Horse Cut during minor flood events. Larger floods would result in significant overtopping and the subsequent flooding of MWT. When the upstream levee on MWT (Levee "A") overtops, the flow over Levee "E" would reverse, and water trapped on the island would discharge back into Dead Horse Cut. Although the structure would be submerged under these conditions, turbulence on the waterside face of Levee "E" would likely initiate local scour there. For this reason, Levee "E" was designed to withstand bi-directional flows with rock protection placed accordingly as shown in Figure 9. The design calls for 24-inch angular rock (USACE, 1991) to be placed to a depth of 30 inches along the entire face and crest of the structure. Note that the riprap may be placed directly on the existing levee face both on the landside and waterside. An access road could be integrated into the crest design as presented in Figure 9, and should include cut-off walls to prevent scour at the interface of the riprap and road. The riverside toe of the levee will require additional erosion protection from a 60-inch launchable riprap toe. The landside toe design (USACE, 1992) includes an integrated end sill to help dissipate energy and protect against scour. One or more filter layers will be required under all placed riprap.

5.6 Levee "F"

Levee "F" is a proposed cross levee associated with Ecosystem Restoration Option 3 only. The structure would be constructed from east to west across MWT to an elevation of 5.5 feet NGVD. Figure 10 presents the concept design for the levee, which shows a topwidth of 10 feet and side slopes of 3:1. The levee footprint would vary according to the local elevation of the island on which it is constructed. Similar to Levee "E", flow over Levee "F" would be bi-directional depending on hydraulic conditions, so protection is required on both faces. However, because discharge over the levee would likely occur from the southern side first, the design presented in Figure 10 includes an end sill on the north toe for energy dissipation. The design calls for 18-inch angular rock (USACE, 1991) to be placed to a depth of 24 inches as shown. One or more filter layers will be required under all placed riprap.

5.7 Box Culvert Drains

According to concept design plans, water trapped on MWT by Ecosystem Restoration Options 2 and 3 will be drained to about 0 ft NGVD through a series of culverts. The total volume of water that could be removed by draining in both alternatives ranges between 4800 and 5500 acre-feet (DWR, 2005). Figure 11 presents concept plans for a 4' by 8' box culvert that could be buried inside perimeter levees and used to drain ponded water. An analysis of the stage-volume relationship for MWT indicates that six such culverts placed on the southern end of the island along the Mokelumne River could drain water trapped by Ecosystem Restoration Option 2 in two to four weeks, depending on tidal cycles. Five such culverts could be used for Option 3 to drain the area north of Levee "F" in a similar period of time. The invert of the culverts should be placed at 0 ft NGVD or lower to take full advantage of low tides. To prevent backflow during high tides, the outlet of each culvert should be fitted with two 3.5' by 4' horizontal tide gates. The inlet and outlet boxes of the culverts should be designed to match the grade of the existing levee in which they are installed to avoid unnecessary local scour. The levee faces on both the inlet and outlet sides should be protected with 18-inch angular rock (USACE, 1991) placed to 24 inches deep according to the dimensions shown in Figure 11.

5.8 Levee "G"

Levee "G" is setback from the existing north levee on Staten Island, and will function as both an inlet to the proposed detention basin for Flood Control Option 1 and as an elevated county road. The structure will have a crest elevation set at 10 feet NGVD, which would sit about 12 feet above the surrounding island base. Figure 12 presents the approximate layout and dimensions for the structure, including the required protection and the two-lane road. Because the entire crest of Levee "G" must be protected with riprap up to the edge of the road, the design calls for a wide paved section with 11-foot lanes and 8-foot shoulders. A concrete cutoff wall will be placed at the road-riprap interface to protect against undercutting of the pavement when the structure is overtopped. The width of the riprap protection adjacent to the roadway will vary according to refined levee designs. Figure 12 estimates 17 feet of protection on either side of the levee crest, though this could be reduced to 10 feet or less. The protection for Levee "G" is to consist of 24-inch angular rock (USACE, 1991) placed to a depth of 30 inches. One or more filter layers will be required under all placed riprap.

5.9 Levees "H" and "J"

Levees "H" and "J" are proposed as the inlet structures to the detention basins associated with Flood Control Options 2 and 3, respectively. Because the two designs are identical, Figure 13 presents both structures. Levees "H" and "J" will be designed with crests at an elevation of 9 feet NGVD and levee faces at 3:1 slopes. Riprap protection on the watersides will extend 10 feet down the levee face flush to grade to protect against turbulence in the approaching flow. The protection will continue across the crest and down the landside face of each structure. The 44-foot crest width presented in Figure 13 is a conservative estimate of the levee geometry that matches the base width of adjacent perimeter levees. Crest widths on Levees "H" and "J" could be reasonably reduced to a minimum of 20 feet. At the landside toe, each structure will include an end sill to help dissipate the energy of the overtopping flow. All riprap protection presented in Figure 13 is to consist of 24-inch angular rock (USACE, 1991) placed to a depth of 30 inches. One or more filter layers will be required under all placed riprap.

6. CONSTRUCTION CONSIDERATIONS

At the conceptual design level, it is difficult to foresee all of the logistical and technical complications that may arise during project construction. However, some general obstacles to construction specific to the alternatives presented in this report have been noted and are, therefore, mentioned.

In general, the excavation of some of the lower elevation levee breaches may be hampered by high ground water and tide levels. The breach proposed in the

Levee "B" design would degrade the existing levee down to 0 feet NGVD, which is over 1½ feet below mean tide level. This may require that the final breaching of the levee be done by barge from the river. Also, MIKE11 cross sections indicate that the land surface of MWT near the cut site is at about 3.5 feet NGVD. Thus, it will be necessary to construct several thousand feet of pilot channel through the island to provide hydraulic connectivity between Levees "B" and "C." The excavation of such a channel may be difficult due to high groundwater tables in MWT.

Some riprap plans presented in this report call for the placement of rock at grade with the island surface. This will require up to 60 inches of excavation at some sites where island elevations are already low. The use of small coffer dams may be necessary to slow seepage into excavation sites or to prevent flooding from tides.

Finally, the scale of the levee cuts proposed by DWR will require huge quantities of rock protection and construction costs may prove to be unreasonable. It is, therefore, recommended that alternative protection measures are considered, such as the in-situ placement of 4 inches of concrete along some levee faces. Another possibility could include the construction of erodable overflow levee structures. The advantages and disadvantages of the riprap, concrete, and erodable structure alternatives should be compared on the basis of cost, aesthetics, environmental impact, and long-term maintenance issues.

7. RECOMMENDATIONS FOR ADDITIONAL STUDIES

The erosion protection and conceptual design plans for the hydraulic elements associated with the Flood Control and Ecosystem Restoration Options were developed using design criteria and hydraulic modeling results provided to **nhc** by DWR. It is important to note that these are preliminary in nature, and that each will require significant refinement and redesign based on future studies. Additional hydraulic modeling of the North Delta and the effects of the conceptual designs is imperative. This should include one-dimensional modeling of the Delta under a variety of hydrologic conditions, multi-dimensional modeling of flows near structures, and physical scale modeling. A rigorous quality assurance review of all modeling, including the UCD MIKE11 model, should be completed. The results from such an effort would provide the additional information necessary to accurately assess the hydraulic, sedimentation, and ecological impacts associated with each option

8. REFERENCES

California Department of Water Resources (DWR), 2005. "mccormack_volumes.xls." Excel spreadsheet received by email from Gwen Knittweis. May 2005.

Frizell, K.H., J.F. Ruff, and S, Mishra, 1997. "New riprap design criteria to prevent embankment dam failure during overtopping." Proc. ASDSO Dam Safety '97, Pittsburg, PA, September 8, 1997.

Frizell, K.H., J.F. Ruff, and S, Mishra, 1998. "Simplified Design Guideline for Riprap Subjected to Overtopping Flow." PAP-790, U.S. Bureau of Reclamation. http://www.usbr.gov/pmts/hydraulics_lab/pubs/PAP/PAP-0790.pdf

U.S. Army Corps of Engineers (USACE), 1992. "Hydraulic Design of Spillways." EM 1110-2-1603, Washington, D.C. http://www.usace.army.mil/publications/eng-manuals/em1110-2-1603/toc.htm

U.S. Army Corps of Engineers (USACE), 1991. "Hydraulic Design of Flood Control Channels." EM 1110-2-1601, Washington, D.C. http://www.usace.army.mil/publications/eng-manuals/em1110-2-1601/toc.htm

APPENDIX A – RESPONSE TO COMMENTS

Response to Comments Presented by DWR on November 18, 2005
December 1, 2005 and March 4, 2006

This memo is an addendum to the **nhc** technical report entitled "Conceptual Design of Erosion Protection for Hydraulic Elements" dated September 22, 2005. It serves as a response to comments submitted by DWR concerning the report.

Response to Comments

1. *The report "needs to provide more background on the specific rationale for the designs - i.e. the equations and relevant parameters or an example from industry practice…"*

It should be noted first and foremost that the idea of transforming a large flood control levee into an overtopping weir is not commonly entertained in the flood protection community. A review of the literature resulted in meager assistance from a few studies that investigated flow over steep rock slopes. As described in Section 3 of the report, the two most comprehensive approaches for sizing rock under such conditions were presented by Frizell, Ruff, and Mishra (1998) and EM 1110-2-1601 published by the USACE (1991). As may be expected for this type of design, the equations presented for the design criteria are empirical. Frizell, Ruff, and Mishra (1998) relate riprap geometry to unit flow rate, and USACE (1991) relates riprap geometry to unit flow rate and channel slope. Corps "EM" documents are generally considered the state of the practice for hydraulic engineering design criteria. Direct web links for downloading these papers are provided in the References section of the original report.

According to the 1997-flood model, MWT would be completely underwater prior to overtopping of the upstream levee (Levee 'A'). Such conditions would greatly reduce the total discharge, local velocities, and erosive potential of the incoming flow. However, the assumption of levee submersion was deemed imprudent as a design condition, being as it is predicted by a single hydraulic model of a single flood event. Design discharges were, therefore, established by observing typical differences in the water surface elevations upstream and downstream of the levee throughout the flood simulation and by assuming only partial submersion of the island at the moment of overtopping. In general, a local depth of 1.5 feet was estimated to be the maximum head that would likely occur over the levee in an unsubmerged condition. A spreadsheet model was used to estimate local unit discharges and appropriate riprap sizes based on this assumption. A similar procedure was used to design riprap for each levee design discussed in the report.

Actual levee dimensions such as side slopes and crown widths were developed using standard levee design practices laid out by the California Code of Regulations (CCR)

Title 23. To the extent possible, levee dimensions were developed based on minimizing earthwork and utilizing existing grades.

2. *"…we'd like to see references to the expected erosion flows each design element is estimated to be subject to…"*

In general, a one-dimensional model such as MIKE11 is not adequate for evaluating the erosive forces associated a levee overtopping. Therefore, the designs of each structure were not based on the results from the single 97-flood simulation. Rather, the results from the hydraulic model were combined with those obtained from a spreadsheet model to try and understand the potential for erosion over a range of potential overtopping scenarios at each element. In addition, engineering judgment and experience played an important role in deciding design alternatives that may or may not have been feasible. Due to the limited scope of this study and limited amount of available hydraulic data, it was not possible quantify specific local velocities and erosion forces. These would be addressed in the preliminary design level.

3. *"…the 6' apron on some of the sections seems too short…"*

The MIKE11 model demonstrates that MWT would be submerged once Levee 'A' overtops. However, the small end-sill toe is included in the design as a conceptual precaution, and its dimensions will certainly be adjusted in future comprehensive design efforts. The text "fully submerged" has been added to the original report to reflect this.

Levee 'E' is the first degraded levee to overtop in the system, and may require additional protection at the landside toe than is currently presented in the conceptual design. However, inspection of the model results indicates a maximum overtopping discharge of 1.5 cfs per foot of levee. This would amount to a crest depth of about 7 inches. Work by Frizell, Ruff, and Mishra (1998) suggests that such an overtopping flow would be completely interstitial, and thus the riprap itself would be the main dissipater of energy as the flow cascades down the levee face.

4. *"Which version of the model?"*

UCD performed all MIKE11 hydraulic modeling. They would have the information regarding version number.

5. *"Why not January 1997? Is it a typo?"*

The 1997 flood event used in UCD's model occurred between the months of December 1997 and January 1998.

<u>March 4, 2006</u>:
The correct date for the flood hydrology is noted as being from December 1996 and January 1997.

6. *"Is it going to withstand the flood flows? What is the basis for design?"*

Refer to responses 1 - 3.

7. *"[The width of the levee is] missing [on figure 5]"*

As shown in the design plans, the degraded portion of Levee 'A' is build directly over the existing flood control levee. The width of the existing levee varies, and so no 'width' dimension is included in the sections provided in this scope. Approximate volumes can be determined based on the information provided in the plans. The concept designs presented in the report have been developed to provide DWR with a reasonable basis for considering construction logistics, rock and cut quantities, and cost.

8. *"Show river bed elevation [on Figure 6]"*

According to the model cross sections, the bed elevation of the Mokelumne River at Levee 'B' is about -13 feet NGVD. Dimensions on the original Figure 6 appear to assume a river depth of only -8 feet NGVD. Therefore, this figure has been updated and the channel bed elevation included.

9. *"Show average Tidal Flood Level [on Figure 9]"*

Mean Tide Level at the southern end of MWT is approximately 1' to 1.5' NGVD.

<u>March 4, 2006</u>:
Additional modeling investigations appear to indicate Mean Tide Level closer to 2.5' at the southern end of MWT. Figure 9 has been updated accordingly.

10. *"[Culvert] entrance should be flared?"*

The idea certainly should be considered in the preliminary design phase. However, the additional head box construction costs will need to be weighed against any demonstrated hydraulic benefits.

11. *"Show sections along the levee centerline [in Figures 5, 10, 12, and 13]"*

All of the Figures mentioned here present compressed plan views of the levees with typical sections and breaklines, so as to fit the designs on a single page. Their relative locations with respect to specific sections would require a detailed base map of the existing levee topography. This level of design would be developed in the preliminary design phase

12. *"Provide design calcs or detailed qualitative explanation of design basis"*

Included with this memo is an Excel spreadsheet that presents our design approach.

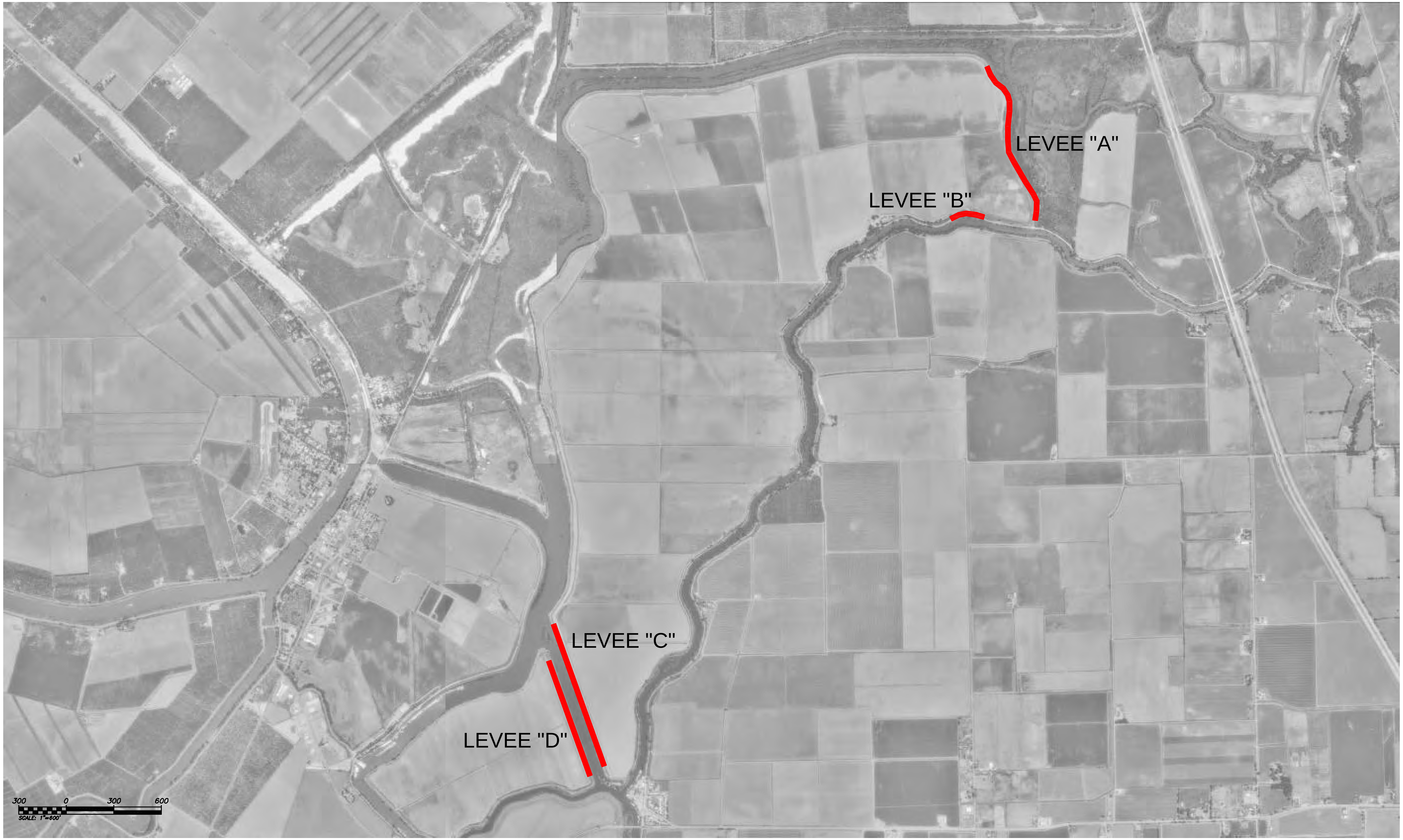


Figure 1. Location of Hydraulic Elements for Ecosystem Restoration Option 1

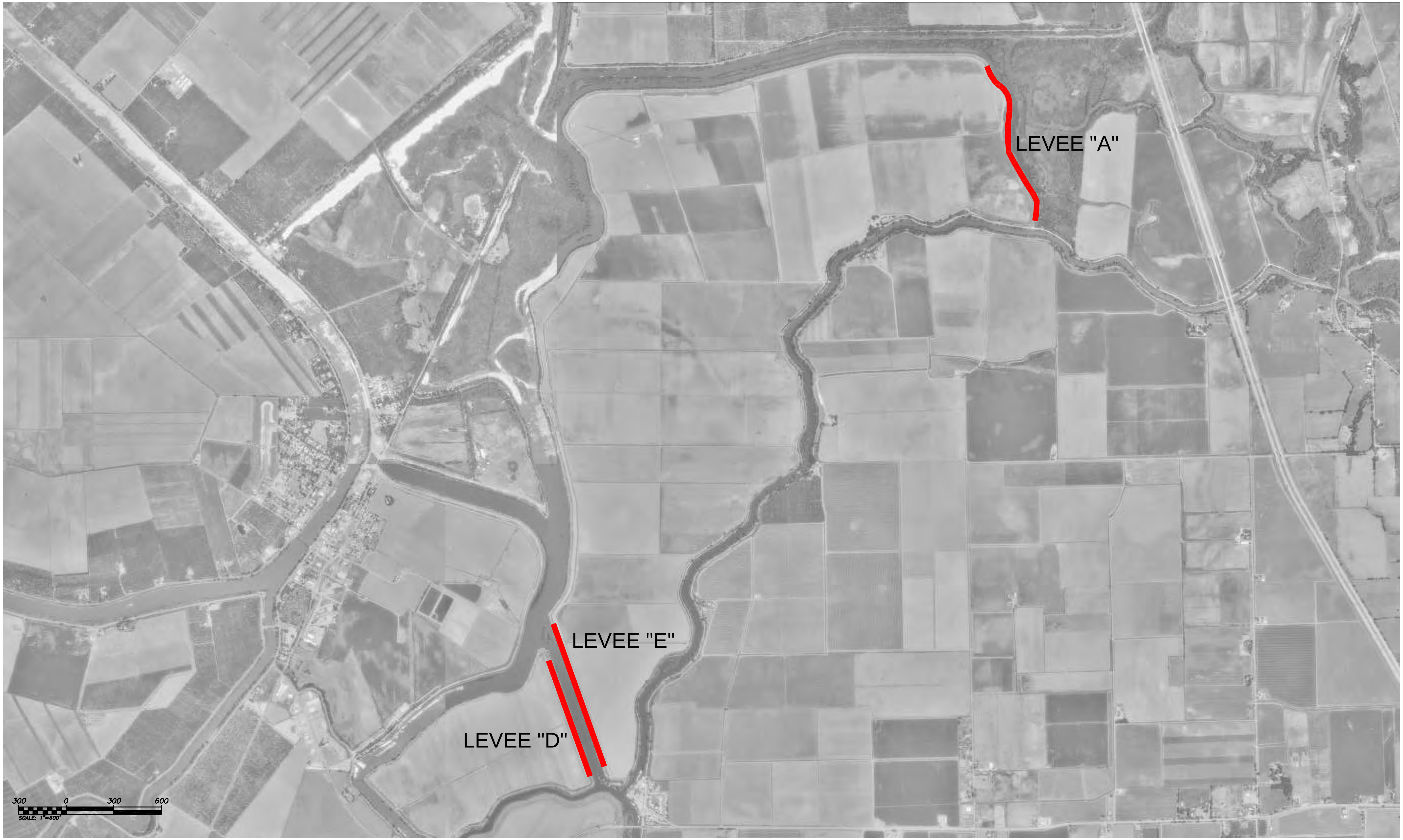


Figure 2. Location of Hydraulic Elements for Ecosystem Restoration Option 2

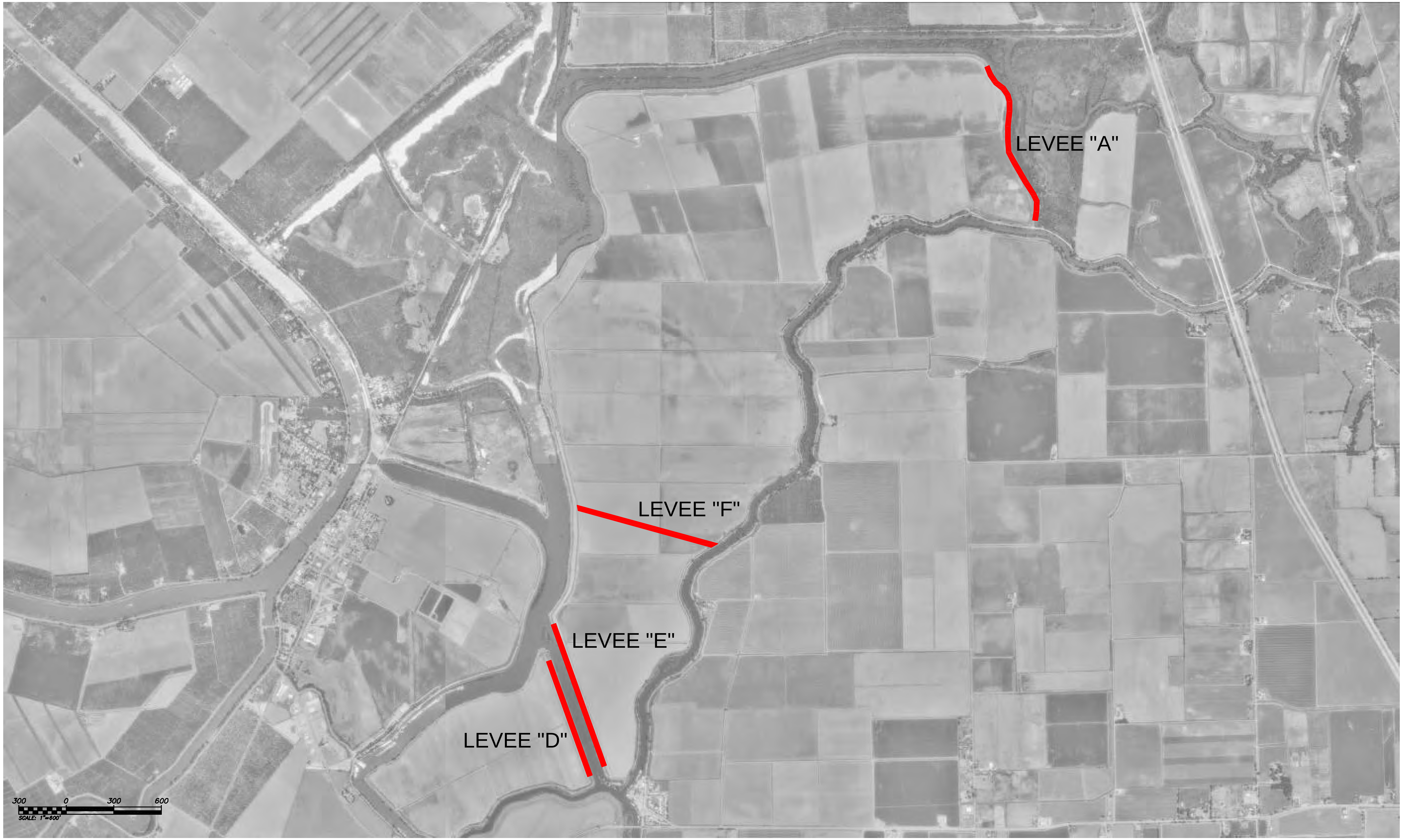


Figure 3. Location of Hydraulic Elements for Ecosystem Restoration Option 3

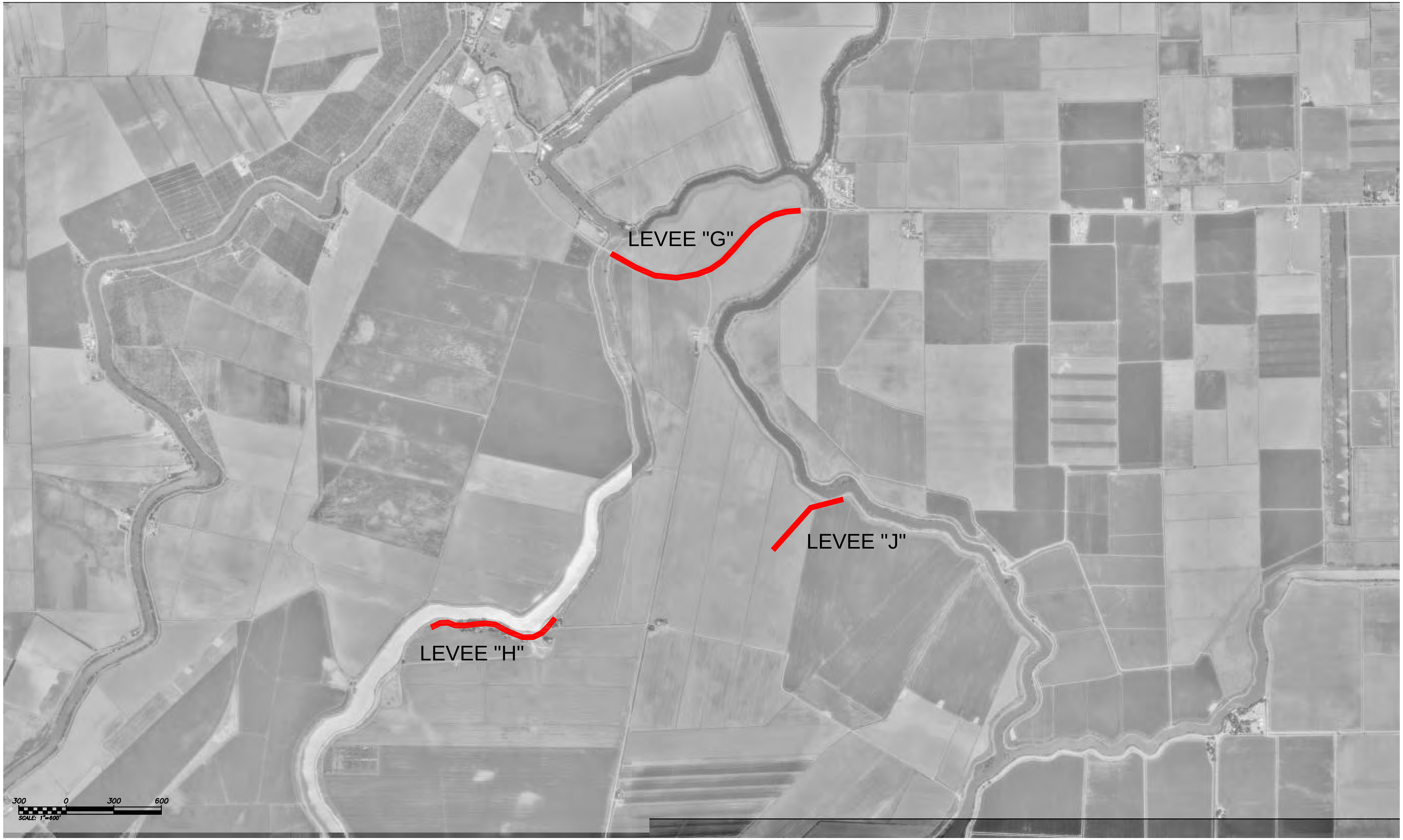


Figure 4. Location of Hydraulic Elements for Flood Control Options 1, 2, and 3

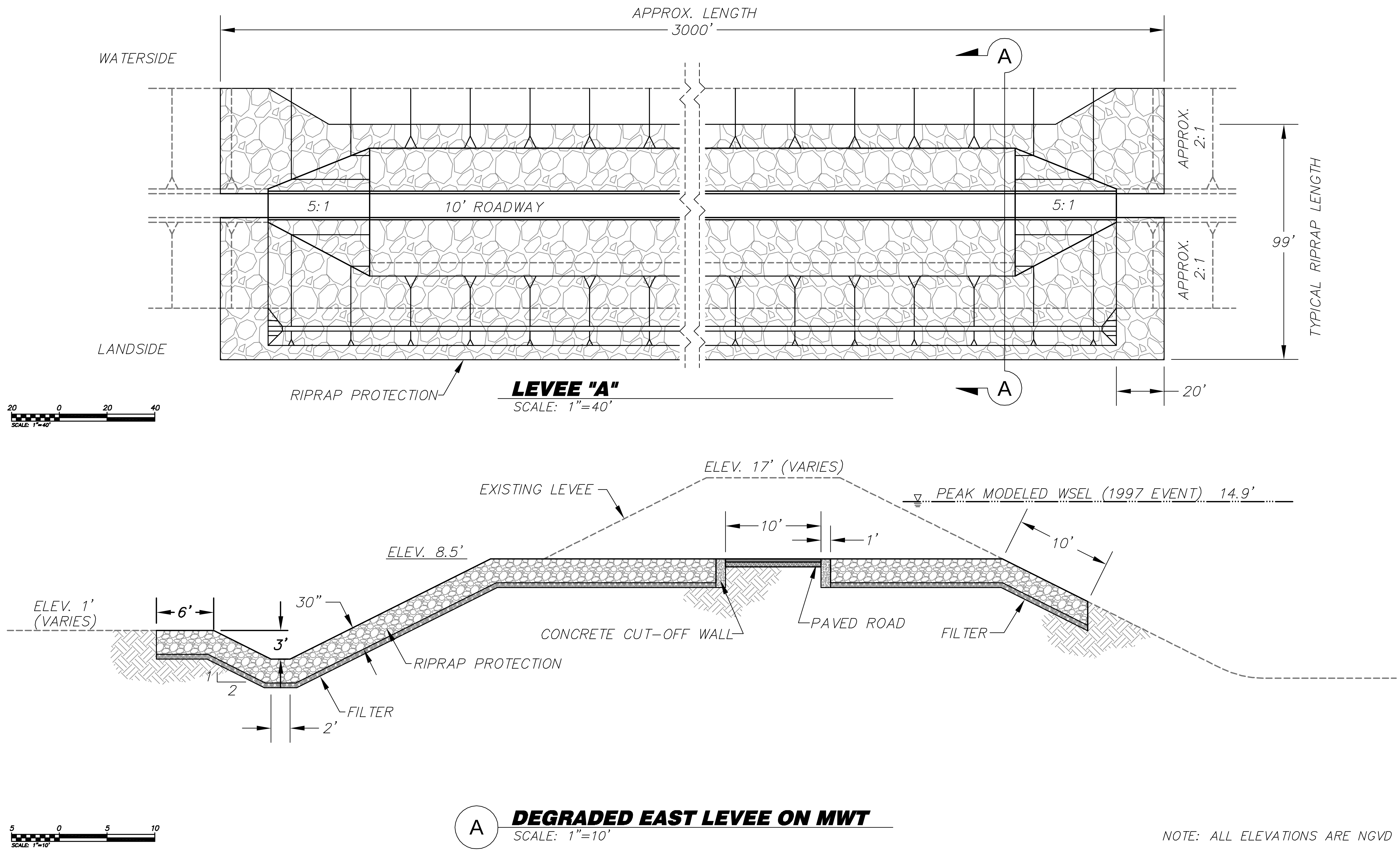
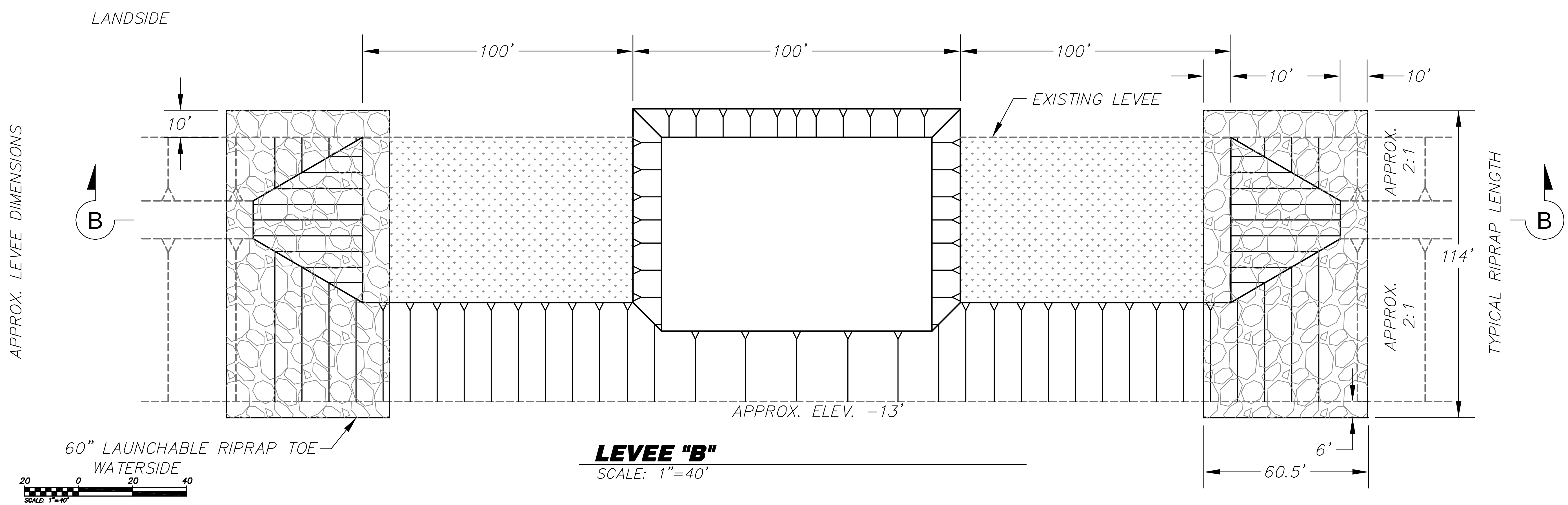


Figure 5. Levee "A"



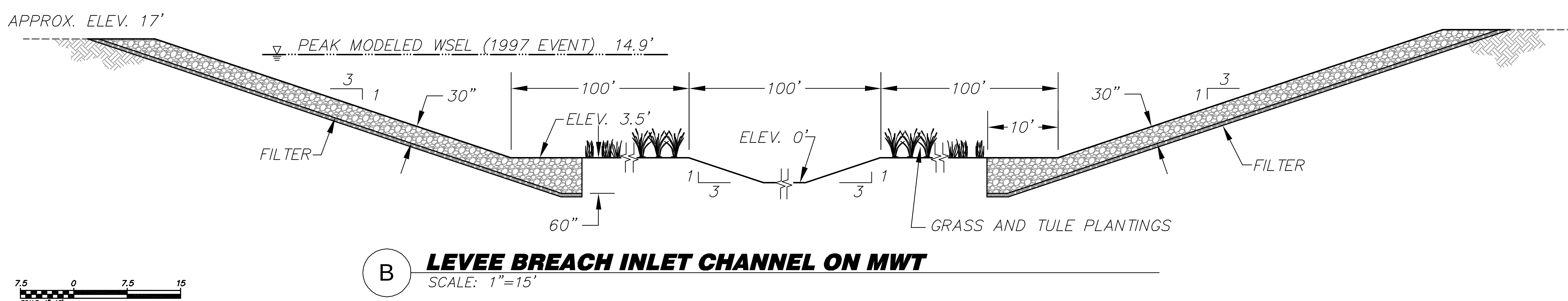
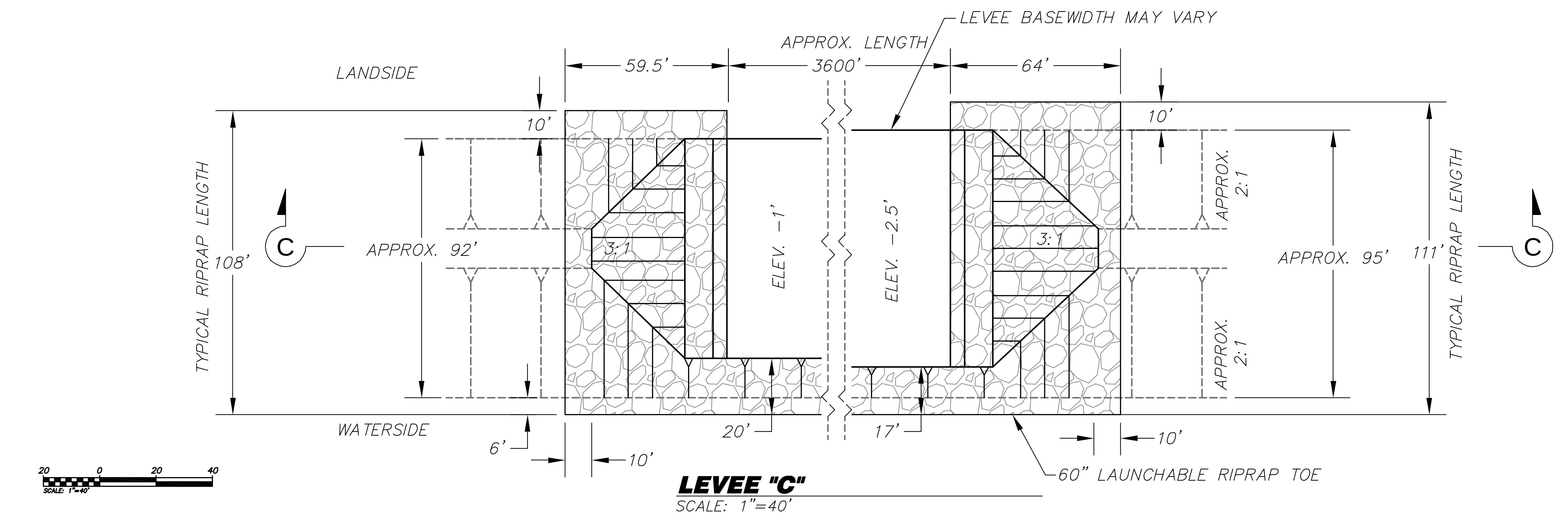
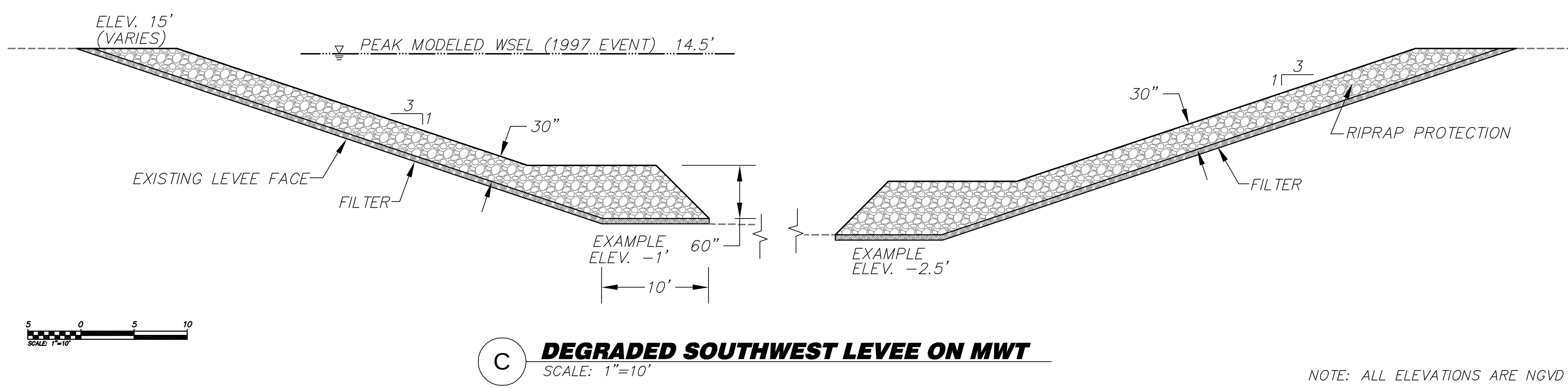


Figure 6. Levee "B"





NOTE: ALL ELEVATIONS ARE NGVD

Figure 7. Levee "C"

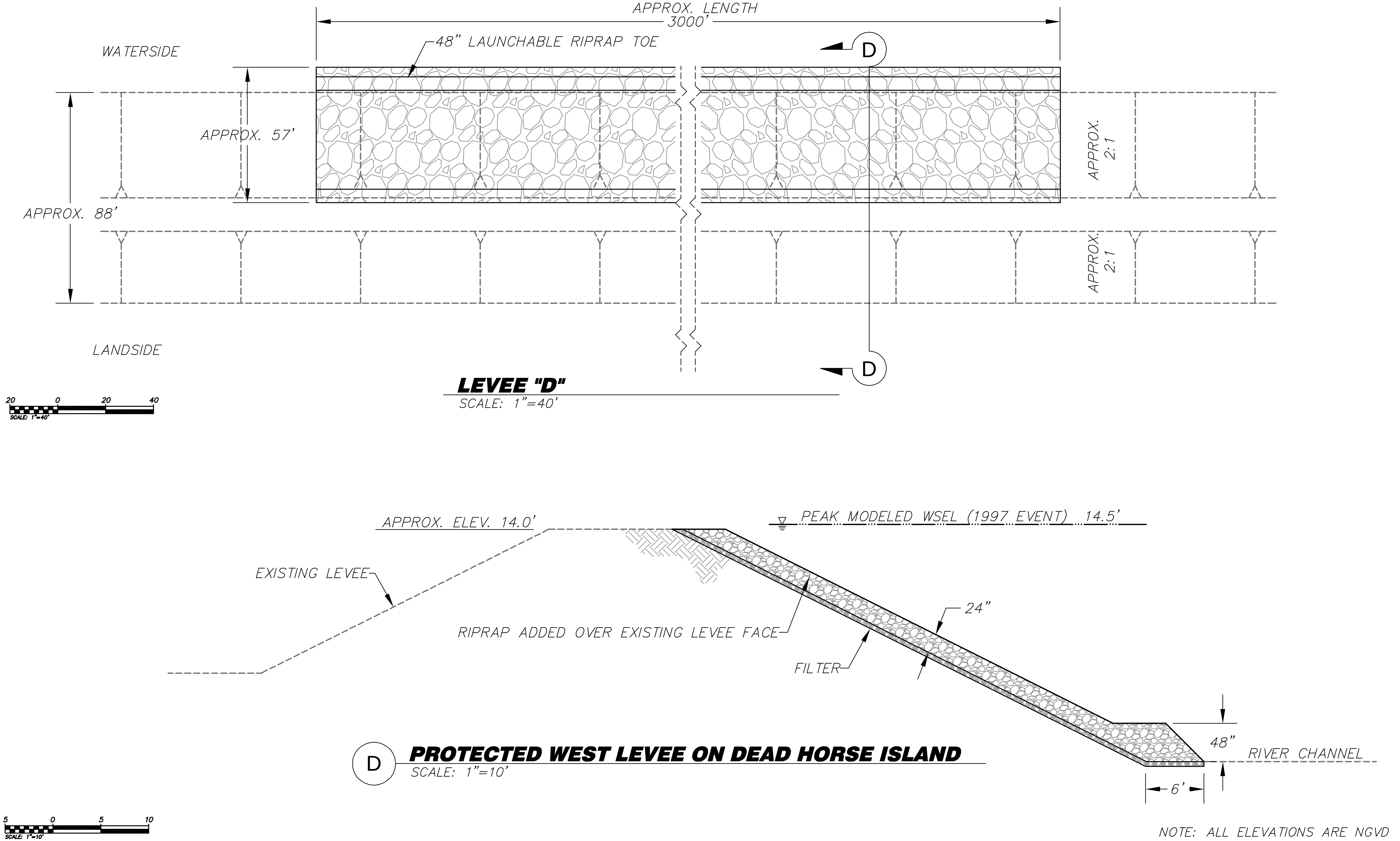


Figure 8. Levee "D"

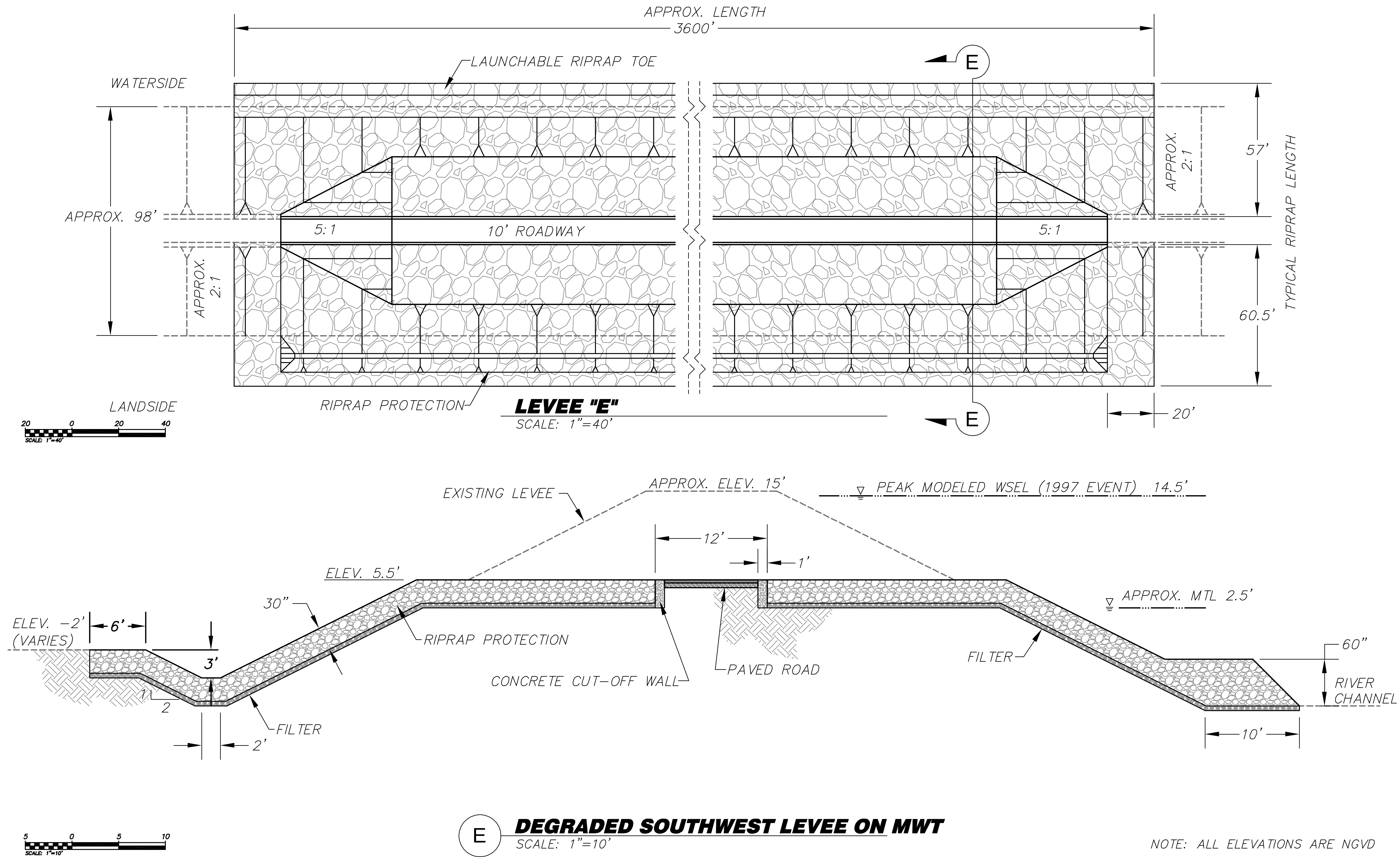
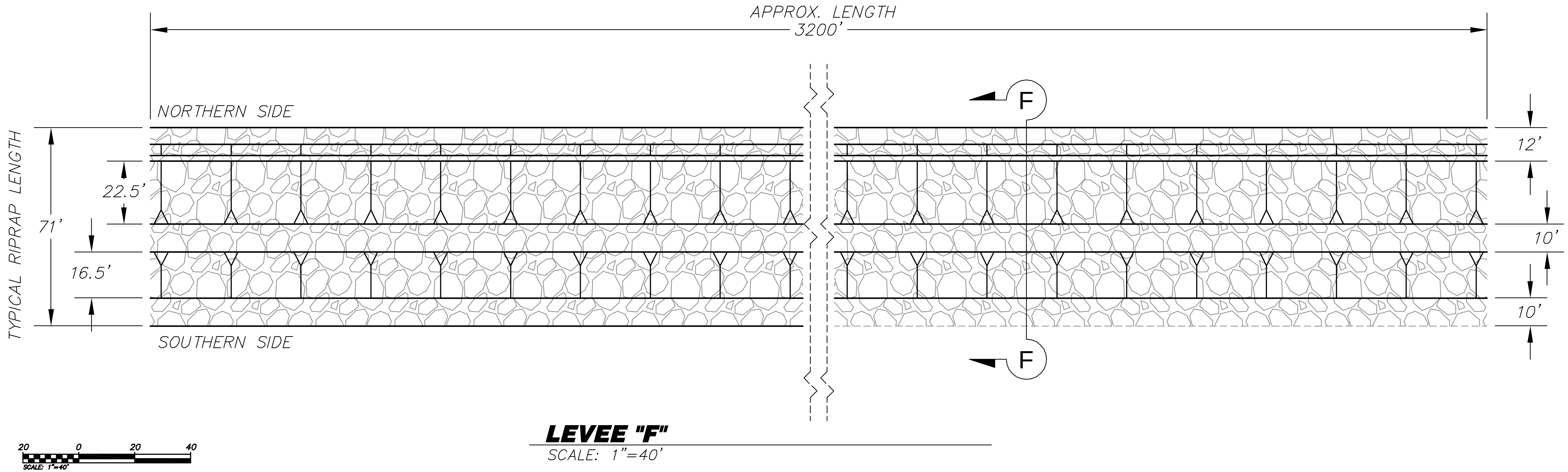
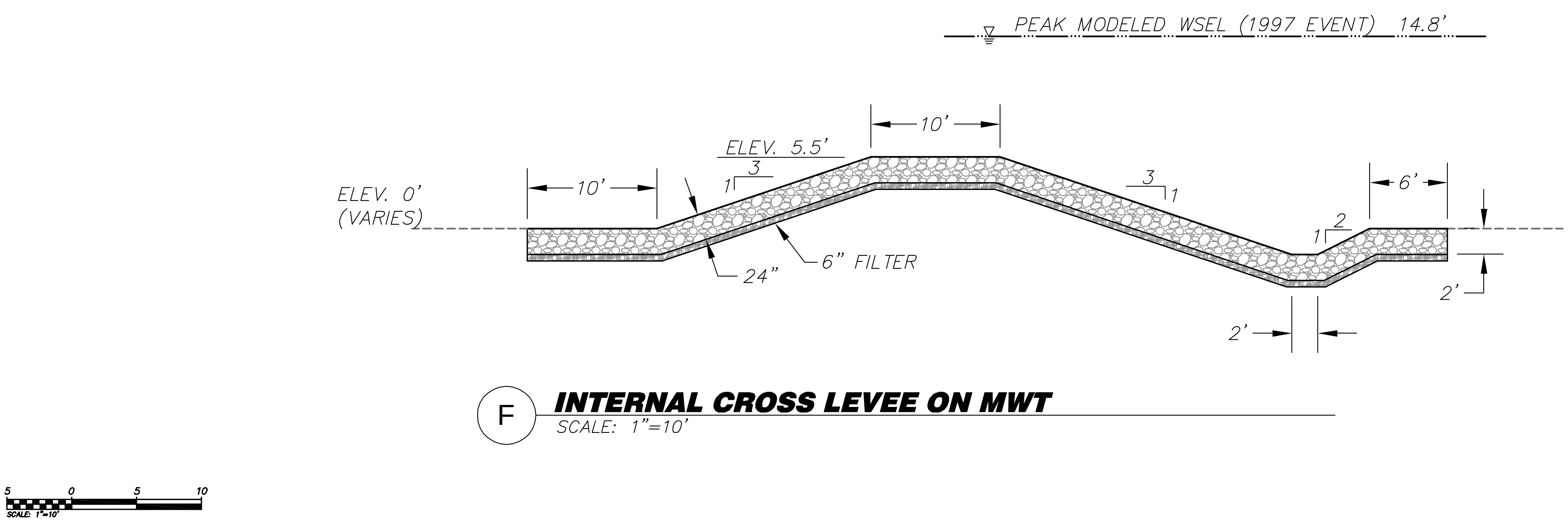


Figure 9. Levee "E"





NOTE: ALL ELEVATIONS ARE NGVD

Figure 10. Levee "F"

nhc
North Delta Concept Design

March 4, 2006

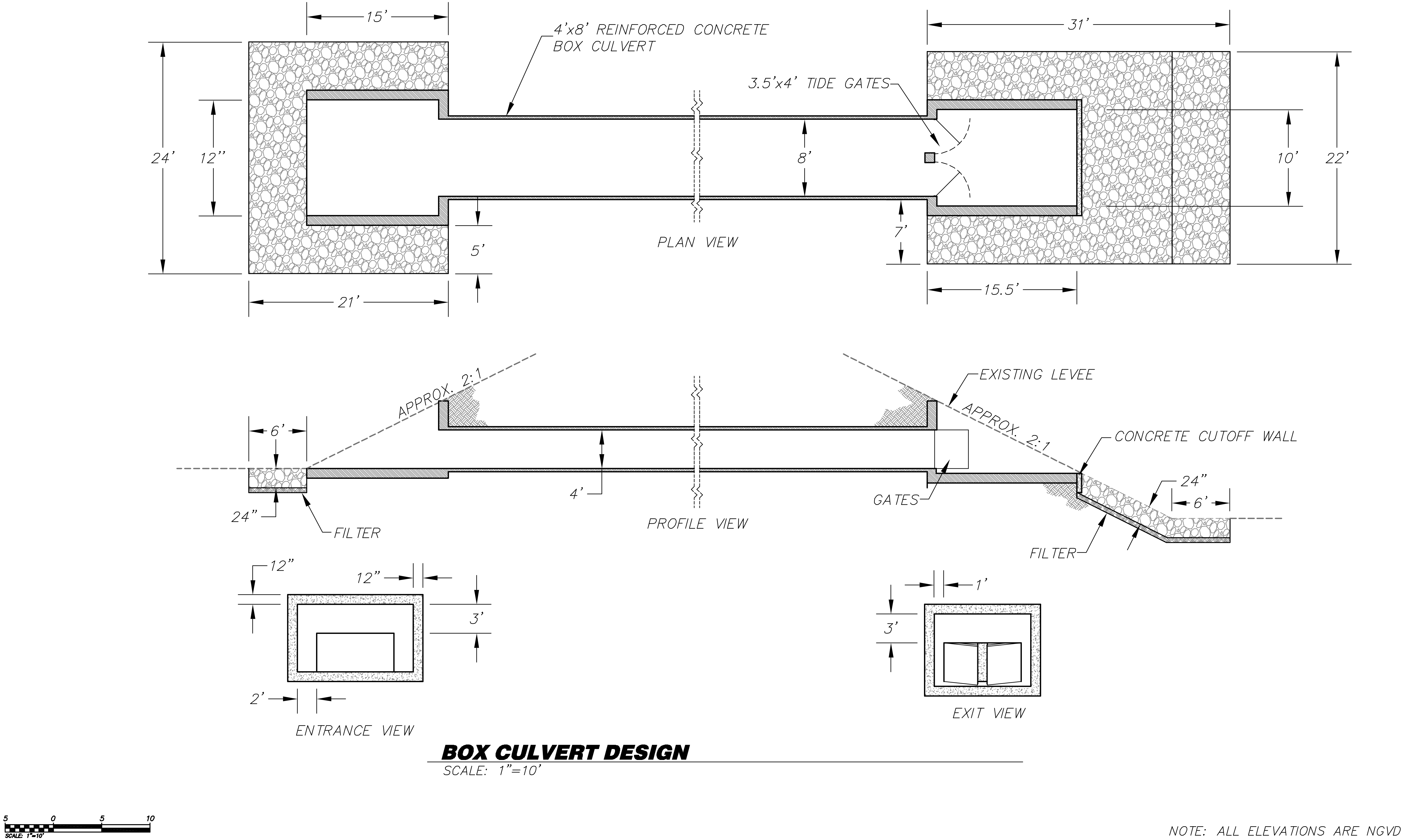


Figure 11. Box Culvert Design

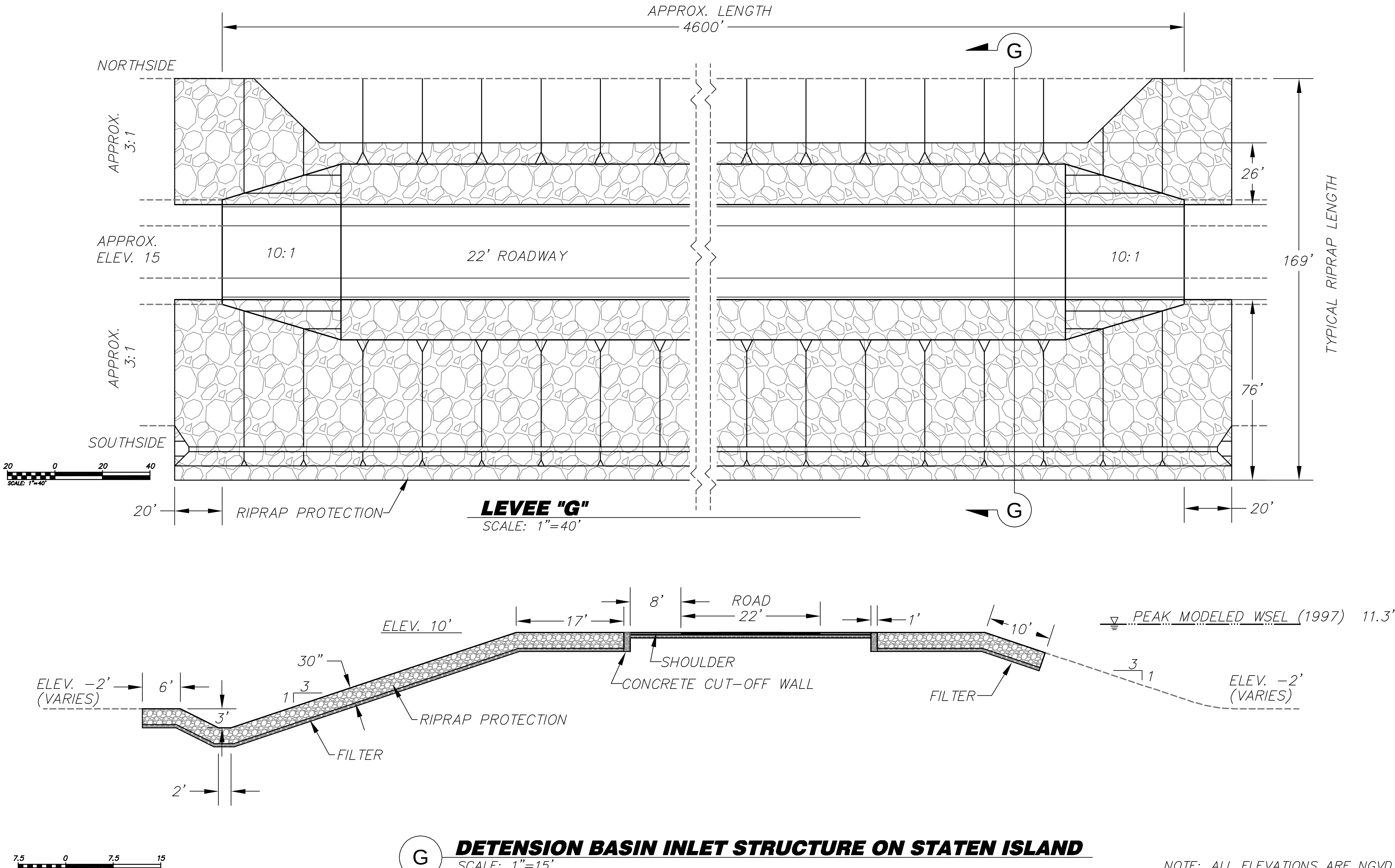


Figure 12. Levee "G"

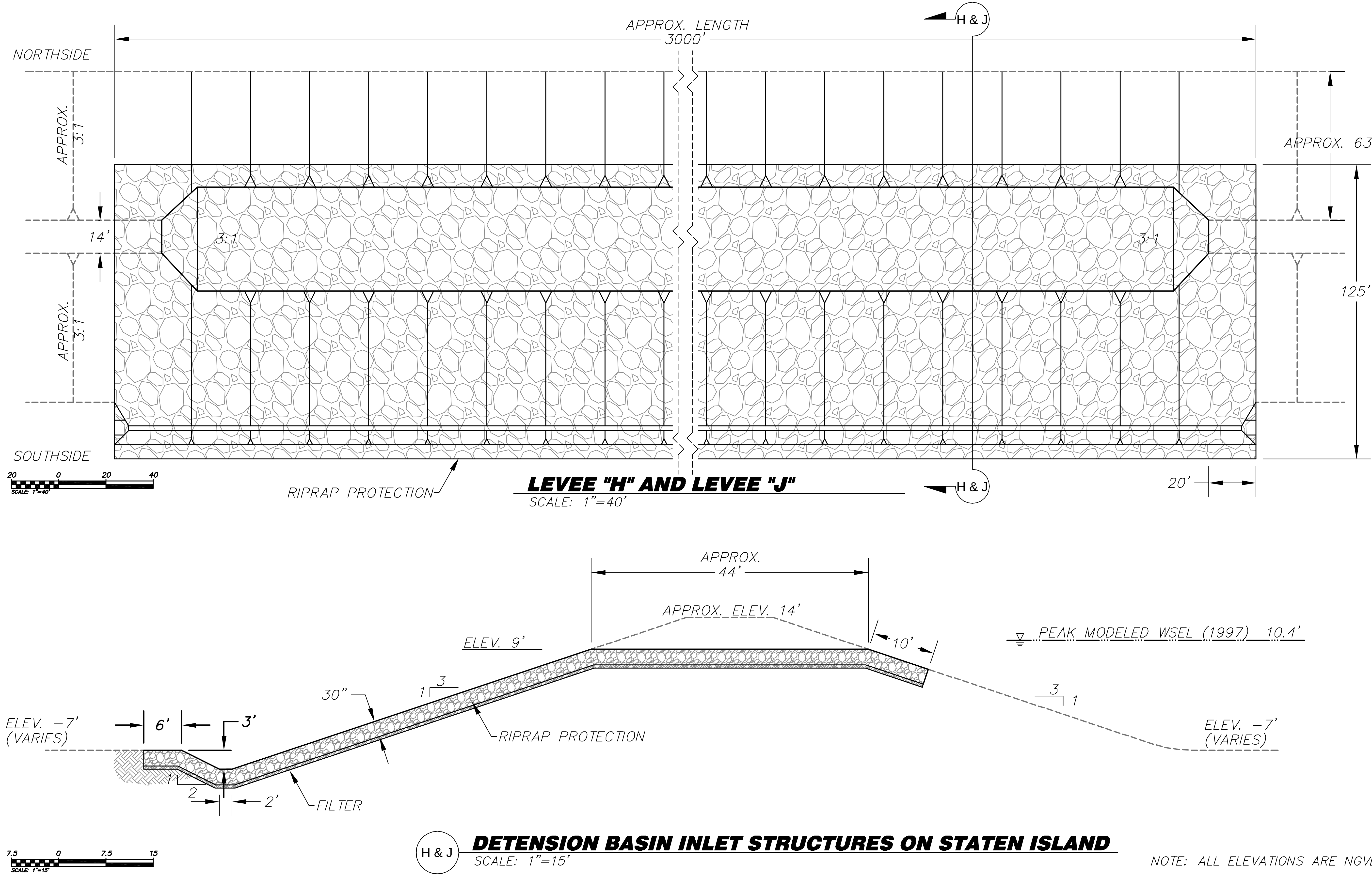
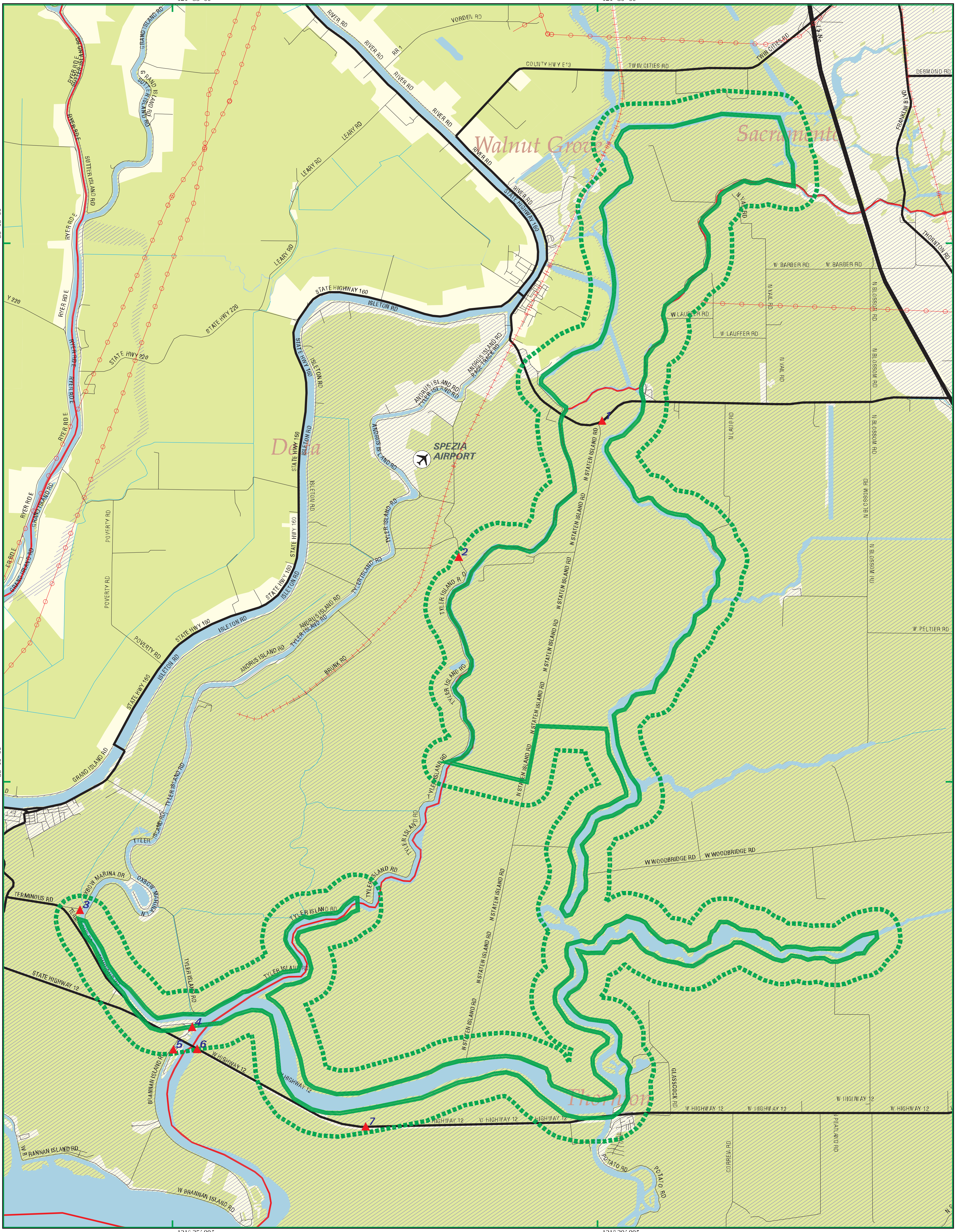


Figure 13. Levee "H" & Levee "J"

Appendix G

EDR Area Study Report and Data Map



EDR DataMap - Area Study

North Delta Project

EDR Environmental Data Resources Inc

North Delta, CA

- Listed Sites
- Earthquake Epicenters (Richter 5 or greater)
- Search Boundary
- Roads
- Major Roads
- Waterways
- Railroads
- Contour Lines
- Pipelines
- Powerlines
- Fault Lines
- Water
- Superfund Sites
- Federal DOD Sites
- Indian Reservations BIA
- 100-Yr Flood Zones
- Wetlands

N

0 1/2 1

Scale in Miles

 01341278.1r - 13 Jan 05

EDR DataMap™
Area Study

North Delta Project
North Delta, CA 95412

January 13, 2005

Inquiry number 01341278.1r

EDR™ Environmental
Data Resources Inc

The Standard in Environmental Risk Management Information

440 Wheelers Farms Road
Milford, Connecticut 06460

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR).

TARGET PROPERTY INFORMATION

ADDRESS

NORTH DELTA, CA 95412
NORTH DELTA, CA 95412

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records within the requested search area for the following databases:

FEDERAL ASTM STANDARD

NPL........ National Priority List
Proposed NPL........ Proposed National Priority List Sites
CERCLIS........ Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP........ CERCLIS No Further Remedial Action Planned
CORRACTS........ Corrective Action Report
RCRA-TSDF........ Resource Conservation and Recovery Act Information
RCRA-LQG........ Resource Conservation and Recovery Act Information
RCRA-SQG........ Resource Conservation and Recovery Act Information

STATE ASTM STANDARD

AWP........ Annual Workplan Sites
Cal-Sites........ Calsites Database
Notify 65........ Proposition 65 Records
Toxic Pits........ Toxic Pits Cleanup Act Sites
SWF/LF........ Solid Waste Information System
WMUDS/SWAT........ Waste Management Unit Database
CA BOND EXP. PLAN........ Bond Expenditure Plan
UST........ List of Underground Storage Tank Facilities
VCP........ Voluntary Cleanup Program Properties
INDIAN LUST........ Leaking Underground Storage Tanks on Indian Land
INDIAN UST........ Underground Storage Tanks on Indian Land
CA FID UST........ Facility Inventory Database

FEDERAL ASTM SUPPLEMENTAL

CONSENT........ Superfund (CERCLA) Consent Decrees
ROD........ Records Of Decision
Delisted NPL........ National Priority List Deletions

EXECUTIVE SUMMARY

FINDS Facility Index System/Facility Identification Initiative Program Summary Report
HMIRS Hazardous Materials Information Reporting System
MLTS Material Licensing Tracking System
MINES Mines Master Index File
NPL Liens Federal Superfund Liens
PADS PCB Activity Database System
DOD Department of Defense Sites
INDIAN RESERV Indian Reservations
UMTRA Uranium Mill Tailings Sites
ODI Open Dump Inventory
FUDS Formerly Used Defense Sites
RAATS RCRA Administrative Action Tracking System
TRIS Toxic Chemical Release Inventory System
TSCA Toxic Substances Control Act
SSTS Section 7 Tracking Systems
FTTS INSP FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

STATE OR LOCAL ASTM SUPPLEMENTAL

CLEANERS Cleaner Facilities
DEED Deed Restriction Listing
SCH School Property Evaluation Program
REF Unconfirmed Properties Referred to Another Agency
EMI Emissions Inventory Data
NFA No Further Action Determination
NFE Properties Needing Further Evaluation

EDR PROPRIETARY HISTORICAL DATABASES

Coal Gas Former Manufactured Gas (Coal Gas) Sites

BROWNFIELDS DATABASES

US BROWNFIELDS A Listing of Brownfields Sites
VCP Voluntary Cleanup Program Properties

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified.

Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

FEDERAL ASTM STANDARD

ERNS: The Emergency Response Notification System records and stores information on reported releases of oil and hazardous substances. The source of this database is the U.S. EPA.

A review of the ERNS list, as provided by EDR, and dated 12/31/2003 has revealed that there are 2 ERNS sites within the searched area.

Site	Address	Map ID	Page
841 BRANNAN ISLAND ROAD	841 BRANNAN ISLAND ROAD	5	10
500 PERRY'S ISLAND ROAD	500 PERRY'S ISLAND ROAD	5	14

STATE ASTM STANDARD

CHMIRS: The California Hazardous Material Incident Report System contains information on reported hazardous material incidents, i.e., accidental releases or spills. The source is the California Office of Emergency Services.

A review of the CHMIRS list, as provided by EDR, and dated 12/31/2003 has revealed that there is 1 CHMIRS site within the searched area.

Site	Address	Map ID	Page
Not reported	500 PERRY'S ISLAND RD.	5	13

CORTESE: This database identifies public drinking water wells with detectable levels of contamination, hazardous substance sites selected for remedial action, sites with known toxic material identified through the abandoned site assessment program, sites with USTs having a reportable release and all solid waste disposal facilities from which there is known migration. The source is the California Environmental Protection Agency/Office of Emergency Information.

A review of the Cortese list, as provided by EDR, has revealed that there are 3 Cortese sites within the searched area.

Site	Address	Map ID	Page
OXBOW MARINA	***100 OXBOW MARINA DR***	***3***	***5***
B & W RESORT MARINA	***964 BRANNAN ISLAND RD***	***4***	***7***
PERRY'S BOAT SALES	***500 PERRY'S ISLAND RD***	***5***	***10***

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the State Water Resources Control Board Leaking Underground Storage Tank Information System.

A review of the LUST list, as provided by EDR, and dated 10/13/2004 has revealed that there are 3 LUST sites within the searched area.

Site	Address	Map ID	Page
OXBOW MARINA	***100 OXBOW MARINA DR***	***3***	***5***
B & W RESORT MARINA	***964 BRANNAN ISLAND RD***	***4***	***7***
PERRY'S BOAT SALES	***500 PERRY'S ISLAND RD***	***5***	***10***

EXECUTIVE SUMMARY

HIST UST: Historical UST Registered Database.

A review of the HIST UST list, as provided by EDR, and dated 10/15/1990 has revealed that there are 5 HIST UST sites within the searched area.

Site	Address	Map ID	Page
NEW HOPE LANDING	13945 W. WALNUT GROVE R	1	3
OX BOW MARINA	100 OXBOW MARINA DR	3	4
B&W RESORT MARINA	964 BRANNAN ISLAND RD	4	9
PERRYS OAT HARBOR	500 PERRY'S ISLAND ROAD	5	12
TOWER PARK MARINA	***14900 W HIGHWAY 12***	***6***	***15***

STATE OR LOCAL ASTM SUPPLEMENTAL

CS: Contaminated Sites.

A review of the Sacramento Co. CS list, as provided by EDR, has revealed that there are 3 Sacramento Co. CS sites within the searched area.

Site	Address	Map ID	Page
OXBOW MARINA	***100 OXBOW MARINA DR***	***3***	***5***
B & W RESORT MARINA	***964 BRANNAN ISLAND RD***	***4***	***7***
PERRY'S BOAT SALES	***500 PERRY'S ISLAND RD***	***5***	***10***

AST: The Aboveground Storage Tank database contains registered ASTs. The data come from the State Water Resources Control Board's Hazardous Substance Storage Container Database.

A review of the AST list, as provided by EDR, and dated 12/01/2003 has revealed that there are 2 AST sites within the searched area.

Site	Address	Map ID	Page
OXBOW MARINA	***100 OXBOW MARINA DR***	***3***	***5***
B & W RESORT MARINA	***964 BRANNAN ISLAND RD***	***4***	***7***

WDS: California Water Resources Control Board - Waste Discharge System.

A review of the CA WDS list, as provided by EDR, and dated 10/11/2004 has revealed that there are 2 CA WDS sites within the searched area.

Site	Address	Map ID	Page
PERRY'S BOAT SALES	***500 PERRY'S ISLAND RD***	***5***	***10***
TOWER PARK MARINA	***14900 W HIGHWAY 12***	***6***	***15***

EXECUTIVE SUMMARY

CA SLIC: SLIC Region comes from the California Regional Water Quality Control Board.

A review of the CA SLIC list, as provided by EDR, has revealed that there are 2 CA SLIC sites within the searched area.

Site	Address	Map ID	Page
TOWER PARK MARINA	14900 HIGHWAY 12 W	6	16
TOWER PARK MARINA	14900 WEST HIGHWAY 12	6	16

HAZNET: The data is extracted from the copies of hazardous waste manifests received each year by the DTSC. The annual volume of manifests is typically 700,000-1,000,000 annually, representing approximately 350,000-500,000 shipments. Data from non-California manifests & continuation sheets are not included at the present time. Data are from the manifests submitted without correction, and therefore many contain some invalid values for data elements such as generator ID, TSD ID, waste category, & disposal method. The source is the Department of Toxic Substance Control is the agency

A review of the HAZNET list, as provided by EDR, and dated 12/31/2002 has revealed that there are 2 HAZNET sites within the searched area.

Site	Address	Map ID	Page
OXBOW MARINA	***100 OXBOW MARINA DR***	***3***	***5***
FTG CONSTRUCTION MATERIALS, IN	5184 WEST HIGHWAY 12	7	16

CA ML: Sacramento County Master List. Any business that has hazardous materials on site - hazardous materials storage sites, underground storage tanks, waste generators.

A review of the Sacramento Co. ML list, as provided by EDR, has revealed that there are 4 Sacramento Co. ML sites within the searched area.

Site	Address	Map ID	Page
MELLO FARMS, INC	17153 TYLER ISLAND RD	2	3
OX BOW MARINA	100 OX BOW MARINA DR	3	4
B & W RESORT MARINA	***964 BRANNAN ISLAND RD***	***4***	***7***
PERRY'S BOAT SALES	***500 PERRY'S ISLAND RD***	***5***	***10***

EXECUTIVE SUMMARY

Please refer to the end of the findings report for unmapped orphan sites due to poor or inadequate address information.

MAP FINDINGS SUMMARY

Database	Total Plotted
FEDERAL ASTM STANDARD	
NPL	0
Proposed NPL	0
CERCLIS	0
CERC-NFRAP	0
CORRACTS	0
RCRA TSD	0
RCRA Lg. Quan. Gen.	0
RCRA Sm. Quan. Gen.	0
ERNS	2
STATE ASTM STANDARD	
AWP	0
Cal-Sites	0
CHMIRS	1
Cortese	3
Notify 65	0
Toxic Pits	0
State Landfill	0
WMUDS/SWAT	0
LUST	3
CA Bond Exp. Plan	0
UST	0
VCP	0
INDIAN LUST	0
INDIAN UST	0
CA FID UST	0
HIST UST	5
FEDERAL ASTM SUPPLEMENTAL	
CONSENT	0
ROD	0
Delisted NPL	0
FINDS	0
HMIRS	0
MLTS	0
MINES	0
NPL Liens	0
PADS	0
DOD	0
INDIAN RESERV	0
UMTRA	0
ODI	0
FUDS	0
RAATS	0
TRIS	0

Database	Total Plotted
TSCA	0
SSTS	0
FTTS	0

STATE OR LOCAL ASTM SUPPLEMENTAL

Database	Total Plotted
Sacramento Co. CS	3
AST	2
CLEANERS	0
CA WDS	2
DEED	0
SCH	0
REF	0
EMI	0
NFA	0
NFE	0
SLIC	2
HAZNET	2
Sacramento Co. ML	4

EDR PROPRIETARY HISTORICAL DATABASES

Database	Total Plotted
Coal Gas	0

BROWNFIELDS DATABASES

Database	Total Plotted
US BROWNFIELDS	0
VCP	0

NOTES:

Sites may be listed in more than one database

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

---

1 **NEW HOPE LANDING** **HIST UST** **U001614012**
13945 W. WALNUT GROVE ROAD **N/A**
THORNTON, CA 95686

UST HIST:

Facility ID:	64148	Owner Name:	DONALD E. DECKERT
Total Tanks:	2	Region:	STATE
Owner Address:	13945 W. WALNUT GROVE ROAD THORNTON, CA 95686		
Tank Used for:	PRODUCT		
Tank Num:	1	Container Num:	#1
Tank Capacity:	00000550	Year Installed:	Not reported
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	Not reported	Telephone:	(209) 794-2627
Facility Type:	Other	Other Type:	MARINA

Facility ID:	64148	Owner Name:	DONALD E. DECKERT
Total Tanks:	2	Region:	STATE
Owner Address:	13945 W. WALNUT GROVE ROAD THORNTON, CA 95686		
Tank Used for:	PRODUCT		
Tank Num:	2	Container Num:	#2
Tank Capacity:	00000550	Year Installed:	Not reported
Type of Fuel:	06	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	Not reported	Telephone:	(209) 794-2627
Facility Type:	Other	Other Type:	MARINA

---

2 **MELLO FARMS, INC** **Sacramento Co. ML** **S105808765**
17153 TYLER ISLAND RD **N/A**
ISLETO, CA 95641

Sacramento ML:

Facility Id:	Not reported
Number of Tanks:	0
WG Bill Code:	53
Food Bill Code :	53
Billing Codes BP:	Farm-No Fee
Billing Codes UST:	Farm-No Fee
Tier Permitting:	Not reported
Risk Mgmt Protection Program :	Not reported
FD:	O
Target Property Bill Code:	50
CUPA Permit Date:	Not reported
HAZMAT Permit Date:	Not reported
HAZMAT Inspection Date:	Not reported
UST Inspection Date:	Not reported
UST Tank Test Date:	Not reported
Waste General Insp Date:	Not reported

3 **OX BOW MARINA**
100 OX BOW MARINA DR
ISLETON, CA 95641

Sacramento Co. ML **S105033356**
N/A

Sacramento ML:

Facility Id:	Not reported
Number of Tanks:	0
WG Bill Code:	Not reported
Food Bill Code :	Not reported
Billing Codes BP:	5203
Billing Codes UST:	5404*
Tier Permitting:	Not reported
Risk Mgmt Protection Program :	Not reported
FD:	Not reported
Target Property Bill Code:	Not reported
CUPA Permit Date:	Not reported
HAZMAT Permit Date:	Not reported
HAZMAT Inspection Date:	Not reported
UST Inspection Date:	Not reported
UST Tank Test Date:	Not reported
Waste General Insp Date:	Not reported

---

3 **OX BOW MARINA**
100 OXBOW MARINA DR
ISLETON, CA 95641

HIST UST **U001613110**
N/A

UST HIST:

Facility ID:	11635	Owner Name:	OX BOW MARINA
Total Tanks:	4	Region:	STATE
Owner Address:	100 OX BOW MARINA DRIVE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	1	Container Num:	1
Tank Capacity:	00006000	Year Installed:	1979
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	JOHN DYER	Telephone:	(916) 777-6060
Facility Type:	Gas Station	Other Type:	Not reported

Facility ID:	11635	Owner Name:	OX BOW MARINA
Total Tanks:	4	Region:	STATE
Owner Address:	100 OX BOW MARINA DRIVE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	2	Container Num:	2
Tank Capacity:	00006000	Year Installed:	1979
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	JOHN DYER	Telephone:	(916) 777-6060
Facility Type:	Gas Station	Other Type:	Not reported

Facility ID:	11635	Owner Name:	OX BOW MARINA
Total Tanks:	4	Region:	STATE
Owner Address:	100 OX BOW MARINA DRIVE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	3	Container Num:	3
Tank Capacity:	00006000	Year Installed:	1979
Type of Fuel:	DIESEL	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	JOHN DYER	Telephone:	(916) 777-6060

OX BOW MARINA (Continued) **U001613110**

Facility Type:	Gas Station	Other Type:	Not reported
Facility ID:	11635	Owner Name:	OX BOW MARINA
Total Tanks:	4	Region:	STATE
Owner Address:	100 OX BOW MARINA DRIVE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	4	Container Num:	4
Tank Capacity:	00002000	Year Installed:	1979
Type of Fuel:	PREMIUM	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	JOHN DYER	Telephone:	(916) 777-6060
Facility Type:	Gas Station	Other Type:	Not reported

---

3 **OXBOW MARINA**
100 OXBOW MARINA DR
ISLETON, CA 95641

Database(s): **HAZNET, LUST, Cortese, AST, Sacramento Co. CS**
EDR ID Number: **S103891938**
EPA ID Number: **N/A**

State LUST:

Cross Street:	TERMINOUS RD		
Qty Leaked:	Not reported		
Case Number	341250		
Reg Board:	5S		
Chemical:	Gasoline		
Lead Agency:	Local Agency		
Local Agency :	34000L		
Case Type:	Drinking Water Aquifer affected		
Status:	Remediation Plan		
Review Date:	1999-04-14 00:00:00	Confirm Leak:	1999-04-14 00:00:00
Workplan:	1999-09-20 00:00:00	Prelim Assess:	1999-09-20 00:00:00
Pollution Char:	2003-01-17 00:00:00	Remed Plan:	2003-01-17 00:00:00
Remed Action:	Not reported		
Monitoring:	Not reported		
Close Date:	Not reported		
Release Date:	Not reported		
Cleanup Fund Id :	14745		
Discover Date :	1999-04-14 00:00:00		
Enforcement Dt :	1965-01-01 00:00:00		
Enf Type:	FREV		
Enter Date :	1999-05-20 00:00:00		
Funding:	Not reported		
Staff Initials:	SJE		
How Discovered:	Tank Closure		
How Stopped:	Close Tank		
Interim :	Not reported		
Leak Cause:	UNK		
Leak Source:	UNK		
MTBE Date :	1999-09-17 00:0		
Max MTBE GW :	7400 Parts per Billion		
MTBE Tested:	MTBE Detected. Site tested for MTBE & MTBE detected		
Priority:	Not reported		
Local Case # :	D567		
Beneficial:	MUN		
Staff :	CFE		
GW Qualifier :	=		
Max MTBE Soil :	54 Parts per Million		
Soil Qualifier :	=		

OXBOW MARINA (Continued) **S103891938**

Hydr Basin #: SACRAMENTO VALLEY (5
Operator : Not reported
Oversight Prgm: LUST
Review Date : Not reported
Stop Date : Not reported
Work Suspended : No
Responsible Party JOE DA CRUZ
RP Address: Not reported
Global Id: T0606701074
Org Name: Not reported
Contact Person: Not reported
MTBE Conc: 4
Mtbe Fuel: 1
Water System Name: Not reported
Well Name: Not reported
Distance To Lust: 0
Waste Discharge Global ID: Not reported
Waste Disch Assigned Name: Not reported

LUST Region 5:
Substance: GASOLINE
Case Type: Drinking Water Aquifer affected
Program: LUST
Staff Initials: CFE Case Number: 341250
Status: Remediation Plan
MTBE Code: 7
Lead Agency: Local

HAZNET:
Gepaid: CAC001461128
TSD EPA ID: CAD099452708
Gen County: Sacramento
Tsd County: Los Angeles
Tons: 1.251
Waste Category: Unspecified oil-containing waste
Disposal Method: Recycler
Contact: LLOYD KORTH/MARILYN DUC,A PART
Telephone: (000) 000-0000
Mailing Address: 100 OXBOW MARINA DR
ISLETON, CA 95641
County Sacramento

CORTESE:
Region: CORTESE
Fac Address 2: 100 OXBOW MARINA DR

SACRAMENTO CS:
Facility Id: RO0001310
Region: SACRAMENTO
State Site Number: D567
Lead Staff: ERIKSON, S.
Lead Agency: HM
Remedial Action Taken: Not reported
Post Remedial Action Monitoring:
Substance: Automotive(motor gasoline and additives)
Date Reported: 06/17/1999
Date Closed: Not reported
Case Type: Other ground water affected

OXBOW MARINA (Continued) **S103891938**

AST:
Owner: OXBOW MARINA
Total Gallons: 8000

---

4 **B & W RESORT MARINA**
964 BRANNAN ISLAND RD
ISLETON, CA 95641

LUST **S101332040**
Cortese **N/A**
AST
Sacramento Co. ML
Sacramento Co. CS

State LUST:

Cross Street:	HIGHWAY 12		
Qty Leaked:	Not reported		
Case Number	340264		
Reg Board:	5S		
Chemical:	Gasoline		
Lead Agency:	Local Agency		
Local Agency :	34000L		
Case Type:	Other ground water affected		
Status:	Remedial action (cleanup) Underway		
Review Date:	Not reported	Confirm Leak:	Not reported
Workplan:	1990-03-28 00:00:00	Prelim Assess:	1990-03-28 00:00:00
Pollution Char:	2001-01-16 00:00:00	Remed Plan:	2001-01-16 00:00:00
Remed Action:	2003-10-13 00:00:00		
Monitoring:	Not reported		
Close Date:	Not reported		
Release Date:	1988-06-28 00:00:00		
Cleanup Fund Id :	Not reported		
Discover Date :	1988-06-21 00:00:00		
Enforcement Dt :	1965-01-01 00:00:00		
Enf Type:	OEFA		
Enter Date :	1988-07-28 00:00:00		
Funding:	Not reported		
Staff Initials:	LSM		
How Discovered:	Not reported		
How Stopped:	Not reported		
Interim :	Not reported		
Leak Cause:	Not reported		
Leak Source:	Not reported		
MTBE Date :	2001-06-28 00:0		
Max MTBE GW :	3700 Parts per Billion		
MTBE Tested:	MTBE Detected. Site tested for MTBE & MTBE detected		
Priority:	Not reported		
Local Case # :	B516		
Beneficial:	GWR		
Staff :	CFE		
GW Qualifier :	=		
Max MTBE Soil :	Not reported		
Soil Qualifier :	Not reported		
Hydr Basin #:	SACRAMENTO VALLEY (5		
Operator :	JAMES DE		
Oversight Prgm:	LUST		
Review Date :	2002-05-13 00:00:00		
Stop Date :	Not reported		
Work Suspended :	No		
Responsible Party	B&W RESORT MARINA		
RP Address:	425 WILLOW TREE LANE, ISLETO		
Global Id:	T0606700204		

B & W RESORT MARINA (Continued) **S101332040**

Org Name: Not reported
Contact Person: Not reported
MTBE Conc: 3
Mtbe Fuel: 1
Water System Name: DEL RIO HOT
Well Name: Not reported
Distance To Lust: 0
Waste Discharge Global ID: W060670011
Waste Disch Assigned Name: 3400116-001GEN

LUST Region 5:
Substance: GASOLINE
Case Type: Other ground water affected
Program: LUST
Staff Initials: CFE Case Number: 340264
Status: Remedial action (cleanup) Underway
MTBE Code: 6
Lead Agency: Local

CORTESE:
Region: CORTESE
Fac Address 2: 964 BRANNAN ISLAND RD

Sacramento ML:
Facility Id: Not reported
Number of Tanks: Not reported
WG Bill Code: Not reported
Food Bill Code : Not reported
Billing Codes BP: 5203
Billing Codes UST: Not reported
Tier Permitting: Not reported
Risk Mgmt Protection Program : Not reported
FD: Not reported
Target Property Bill Code: Not reported
CUPA Permit Date: Not reported
HAZMAT Permit Date: Not reported
HAZMAT Inspection Date: Not reported
UST Inspection Date: Not reported
UST Tank Test Date: Not reported
Waste General Insp Date: Not reported

SACRAMENTO CS:
Facility Id: RO0000257
Region: SACRAMENTO
State Site Number: B516
Lead Staff: MARSHALL, L.
Lead Agency: HM
Remedial Action Taken: Not reported
Post Remedial Action Monitoring:
Substance: Automotive(motor gasoline and additives)
Date Reported: 06/28/1988
Date Closed: Not reported
Case Type: Other ground water affected

B & W RESORT MARINA (Continued) **S101332040**

AST:
Owner: B & W RESORT MARINA
Total Gallons: 3900

---

4 **B&W RESORT MARINA** **HIST UST** **U001613099**
964 BRANNAN ISLAND RD **N/A**
ISLETON, CA 95641

UST HIST:

Facility ID:	2417	Owner Name:	JAMES A. DEAK
Total Tanks:	4	Region:	STATE
Owner Address:	441 W WILLOW TREE LANE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	1	Container Num:	1
Tank Capacity:	00002000	Year Installed:	Not reported
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Visual, Stock Inventor, None		
Contact Name:	Not reported	Telephone:	(916) 777-6161
Facility Type:	Gas Station	Other Type:	Not reported

Facility ID:	2417	Owner Name:	JAMES A. DEAK
Total Tanks:	4	Region:	STATE
Owner Address:	441 W WILLOW TREE LANE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	2	Container Num:	2
Tank Capacity:	00002000	Year Installed:	Not reported
Type of Fuel:	PREMIUM	Tank Construction:	Not Reported
Leak Detection:	Visual, Stock Inventor, None		
Contact Name:	Not reported	Telephone:	(916) 777-6161
Facility Type:	Gas Station	Other Type:	Not reported

Facility ID:	2417	Owner Name:	JAMES A. DEAK
Total Tanks:	4	Region:	STATE
Owner Address:	441 W WILLOW TREE LANE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	3	Container Num:	3
Tank Capacity:	00001000	Year Installed:	Not reported
Type of Fuel:	UNLEADED	Tank Construction:	Not Reported
Leak Detection:	Visual, Stock Inventor, None		
Contact Name:	Not reported	Telephone:	(916) 777-6161
Facility Type:	Gas Station	Other Type:	Not reported

Facility ID:	2417	Owner Name:	JAMES A. DEAK
Total Tanks:	4	Region:	STATE
Owner Address:	441 W WILLOW TREE LANE ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	4	Container Num:	4
Tank Capacity:	00002000	Year Installed:	Not reported
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Visual, Stock Inventor, None		
Contact Name:	Not reported	Telephone:	(916) 777-6161
Facility Type:	Gas Station	Other Type:	Not reported

5 **841 BRANNAN ISLAND ROAD** — **ERNS** — **94397310** / **N/A**
841 BRANNAN ISLAND ROAD
ANDRUS ISLAND, CA

Click this hyperlink while viewing on your computer to access additional ERNS detail in the EDR Site Report.

---

5 **PERRY'S BOAT SALES** — **LUST, Cortese, Sacramento Co. ML, CA WDS, Sacramento Co. CS** — **S102318547** / **N/A**
500 PERRY'S ISLAND RD
ISLETON, CA 95641

State LUST:

Cross Street:	BRANNON		
Qty Leaked:	Not reported		
Case Number	340592		
Reg Board:	5S		
Chemical:	Gasoline		
Lead Agency:	Local Agency		
Local Agency :	34000L		
Case Type:	Drinking Water Aquifer affected		
Status:	Case Closed		
Abate Method:	Excavate and Treat - remove contaminated soil and treat (includes spreading or land farming)		
Review Date:	1991-09-26 00:00:00	Confirm Leak:	1991-09-26 00:00:00
Workplan:	Not reported	Prelim Assess:	Not reported
Pollution Char:	Not reported	Remed Plan:	Not reported
Remed Action:	Not reported		
Monitoring:	Not reported		
Close Date:	1996-03-19 00:00:00		
Release Date:	1991-11-18 00:00:00		
Cleanup Fund Id :	Not reported		
Discover Date :	1991-09-26 00:00:00		
Enforcement Dt :	1965-01-01 00:00:00		
Enf Type:	None Taken		
Enter Date :	1991-12-10 00:00:00		
Funding:	Federal Funds		
Staff Initials:	SJE		
How Discovered:	Not reported		
How Stopped:	Not reported		
Interim :	Not reported		
Leak Cause:	Not reported		
Leak Source:	Not reported		
MTBE Date :	Not reported		
Max MTBE GW :	Not reported		
MTBE Tested:	Site NOT Tested for MTBE.Includes Unknown and Not Analyzed.		
Priority:	Medium priority		
Local Case # :	B589		
Beneficial:	Not reported		
Staff :	CFE		
GW Qualifier :	Not reported		
Max MTBE Soil :	Not reported		
Soil Qualifier :	Not reported		
Hydr Basin #:	SACRAMENTO VALLEY (5		
Operator :	SELDON P		
Oversight Prgm:	LUST		

PERRY'S BOAT SALES (Continued) **S102318547**

Review Date : 1996-03-21 00:00:00
Stop Date : Not reported
Work Suspended : No
Responsible Party PERRY'S BOAT SALES
RP Address: 500 PERRY'S ISLAND RD,ISLETO
Global Id: T0606700505
Org Name: Not reported
Contact Person: Not reported
MTBE Conc: 0
Mtbe Fuel: 1
Water System Name: DEL RIO HOT
Well Name: Not reported
Distance To Lust: 0
Waste Discharge Global ID: W060670011
Waste Disch Assigned Name: 3400116-001GEN

LUST Region 5:
Substance: GASOLINE
Case Type: Drinking Water Aquifer affected
Program: LUST
Staff Initials: CFE Case Number: 340592
Status: Case Closed
MTBE Code: N/A
Lead Agency: Local

CORTESE:
Region: CORTESE
Fac Address 2: 500 PERRY'S ISLAND RD

WDS:
Facility ID: 5S 34I012661
Facility Contact Not reported Facility Telephone Not reported
SIC Code: 0 SIC Code 2: Not reported
Agency Name: SELDEN L PERRY
Agency Address: Not reported
Agency Contact: Not reported Agency Phone: Not reported
Design Flow: 0 Million Gal/Day Baseline Flow: 0 Million Gal/Day
Facility Type: Not reported
Facility Status: Active - Any facility with a continuous or seasonal discharge that is under Waste Discharge Requirements.
Agency Type: Not reported
Waste Type: Not reported
Threat to Water: Minor Threat to Water Quality. A violation of a regional board order should cause a relatively minor impairment of beneficial uses compared to a major or minor threat. Not: All nurds without a TTWQ will be considered a minor threat to water quality unless coded at a higher Level. A Zero (0) may be used to code those NURDS that are found to represent no threat to water quality.
Complexity: Category C - Facilities having no waste treatment systems, such as cooling water dischargers or thosewho must comply through best management practices, facilities with passive waste treatment and disposal systems, such as septic systems with subsurface disposal, or dischargers having waste storage systems with land disposal such as dairy waste ponds.
Reclamation: Not reported
POTW: Not reported
NPDES Number: CAS000001 The 1st 2 characters designate the state. The remaining 7 are assigned by the Regional Board
Subregion: 0

PERRY'S BOAT SALES (Continued) **S102318547**

Sacramento ML:

Facility Id:	O0177488
Number of Tanks:	0
WG Bill Code:	50
Food Bill Code :	50
Billing Codes BP:	Disclaimer
Billing Codes UST:	No Tanks
Tier Permitting:	Not reported
Risk Mgmt Protection Program :	Not reported
FD:	O
Target Property Bill Code:	50
CUPA Permit Date:	Not reported
HAZMAT Permit Date:	07/01/89
HAZMAT Inspection Date:	10/03/89
UST Inspection Date:	Not reported
UST Tank Test Date:	Not reported
Waste General Insp Date:	Not reported

SACRAMENTO CS:

Facility Id:	RO0000971
Region:	SACRAMENTO
State Site Number:	B589
Lead Staff:	ERIKSON, S.
Lead Agency:	HM
Remedial Action Taken:	NO ACTION
Post Remedial Action Monitoring:	
Substance:	Automotive(motor gasoline and additives)
Date Reported:	09/26/1991
Date Closed:	02/16/1996
Case Type:	Other ground water affected

---

5 **PERRYS OAT HARBOR**
500 PERRY'S ISLAND ROAD
ISLETON, CA 95641

HIST UST **U001613111**
N/A

UST HIST:

Facility ID:	16249	Owner Name:	ANONA D PERRY & SELDEN L PERRY
Total Tanks:	4	Region:	STATE
Owner Address:	500 PERRY'S ISLAND ROAD ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	1	Container Num:	2
Tank Capacity:	00001000	Year Installed:	Not reported
Type of Fuel:	DIESEL	Tank Construction:	Not Reported
Leak Detection:	Visual, Pressure Test		
Contact Name:	Not reported	Telephone:	(916) 777-6401
Facility Type:	Gas Station	Other Type:	Not reported

Facility ID:	16249	Owner Name:	ANONA D PERRY & SELDEN L PERRY
Total Tanks:	4	Region:	STATE
Owner Address:	500 PERRY'S ISLAND ROAD ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	2	Container Num:	0000000001
Tank Capacity:	00002000	Year Installed:	Not reported
Type of Fuel:	PREMIUM	Tank Construction:	Not Reported
Leak Detection:	Stock Inventor, Pressure Test		
Contact Name:	Not reported	Telephone:	(916) 777-6401
Facility Type:	Gas Station	Other Type:	Not reported

PERRYS OAT HARBOR (Continued) **U001613111**

Facility ID:	16249	Owner Name:	ANONA D PERRY & SELDEN L PERRY
Total Tanks:	4	Region:	STATE
Owner Address:	500 PERRY'S ISLAND ROAD ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	3	Container Num:	4
Tank Capacity:	00005000	Year Installed:	Not reported
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	None		
Contact Name:	Not reported	Telephone:	(916) 777-6401
Facility Type:	Gas Station	Other Type:	Not reported

Facility ID:	16249	Owner Name:	ANONA D PERRY & SELDEN L PERRY
Total Tanks:	4	Region:	STATE
Owner Address:	500 PERRY'S ISLAND ROAD ISLETON, CA 95641		
Tank Used for:	PRODUCT		
Tank Num:	4	Container Num:	1
Tank Capacity:	00010000	Year Installed:	Not reported
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Stock Inventor, Pressure Test		
Contact Name:	Not reported	Telephone:	(916) 777-6401
Facility Type:	Gas Station	Other Type:	Not reported

5 **CHMIRS** **S105882109**
N/A
500 PERRY'S ISLAND RD.
ISLETON, CA 95691

CHMIRS:

OES Control Number:	02-0491
Chemical Name:	Fuel
Extent of Release:	Not reported
Property Use:	Not reported
Incident Date:	Not reported
Date Completed:	Not reported
Time Completed :	Not reported
Agency Id Number :	Not reported
Agency Incident Number :	Not reported
OES Incident Number :	02-0491
Time Notified :	Not reported
Surrounding Area :	Not reported
Estimated Temperature :	Not reported
Property Management :	Not reported
More Than Two Substances Involved? :	Not reported
Special Studies 1 :	Not reported
Special Studies 2 :	Not reported
Special Studies 3 :	Not reported
Special Studies 4 :	Not reported
Special Studies 5 :	Not reported
Special Studies 6 :	Not reported
Responding Agency Personel # Of Injuries :	Not reported
Responding Agency Personel # Of Fatalities :	0
Resp Agncy Personel # Of Decontaminated :	Not reported
Others Number Of Decontaminated :	Not reported
Others Number Of Injuries :	Not reported
Others Number Of Fatalities :	Not reported
Vehicle Make/year :	Not reported
Vehicle License Number :	Not reported

(Continued) **S105882109**

Vehicle State :	Not reported
Vehicle Id Number :	Not reported
CA/DOT/PUC/ICC Number :	Not reported
Company Name :	Not reported
Reporting Officer Name/ID :	Not reported
Report Date :	Not reported
Comments :	Not reported
Facility Telephone Number :	Not reported
Waterway Involved :	Yes
Waterway :	Perry's Boat Harbor
Spill Site :	Ship/Harbor/Port
Cleanup By :	N/A
Containment :	Yes
What Happened :	Not reported
Type :	Not reported
Other :	Not reported
Chemical 1 :	Not Reported
Chemical 2 :	Not Reported
Chemical 3 :	Not Reported
Date/Time :	1/25/200201:27:33 PM
Evacuations :	0
True date :	12/31/03
Year :	2002
Agency :	DFG
BBLS :	0
Cups :	0
CUFT :	0
Gallons :	0.000000
Grams :	0
Pounds :	0
Liters :	0
Ounces :	0
Pints :	1
Quarts :	0
Sheen :	0
Tons :	0
Unknown :	0
Description :	USCG advised the caller of this sheen. RP believes this sheen is from a repairs made last week and is from the bilge.
Incident date :	1/25/200212:00:00 AM
Admin Agency :	Sacramento County Environmental Mgmt.
OES date :	Not reported
OES time :	Not reported
Amount :	Not reported

5 **500 PERRY'S ISLAND ROAD** **ERNS** **2002592232**
500 PERRY'S ISLAND ROAD **N/A**
ISLETON, CA 95641

Click this hyperlink while viewing on your computer to access additional ERNS detail in the EDR Site Report.

6 **TOWER PARK MARINA** **CA WDS** **U001604538**
14900 W HIGHWAY 12 **HIST UST** **N/A**
LODI, CA 95240

WDS:

Facility ID:	5S 39I009714		
Facility Contact	Not reported	Facility Telephone	Not reported
SIC Code:	0	SIC Code 2:	Not reported
Agency Name:	TOWER PARK INVESTORS LP		
Agency Address:	Not reported		
Agency Contact:	Not reported	Agency Phone:	Not reported
Design Flow:	0 Million Gal/Day	Baseline Flow:	0 Million Gal/Day
Facility Type:	Not reported		
Facility Status:	Active - Any facility with a continuous or seasonal discharge that is under Waste Discharge Requirements.		
Agency Type:	Not reported		
Waste Type:	Not reported		
Threat to Water:	Minor Threat to Water Quality. A violation of a regional board order should cause a relatively minor impairment of beneficial uses compared to a major or minor threat. Not: All nurds without a TTWQ will be considered a minor threat to water quality unless coded at a higher Level. A Zero (0) may be used to code those NURDS that are found to represent no threat to water quality.		
Complexity:	Category C - Facilities having no waste treatment systems, such as cooling water dischargers or thosewho must comply through best management practices, facilities with passive waste treatment and disposal systems, such as septic systems with subsurface disposal, or dischargers having waste storage systems with land disposal such as dairy waste ponds.		
Reclamation:	Not reported		
POTW:	Not reported		
NPDES Number:	CAS000001 The 1st 2 characters designate the state. The remaining 7 are assigned by the Regional Board		
Subregion:	0		

UST HIST:

Facility ID:	52900	Owner Name:	TOWER PARK MARINA
Total Tanks:	2	Region:	STATE
Owner Address:	14900 WEST HWY 12 LODI, CA 95240		
Tank Used for:	PRODUCT		
Tank Num:	1	Container Num:	1
Tank Capacity:	00010000	Year Installed:	1971
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	Not reported	Telephone:	(209) 369-1041
Facility Type:	Other	Other Type:	MARINA

Facility ID:	52900	Owner Name:	TOWER PARK MARINA
Total Tanks:	2	Region:	STATE
Owner Address:	14900 WEST HWY 12 LODI, CA 95240		
Tank Used for:	PRODUCT		
Tank Num:	2	Container Num:	2
Tank Capacity:	00010000	Year Installed:	1972
Type of Fuel:	REGULAR	Tank Construction:	Not Reported
Leak Detection:	Visual		
Contact Name:	Not reported	Telephone:	(209) 369-1041
Facility Type:	Other	Other Type:	MARINA

Map ID
Direction
Distance
Distance (ft.)Site | Database(s) | EDR ID Number / EPA ID Number

6 **TOWER PARK MARINA** **CA SLIC** **S105982784**
14900 HIGHWAY 12 W **N/A**
LODI, CA

SLIC Region 5:
Facility Status: Closed by RB
Pollutant: TPH - d, g   Unit: Facility is a Spill or site
Report Date: / /   Date Filed: / /
Lead Agency: Not reported

6 **TOWER PARK MARINA** **CA SLIC** **S106484263**
14900 WEST HIGHWAY 12 **N/A**
LODI, CA

CA STATE SLIC :
Global Id : SL375033634
Region : STATE
Assigned Name : SLICSITE
Lead Agency Contact : JAMES L. BARTON
Lead Agency : CENTRAL VALLEY RWQCB (REGION 5S)
Lead Agency Case Number : SL375033634
Responsible Party : JAMES MILLS
Recent Dtw : Not reported
Substance Released : PET

7 **FTG CONSTRUCTION MATERIALS, INC.** **HAZNET** **S103965267**
5184 WEST HIGHWAY 12 **N/A**
LODI, CA 95242

HAZNET:
Gepaid: CAL000141862
TSD EPA ID: CAT080011059
Gen County: San Joaquin
Tsd County: Los Angeles
Tons: .3250
Waste Category: Unspecified oil-containing waste
Disposal Method: Transfer Station
Contact: ANTHONY J. ALEGRI, PRESIDENT
Telephone: (209) 334-2112
Mailing Address: 5100 W HIGHWAY 12
LODI, CA 95242 - 9529
County San Joaquin

Gepaid: CAL000141862
TSD EPA ID: CAT080011059
Gen County: San Joaquin
Tsd County: Los Angeles
Tons: .5000
Waste Category: Unspecified oil-containing waste
Disposal Method: Treatment, Tank
Contact: ANTHONY J. ALEGRI, PRESIDENT
Telephone: (209) 334-2112
Mailing Address: 5100 W HIGHWAY 12
LODI, CA 95242 - 9529
County San Joaquin

FTG CONSTRUCTION MATERIALS, INC. (Continued) **S103965267**

Gepaid:	CAL000141862
TSD EPA ID:	CAT080011059
Gen County:	San Joaquin
Tsd County:	Los Angeles
Tons:	1.0750
Waste Category:	Unspecified oil-containing waste
Disposal Method:	Disposal, Other
Contact:	ANTHONY J. ALEGRI, PRESIDENT
Telephone:	(209) 334-2112
Mailing Address:	5100 W HIGHWAY 12 LODI, CA 95242 - 9529
County	San Joaquin

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
ELK GROVE	S104573703	P G & E	SE CRNR OF ELK GROVE BLVD/HWY 5 1 MI	95758	HAZNET
ISLETON	S100852408	1X RAYMOS OIL COMPANY ISLETON PLANT	HIGHWAY 160 / 1ST STREET	95641	HAZNET, CA SLIC
ISLETON	S103993320	UNITED STATES POST OFFICE	HWY 160	95641	HAZNET, Sacramento Co. ML
ISLETON	1006249113	P G & E	BRANNAN ISLAND ROAD	95641	FINDS, EMI
LODI	S105084006	P G & E/TERMINOUS SUBSTATION	8735 HWY 12	95242	HAZNET
LODI	1006833572	SUNWEST LIQUORS	801 E HIGHWAY 12	95242	FINDS, EMI
LODI	1006828747	TOWER PARK MARINA	14900 W HWY 12	95242	FINDS, EMI
RYER ISLAND	U003113127	BELLI & FAHN	HIGHWAY 132	95690	UST
RYER ISLAND	U003700411	CAL TRANS - STEAMBOAT FERRY	ST RTE 220 PM 3.1	95690	LUST
RYER ISLAND	U003975762	CAL TRANS - STEAMBOAT FERRY	ST RTE 220 PM 3.1	95690	UST
RYER ISLAND	U003973539	BELLI & FAHN	STATE HIGHWAY 132	95690	UST
SEA RANCH	S105939492	SEA RANCH NORTH POTW	EAST SIDE, STATE HWY 1	95412	EMI
SEA RANCH	S105939491	SEA RANCH CENTRAL POTW	EAST SIDE, STATE HWY 1	95412	EMI
WALNUT GROVE	S103707537	WILCOX BROTHERS	14180 HIGHWAY 160	95690	HAZNET
WALNUT GROVE	S105027297	SCHAUER RIVER FRONT PROP.	14162 HWY 160	95690	LUST, Cortese, Sacramento Co. ML
WALNUT GROVE	1005489118	WALNUT GROVE WWTP (CSD1)	2500 FT E OF WALNUT GROVE	95690	FINDS, CA WDS
WALNUT GROVE	1004439482	PACIFIC DELTA SERVICES, INC	P O BOX 381	95690	FINDS
WALNUT GROVE	S102797775	RIVER DELTA UNIFIED SCHOOL	14181 WALNUT GROVE ST.	95690	HAZNET
WALNUT GROVE	S103630794	CGG LAND SEISMIC	14440 WALNUT GROVE RD	95690	HAZNET
WALNUT GROVE	S102437960	FRANK SPINGOLO WAREHOUSE	14531 WALNUT GROVE-THORNTON RD	95690	LUST
WALNUT GROVE	S104970719	FRANK SPINGOLO WAREHOUSE	14531 WALNUT GROVE-THOR	95690	LUST, Sacramento Co. CS

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Elapsed ASTM days: Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

FEDERAL ASTM STANDARD RECORDS

NPL: National Priority List
Source: EPA
Telephone: N/A
National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 10/12/04
Date Made Active at EDR: 12/09/04
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 11/02/04
Elapsed ASTM days: 37
Date of Last EDR Contact: 11/02/04

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 6
Telephone: 214-655-6659

EPA Region 8
Telephone: 303-312-6774

Proposed NPL: Proposed National Priority List Sites
Source: EPA
Telephone: N/A

Date of Government Version: 09/23/04
Date Made Active at EDR: 12/09/04
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 11/02/04
Elapsed ASTM days: 37
Date of Last EDR Contact: 11/02/04

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA
Telephone: 703-413-0223
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 08/10/04
Date Made Active at EDR: 10/27/04
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 09/21/04
Elapsed ASTM days: 36
Date of Last EDR Contact: 09/21/04

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned
Source: EPA
Telephone: 703-413-0223
As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 08/10/04
Date Made Active at EDR: 10/27/04
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 09/21/04
Elapsed ASTM days: 36
Date of Last EDR Contact: 09/21/04

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 800-424-9346
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 09/23/04
Date Made Active at EDR: 11/18/04
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 10/07/04
Elapsed ASTM days: 42
Date of Last EDR Contact: 12/07/04

RCRA: Resource Conservation and Recovery Act Information
Source: EPA
Telephone: 800-424-9346
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS). The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month. Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month. Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month. Transporters are individuals or entities that move hazardous waste from the generator off-site to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 08/10/04
Date Made Active at EDR: 10/11/04
Database Release Frequency: Varies
Date of Data Arrival at EDR: 08/24/04
Elapsed ASTM days: 48
Date of Last EDR Contact: 11/24/04

ERNS: Emergency Response Notification System
Source: National Response Center, United States Coast Guard
Telephone: 202-260-2342
Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/03
Date Made Active at EDR: 03/12/04
Database Release Frequency: Annually
Date of Data Arrival at EDR: 01/26/04
Elapsed ASTM days: 46
Date of Last EDR Contact: 10/25/04

FEDERAL ASTM SUPPLEMENTAL RECORDS

BRS: Biennial Reporting System
Source: EPA/NTIS
Telephone: 800-424-9346
The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/01/01
Database Release Frequency: Biennially
Date of Last EDR Contact: 09/20/04
Date of Next Scheduled EDR Contact: 12/13/04

CONSENT: Superfund (CERCLA) Consent Decrees
Source: Department of Justice, Consent Decree Library
Telephone: Varies
Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 03/05/04
Database Release Frequency: Varies
Date of Last EDR Contact: 10/25/04
Date of Next Scheduled EDR Contact: 01/24/05

ROD: Records Of Decision
Source: EPA
Telephone: 703-416-0223
Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 09/09/04
Database Release Frequency: Annually
Date of Last EDR Contact: 10/06/04
Date of Next Scheduled EDR Contact: 01/03/05

DELISTED NPL: National Priority List Deletions
Source: EPA
Telephone: N/A
The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 10/12/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 11/02/04
Date of Next Scheduled EDR Contact: 01/31/05

FINDS: Facility Index System/Facility Identification Initiative Program Summary Report
Source: EPA
Telephone: N/A
Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 09/09/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/08/04
Date of Next Scheduled EDR Contact: 01/03/05

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4555
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 09/08/04
Database Release Frequency: Annually
Date of Last EDR Contact: 10/28/04
Date of Next Scheduled EDR Contact: 01/17/05

MLTS: Material Licensing Tracking System
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 07/15/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/04/04
Date of Next Scheduled EDR Contact: 01/03/05

MINES: Mines Master Index File
Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959

Date of Government Version: 09/13/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 09/28/04
Date of Next Scheduled EDR Contact: 12/27/04

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 202-564-4267
Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91 | Date of Last EDR Contact: 11/22/04
Database Release Frequency: No Update Planned | Date of Next Scheduled EDR Contact: 02/21/05

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-564-3887
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 06/29/04 | Date of Last EDR Contact: 11/12/04
Database Release Frequency: Annually | Date of Next Scheduled EDR Contact: 02/07/05

DOD: Department of Defense Sites
Source: USGS
Telephone: 703-692-8801
This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 10/01/03 | Date of Last EDR Contact: 11/12/04
Database Release Frequency: Semi-Annually | Date of Next Scheduled EDR Contact: 02/07/05

UMTRA: Uranium Mill Tailings Sites
Source: Department of Energy
Telephone: 505-845-0011
Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized. In 1978, 24 inactive uranium mill tailings sites in Oregon, Idaho, Wyoming, Utah, Colorado, New Mexico, Texas, North Dakota, South Dakota, Pennsylvania, and on Navajo and Hopi tribal lands, were targeted for cleanup by the Department of Energy.

Date of Government Version: 04/22/04 | Date of Last EDR Contact: 09/20/04
Database Release Frequency: Varies | Date of Next Scheduled EDR Contact: 12/20/04

ODI: Open Dump Inventory
Source: Environmental Protection Agency
Telephone: 800-424-9346
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/85 | Date of Last EDR Contact: 05/23/95
Database Release Frequency: No Update Planned | Date of Next Scheduled EDR Contact: N/A

FUDS: Formerly Used Defense Sites
Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/03 | Date of Last EDR Contact: 10/04/04
Database Release Frequency: Varies | Date of Next Scheduled EDR Contact: 01/03/05

INDIAN RESERV: Indian Reservations
Source: USGS
Telephone: 202-208-3710
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 10/01/03
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/12/04
Date of Next Scheduled EDR Contact: 02/07/05

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95
Database Release Frequency: No Update Planned
Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

TRIS: Toxic Chemical Release Inventory System
Source: EPA
Telephone: 202-566-0250
Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/02
Database Release Frequency: Annually
Date of Last EDR Contact: 09/20/04
Date of Next Scheduled EDR Contact: 12/20/04

TSCA: Toxic Substances Control Act
Source: EPA
Telephone: 202-260-5521
Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/02
Database Release Frequency: Every 4 Years
Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA
Telephone: 202-564-2501

Date of Government Version: 04/13/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/07/04
Date of Next Scheduled EDR Contact: 12/20/04

SSTS: Section 7 Tracking Systems
Source: EPA
Telephone: 202-564-5008
Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/01
Database Release Frequency: Annually
Date of Last EDR Contact: 10/18/04
Date of Next Scheduled EDR Contact: 01/17/05

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-564-2501
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 09/13/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/07/04
Date of Next Scheduled EDR Contact: 12/20/04

STATE OF CALIFORNIA ASTM STANDARD RECORDS

AWP: Annual Workplan Sites
Source: California Environmental Protection Agency
Telephone: 916-323-3400
Known Hazardous Waste Sites. California DTSC's Annual Workplan (AWP), formerly BEP, identifies known hazardous substance sites targeted for cleanup.

Date of Government Version: 11/09/04
Date Made Active at EDR: 01/04/05
Database Release Frequency: Annually
Date of Data Arrival at EDR: 12/02/04
Elapsed ASTM days: 33
Date of Last EDR Contact: 12/02/04

CAL-SITES: Calsites Database
Source: Department of Toxic Substance Control
Telephone: 916-323-3400
The Calsites database contains potential or confirmed hazardous substance release properties. In 1996, California EPA reevaluated and significantly reduced the number of sites in the Calsites database.

Date of Government Version: 11/09/04
Date Made Active at EDR: 01/04/05
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 12/02/04
Elapsed ASTM days: 33
Date of Last EDR Contact: 12/02/04

CHMIRS: California Hazardous Material Incident Report System
Source: Office of Emergency Services
Telephone: 916-845-8400
California Hazardous Material Incident Reporting System. CHMIRS contains information on reported hazardous material incidents (accidental releases or spills).

Date of Government Version: 12/31/03
Date Made Active at EDR: 06/25/04
Database Release Frequency: Varies
Date of Data Arrival at EDR: 05/18/04
Elapsed ASTM days: 38
Date of Last EDR Contact: 11/22/04

CORTESE: "Cortese" Hazardous Waste & Substances Sites List
Source: CAL EPA/Office of Emergency Information
Telephone: 916-323-9100
The sites for the list are designated by the State Water Resource Control Board (LUST), the Integrated Waste Board (SWF/LS), and the Department of Toxic Substances Control (Cal-Sites). This listing is no longer updated by the state agency.

Date of Government Version: 04/01/01
Date Made Active at EDR: 07/26/01
Database Release Frequency: No Update Planned
Date of Data Arrival at EDR: 05/29/01
Elapsed ASTM days: 58
Date of Last EDR Contact: 10/28/04

NOTIFY 65: Proposition 65 Records
Source: State Water Resources Control Board
Telephone: 916-445-3846
Proposition 65 Notification Records. NOTIFY 65 contains facility notifications about any release which could impact drinking water and thereby expose the public to a potential health risk.

Date of Government Version: 10/21/93
Date Made Active at EDR: 11/19/93
Database Release Frequency: No Update Planned
Date of Data Arrival at EDR: 11/01/93
Elapsed ASTM days: 18
Date of Last EDR Contact: 10/18/04

TOXIC PITS: Toxic Pits Cleanup Act Sites
Source: State Water Resources Control Board
Telephone: 916-227-4364
Toxic PITS Cleanup Act Sites. TOXIC PITS identifies sites suspected of containing hazardous substances where cleanup has not yet been completed.

Date of Government Version: 07/01/95
Date Made Active at EDR: 09/26/95
Database Release Frequency: No Update Planned
Date of Data Arrival at EDR: 08/30/95
Elapsed ASTM days: 27
Date of Last EDR Contact: 11/01/04

SWF/LF (SWIS): Solid Waste Information System
Source: Integrated Waste Management Board
Telephone: 916-341-6320
Active, Closed and Inactive Landfills. SWF/LF records typically contain an inve ntory of solid waste disposal facilities or landfills. These may be active or i nactive facilities or open dumps that failed to meet RCRA Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 09/13/04
Date Made Active at EDR: 10/12/04
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 09/14/04
Elapsed ASTM days: 28
Date of Last EDR Contact: 09/14/04

WMUDS/SWAT: Waste Management Unit Database
Source: State Water Resources Control Board
Telephone: 916-227-4448
Waste Management Unit Database System. WMUDS is used by the State Water Resources Control Board staff and the Regional Water Quality Control Boards for program tracking and inventory of waste management units. WMUDS is composed of the following databases: Facility Information, Scheduled Inspections Information, Waste Management Unit Information, SWAT Program Information, SWAT Report Summary Information, SWAT Report Summary Data, Chapter 15 (formerly Subchapter 15) Information, Chapter 15 Monitoring Parameters, TPCA Program Information, RCRA Program Information, Closure Information, and Interested Parties Information.

Date of Government Version: 04/01/00
Date Made Active at EDR: 05/10/00
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 04/10/00
Elapsed ASTM days: 30
Date of Last EDR Contact: 12/06/04

LUST: Leaking Underground Storage Tank Information System
Source: State Water Resources Control Board
Telephone: 916-341-5752
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 10/13/04
Date Made Active at EDR: 11/03/04
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 10/13/04
Elapsed ASTM days: 21
Date of Last EDR Contact: 10/13/04

CA BOND EXP. PLAN: Bond Expenditure Plan
Source: Department of Health Services
Telephone: 916-255-2118
Department of Health Services developed a site-specific expenditure plan as the basis for an appropriation of Hazardous Substance Cleanup Bond Act funds. It is not updated.

Date of Government Version: 01/01/89
Date Made Active at EDR: 08/02/94
Database Release Frequency: No Update Planned
Date of Data Arrival at EDR: 07/27/94
Elapsed ASTM days: 6
Date of Last EDR Contact: 05/31/94

CA UST:

UST: Active UST Facilities
Source: SWRCB
Telephone: 916-341-5752
Active UST facilities gathered from the local regulatory agencies

Date of Government Version: 10/13/04
Date Made Active at EDR: 11/03/04
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 10/13/04
Elapsed ASTM days: 21
Date of Last EDR Contact: 10/13/04

VCP: Voluntary Cleanup Program Properties
Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Contains low threat level properties with either confirmed or unconfirmed releases and the project proponents have request that DTSC oversee investigation and/or cleanup activities and have agreed to provide coverage for DTSC's costs.

Date of Government Version: 10/05/04
Date Made Active at EDR: 11/03/04
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 10/15/04
Elapsed ASTM days: 19
Date of Last EDR Contact: 12/02/04

INDIAN LUST: Leaking Underground Storage Tanks on Indian Land
Source: Environmental Protection Agency
Telephone: 415-972-3372
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 10/03/04
Date Made Active at EDR: 11/03/04
Database Release Frequency: Varies
Date of Data Arrival at EDR: 10/06/04
Elapsed ASTM days: 28
Date of Last EDR Contact: 11/22/04

INDIAN LUST: Leaking Underground Storage Tanks on Indian Land
Source: EPA Region 10
Telephone: 206-553-2857
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 09/29/04
Date Made Active at EDR: 10/22/04
Database Release Frequency: Varies
Date of Data Arrival at EDR: 10/01/04
Elapsed ASTM days: 21
Date of Last EDR Contact: 11/22/04

INDIAN UST: Underground Storage Tanks on Indian Land
Source: EPA Region 9
Telephone: 415-972-3368

Date of Government Version: 11/02/04
Date Made Active at EDR: 12/13/04
Database Release Frequency: Varies
Date of Data Arrival at EDR: 11/03/04
Elapsed ASTM days: 40
Date of Last EDR Contact: 10/25/04

CA FID UST: Facility Inventory Database
Source: California Environmental Protection Agency
Telephone: 916-445-6532
The Facility Inventory Database (FID) contains a historical listing of active and inactive underground storage tank locations from the State Water Resource Control Board. Refer to local/county source for current data.

Date of Government Version: 10/31/94
Date Made Active at EDR: 09/29/95
Database Release Frequency: No Update Planned
Date of Data Arrival at EDR: 09/05/95
Elapsed ASTM days: 24
Date of Last EDR Contact: 12/28/98

HIST UST: Hazardous Substance Storage Container Database
Source: State Water Resources Control Board
Telephone: 916-341-5700
The Hazardous Substance Storage Container Database is a historical listing of UST sites. Refer to local/county source for current data.

Date of Government Version: 10/15/90
Date Made Active at EDR: 02/12/91
Database Release Frequency: No Update Planned
Date of Data Arrival at EDR: 01/25/91
Elapsed ASTM days: 18
Date of Last EDR Contact: 07/26/01

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

STATE OF CALIFORNIA ASTM SUPPLEMENTAL RECORDS

AST: Aboveground Petroleum Storage Tank Facilities
Source: State Water Resources Control Board
Telephone: 916-341-5712
Registered Aboveground Storage Tanks.

Date of Government Version: 12/01/03
Database Release Frequency: Quarterly
Date of Last EDR Contact: 11/01/04
Date of Next Scheduled EDR Contact: 01/31/05

CLEANERS: Cleaner Facilities
Source: Department of Toxic Substance Control
Telephone: 916-225-0873
A list of drycleaner related facilities that have EPA ID numbers. These are facilities with certain SIC codes: power laundries, family and commercial; garment pressing and cleaner's agents; linen supply; coin-operated laundries and cleaning; drycleaning plants, except rugs; carpet and upholster cleaning; industrial launderers; laundry and garment services.

Date of Government Version: 11/29/04
Database Release Frequency: Annually
Date of Last EDR Contact: 01/04/05
Date of Next Scheduled EDR Contact: 04/04/05

CA WDS: Waste Discharge System
Source: State Water Resources Control Board
Telephone: 916-341-5227
Sites which have been issued waste discharge requirements.

Date of Government Version: 10/11/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/21/04
Date of Next Scheduled EDR Contact: 12/20/04

DEED: Deed Restriction Listing
Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Site Mitigation and Brownfields Reuse Program Facility Sites with Deed Restrictions & Hazardous Waste Management Program Facility Sites with Deed / Land Use Restriction. The DTSC Site Mitigation and Brownfields Reuse Program (SMBRP) list includes sites cleaned up under the program's oversight and generally does not include current or former hazardous waste facilities that required a hazardous waste facility permit. The list represents deed restrictions that are active. Some sites have multiple deed restrictions. The DTSC Hazardous Waste Management Program (HWMP) has developed a list of current or former hazardous waste facilities that have a recorded land use restriction at the local county recorder's office. The land use restrictions on this list were required by the DTSC HWMP as a result of the presence of hazardous substances that remain on site after the facility (or part of the facility) has been closed or cleaned up. The types of land use restriction include deed notice, deed restriction, or a land use restriction that binds current and future owners.

Date of Government Version: 10/04/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/04/04
Date of Next Scheduled EDR Contact: 01/03/05

NFA: No Further Action Determination
Source: Department of Toxic Substances Control
Telephone: 916-323-3400
This category contains properties at which DTSC has made a clear determination that the property does not pose a problem to the environment or to public health.

Date of Government Version: 10/05/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/02/04
Date of Next Scheduled EDR Contact: 02/28/05

EMI: Emissions Inventory Data
Source: California Air Resources Board
Telephone: 916-322-2990
Toxics and criteria pollutant emissions data collected by the ARB and local air pollution agencies.

Date of Government Version: 12/31/02
Database Release Frequency: Varies

Date of Last EDR Contact: 10/22/04
Date of Next Scheduled EDR Contact: 01/17/05

REF: Unconfirmed Properties Referred to Another Agency
Source: Department of Toxic Substances Control
Telephone: 916-323-3400
This category contains properties where contamination has not been confirmed and which were determined as not requiring direct DTSC Site Mitigation Program action or oversight. Accordingly, these sites have been referred to another state or local regulatory agency.

Date of Government Version: 10/05/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/02/04
Date of Next Scheduled EDR Contact: 02/28/05

SCH: School Property Evaluation Program
Source: Department of Toxic Substances Control
Telephone: 916-323-3400
This category contains proposed and existing school sites that are being evaluated by DTSC for possible hazardous materials contamination. In some cases, these properties may be listed in the CalSites category depending on the level of threat to public health and safety or the environment they pose.

Date of Government Version: 10/05/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/02/04
Date of Next Scheduled EDR Contact: 02/28/05

NFE: Properties Needing Further Evaluation
Source: Department of Toxic Substances Control
Telephone: 916-323-3400
This category contains properties that are suspected of being contaminated. These are unconfirmed contaminated properties that need to be assessed using the PEA process. PEA in Progress indicates properties where DTSC is currently conducting a PEA. PEA Required indicates properties where DTSC has determined a PEA is required, but not currently underway.

Date of Government Version: 11/09/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/02/04
Date of Next Scheduled EDR Contact: 02/28/05

SLIC: Statewide SLIC Cases
Source: State Water Resources Control Board
Telephone: 916-341-5752
The Spills, Leaks, Investigations, and Cleanups (SLIC) listings includes unauthorized discharges from spills and leaks, other than from underground storage tanks or other regulated sites.

Date of Government Version: 10/13/04
Database Release Frequency: Varies

Date of Last EDR Contact: 10/13/04
Date of Next Scheduled EDR Contact: 01/10/05

HAZNET: Facility and Manifest Data
Source: California Environmental Protection Agency
Telephone: 916-255-1136
Facility and Manifest Data. The data is extracted from the copies of hazardous waste manifests received each year by the DTSC. The annual volume of manifests is typically 700,000 - 1,000,000 annually, representing approximately 350,000 - 500,000 shipments. Data are from the manifests submitted without correction, and therefore many contain some invalid values for data elements such as generator ID, TSD ID, waste category, and disposal method.

Date of Government Version: 12/31/02
Database Release Frequency: Annually

Date of Last EDR Contact: 11/08/04
Date of Next Scheduled EDR Contact: 02/07/05

LOCAL RECORDS

ALAMEDA COUNTY:

Local Oversight Program Listing of UGT Cleanup Sites
Source: Alameda County Environmental Health Services
Telephone: 510-567-6700

Date of Government Version: 11/24/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/25/04
Date of Next Scheduled EDR Contact: 01/24/05

Underground Tanks
Source: Alameda County Environmental Health Services
Telephone: 510-567-6700

Date of Government Version: 11/24/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/25/04
Date of Next Scheduled EDR Contact: 01/24/05

CONTRA COSTA COUNTY:

Site List
Source: Contra Costa Health Services Department
Telephone: 925-646-2286
List includes sites from the underground tank, hazardous waste generator and business plan/2185 programs.

Date of Government Version: 08/30/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/29/04
Date of Next Scheduled EDR Contact: 02/28/05

FRESNO COUNTY:

CUPA Resources List
Source: Dept. of Community Health
Telephone: 559-445-3271
Certified Unified Program Agency. CUPA's are responsible for implementing a unified hazardous materials and hazardous waste management regulatory program. The agency provides oversight of businesses that deal with hazardous materials, operate underground storage tanks or aboveground storage tanks.

Date of Government Version: 10/21/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/08/04
Date of Next Scheduled EDR Contact: 02/07/05

KERN COUNTY:

Underground Storage Tank Sites & Tank Listing
Source: Kern County Environment Health Services Department
Telephone: 661-862-8700
Kern County Sites and Tanks Listing.

Date of Government Version: 12/13/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

LOS ANGELES COUNTY:

List of Solid Waste Facilities
Source: La County Department of Public Works
Telephone: 818-458-5185

Date of Government Version: 06/03/03
Database Release Frequency: Varies
Date of Last EDR Contact: 11/18/04
Date of Next Scheduled EDR Contact: 02/14/05

City of El Segundo Underground Storage Tank
Source: City of El Segundo Fire Department
Telephone: 310-524-2236

Date of Government Version: 11/29/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/15/04
Date of Next Scheduled EDR Contact: 02/14/05

City of Long Beach Underground Storage Tank
Source: City of Long Beach Fire Department
Telephone: 562-570-2543

Date of Government Version: 03/28/03
Database Release Frequency: Annually
Date of Last EDR Contact: 11/29/04
Date of Next Scheduled EDR Contact: 02/21/05

City of Torrance Underground Storage Tank
Source: City of Torrance Fire Department
Telephone: 310-618-2973

Date of Government Version: 08/16/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/15/04
Date of Next Scheduled EDR Contact: 02/14/05

City of Los Angeles Landfills
Source: Engineering & Construction Division
Telephone: 213-473-7869

Date of Government Version: 03/01/04
Database Release Frequency: Varies
Date of Last EDR Contact: 09/14/04
Date of Next Scheduled EDR Contact: 12/13/04

HMS: Street Number List
Source: Department of Public Works
Telephone: 626-458-3517
Industrial Waste and Underground Storage Tank Sites.

Date of Government Version: 09/30/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/12/04
Date of Next Scheduled EDR Contact: 02/14/05

Site Mitigation List
Source: Community Health Services
Telephone: 323-890-7806
Industrial sites that have had some sort of spill or complaint.

Date of Government Version: 02/26/04
Database Release Frequency: Annually
Date of Last EDR Contact: 11/15/04
Date of Next Scheduled EDR Contact: 02/14/05

San Gabriel Valley Areas of Concern
Source: EPA Region 9
Telephone: 415-972-3178
San Gabriel Valley areas where VOC contamination is at or above the MCL as designated by region 9 EPA office.

Date of Government Version: 12/31/98
Database Release Frequency: No Update Planned
Date of Last EDR Contact: 07/06/99
Date of Next Scheduled EDR Contact: N/A

MARIN COUNTY:

Underground Storage Tank Sites
Source: Public Works Department Waste Management
Telephone: 415-499-6647
Currently permitted USTs in Marin County.

Date of Government Version: 11/16/04 | Date of Last EDR Contact: 11/01/04
Database Release Frequency: Semi-Annually | Date of Next Scheduled EDR Contact: 01/31/05

NAPA COUNTY:

Sites With Reported Contamination
Source: Napa County Department of Environmental Management
Telephone: 707-253-4269

Date of Government Version: 09/29/04 | Date of Last EDR Contact: 09/27/04
Database Release Frequency: Semi-Annually | Date of Next Scheduled EDR Contact: 12/27/04

Closed and Operating Underground Storage Tank Sites
Source: Napa County Department of Environmental Management
Telephone: 707-253-4269

Date of Government Version: 09/29/04 | Date of Last EDR Contact: 09/27/04
Database Release Frequency: Annually | Date of Next Scheduled EDR Contact: 12/27/04

ORANGE COUNTY:

List of Underground Storage Tank Cleanups
Source: Health Care Agency
Telephone: 714-834-3446
Orange County Underground Storage Tank Cleanups (LUST).

Date of Government Version: 10/14/04 | Date of Last EDR Contact: 12/10/04
Database Release Frequency: Quarterly | Date of Next Scheduled EDR Contact: 03/07/05

List of Underground Storage Tank Facilities
Source: Health Care Agency
Telephone: 714-834-3446
Orange County Underground Storage Tank Facilities (UST).

Date of Government Version: 09/01/04 | Date of Last EDR Contact: 12/10/04
Database Release Frequency: Quarterly | Date of Next Scheduled EDR Contact: 03/07/05

List of Industrial Site Cleanups
Source: Health Care Agency
Telephone: 714-834-3446
Petroleum and non-petroleum spills.

Date of Government Version: 09/01/04 | Date of Last EDR Contact: 12/10/04
Database Release Frequency: Annually | Date of Next Scheduled EDR Contact: 03/07/05

PLACER COUNTY:

Master List of Facilities
Source: Placer County Health and Human Services
Telephone: 530-889-7312
List includes aboveground tanks, underground tanks and cleanup sites.

Date of Government Version: 10/04/04 | Date of Last EDR Contact: 09/20/04
Database Release Frequency: Semi-Annually | Date of Next Scheduled EDR Contact: 12/20/04

RIVERSIDE COUNTY:

Listing of Underground Tank Cleanup Sites
Source: Department of Public Health
Telephone: 909-358-5055
Riverside County Underground Storage Tank Cleanup Sites (LUST).

Date of Government Version: 06/21/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/18/04
Date of Next Scheduled EDR Contact: 01/17/05

Underground Storage Tank Tank List
Source: Health Services Agency
Telephone: 909-358-5055

Date of Government Version: 06/21/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/18/04
Date of Next Scheduled EDR Contact: 01/17/05

SACRAMENTO COUNTY:

CS - Contaminated Sites
Source: Sacramento County Environmental Management
Telephone: 916-875-8406

Date of Government Version: 08/28/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/13/04
Date of Next Scheduled EDR Contact: 01/31/05

ML - Regulatory Compliance Master List
Source: Sacramento County Environmental Management
Telephone: 916-875-8406
Any business that has hazardous materials on site - hazardous material storage sites, underground storage tanks, waste generators.

Date of Government Version: 09/02/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 11/02/04
Date of Next Scheduled EDR Contact: 01/31/05

SAN BERNARDINO COUNTY:

Hazardous Material Permits
Source: San Bernardino County Fire Department Hazardous Materials Division
Telephone: 909-387-3041
This listing includes underground storage tanks, medical waste handlers/generators, hazardous materials handlers, hazardous waste generators, and waste oil generators/handlers.

Date of Government Version: 09/17/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

SAN DIEGO COUNTY:

Solid Waste Facilities
Source: Department of Health Services
Telephone: 619-338-2209
San Diego County Solid Waste Facilities.

Date of Government Version: 08/01/00
Database Release Frequency: Varies
Date of Last EDR Contact: 11/22/04
Date of Next Scheduled EDR Contact: 02/21/05

Hazardous Materials Management Division Database

Source: Hazardous Materials Management Division
Telephone: 619-338-2268
The database includes: HE58 - This report contains the business name, site address, business phone number, establishment 'H' permit number, type of permit, and the business status. HE17 - In addition to providing the same information provided in the HE58 listing, HE17 provides inspection dates, violations received by the establishment, hazardous waste generated, the quantity, method of storage, treatment/disposal of waste and the hauler, and information on underground storage tanks. Unauthorized Release List - Includes a summary of environmental contamination cases in San Diego County (underground tank cases, non-tank cases, groundwater contamination, and soil contamination are included.)

Date of Government Version: 06/29/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/08/04
Date of Next Scheduled EDR Contact: 01/03/05

SAN FRANCISCO COUNTY:

Local Oversite Facilities

Source: Department Of Public Health San Francisco County
Telephone: 415-252-3920

Date of Government Version: 09/15/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

Underground Storage Tank Information

Source: Department of Public Health
Telephone: 415-252-3920

Date of Government Version: 09/15/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/20/04
Date of Next Scheduled EDR Contact: 12/26/04

SAN MATEO COUNTY:

Fuel Leak List

Source: San Mateo County Environmental Health Services Division
Telephone: 650-363-1921

Date of Government Version: 10/27/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/12/04
Date of Next Scheduled EDR Contact: 01/10/05

Business Inventory

Source: San Mateo County Environmental Health Services Division
Telephone: 650-363-1921
List includes Hazardous Materials Business Plan, hazardous waste generators, and underground storage tanks.

Date of Government Version: 08/19/04
Database Release Frequency: Annually
Date of Last EDR Contact: 10/12/04
Date of Next Scheduled EDR Contact: 01/10/05

SANTA CLARA COUNTY:

Fuel Leak Site Activity Report

Source: Santa Clara Valley Water District
Telephone: 408-265-2600

Date of Government Version: 06/30/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 09/27/04
Date of Next Scheduled EDR Contact: 12/27/04

Hazardous Material Facilities
Source: City of San Jose Fire Department
Telephone: 408-277-4659

Date of Government Version: 10/01/03
Database Release Frequency: Annually
Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

SOLANO COUNTY:

Leaking Underground Storage Tanks
Source: Solano County Department of Environmental Management
Telephone: 707-421-6770

Date of Government Version: 09/20/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/13/04
Date of Next Scheduled EDR Contact: 12/13/04

Underground Storage Tanks
Source: Solano County Department of Environmental Management
Telephone: 707-421-6770

Date of Government Version: 12/14/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 11/29/04
Date of Next Scheduled EDR Contact: 02/14/05

SONOMA COUNTY:

Leaking Underground Storage Tank Sites
Source: Department of Health Services
Telephone: 707-565-6565

Date of Government Version: 10/25/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/25/04
Date of Next Scheduled EDR Contact: 01/24/05

SUTTER COUNTY:

Underground Storage Tanks
Source: Sutter County Department of Agriculture
Telephone: 530-822-7500

Date of Government Version: 01/29/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/18/04
Date of Next Scheduled EDR Contact: 01/03/05

VENTURA COUNTY:

Inventory of Illegal Abandoned and Inactive Sites
Source: Environmental Health Division
Telephone: 805-654-2813
Ventura County Inventory of Closed, Illegal Abandoned, and Inactive Sites.

Date of Government Version: 08/01/04
Database Release Frequency: Annually
Date of Last EDR Contact: 11/22/04
Date of Next Scheduled EDR Contact: 02/21/05

Listing of Underground Tank Cleanup Sites
Source: Environmental Health Division
Telephone: 805-654-2813
Ventura County Underground Storage Tank Cleanup Sites (LUST).

Date of Government Version: 09/02/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/14/04
Date of Next Scheduled EDR Contact: 12/13/04

Underground Tank Closed Sites List
Source: Environmental Health Division
Telephone: 805-654-2813
Ventura County Operating Underground Storage Tank Sites (UST)/Underground Tank Closed Sites List.

Date of Government Version: 09/29/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/13/04
Date of Next Scheduled EDR Contact: 01/10/05

Business Plan, Hazardous Waste Producers, and Operating Underground Tanks
Source: Ventura County Environmental Health Division
Telephone: 805-654-2813
The BWT list indicates by site address whether the Environmental Health Division has Business Plan (B), Waste Producer (W), and/or Underground Tank (T) information.

Date of Government Version: 09/02/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 09/14/04
Date of Next Scheduled EDR Contact: 12/13/04

YOLO COUNTY:

Underground Storage Tank Comprehensive Facility Report
Source: Yolo County Department of Health
Telephone: 530-666-8646

Date of Government Version: 06/02/04
Database Release Frequency: Annually
Date of Last EDR Contact: 10/18/04
Date of Next Scheduled EDR Contact: 01/17/05

California Regional Water Quality Control Board (RWQCB) LUST Records

LUST REG 1: Active Toxic Site Investigation
Source: California Regional Water Quality Control Board North Coast (1)
Telephone: 707-576-2220
Del Norte, Humboldt, Lake, Mendocino, Modoc, Siskiyou, Sonoma, Trinity counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 02/01/01
Database Release Frequency: No Update Planned
Date of Last EDR Contact: 11/22/04
Date of Next Scheduled EDR Contact: 02/21/05

LUST REG 2: Fuel Leak List
Source: California Regional Water Quality Control Board San Francisco Bay Region (2)
Telephone: 510-286-0457

Date of Government Version: 09/30/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/13/04
Date of Next Scheduled EDR Contact: 01/10/05

LUST REG 3: Leaking Underground Storage Tank Database
Source: California Regional Water Quality Control Board Central Coast Region (3)
Telephone: 805-549-3147

Date of Government Version: 05/19/03
Database Release Frequency: Varies
Date of Last EDR Contact: 11/17/04
Date of Next Scheduled EDR Contact: 02/14/05

LUST REG 4: Underground Storage Tank Leak List
Source: California Regional Water Quality Control Board Los Angeles Region (4)
Telephone: 213-576-6600
Los Angeles, Ventura counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 09/07/04 — Date of Last EDR Contact: 08/16/04
Database Release Frequency: No Update Planned — Date of Next Scheduled EDR Contact: 12/27/04

LUST REG 5: Leaking Underground Storage Tank Database
Source: California Regional Water Quality Control Board Central Valley Region (5)
Telephone: 916-464-3291

Date of Government Version: 10/01/04 — Date of Last EDR Contact: 10/22/04
Database Release Frequency: Quarterly — Date of Next Scheduled EDR Contact: 01/30/05

LUST REG 6L: Leaking Underground Storage Tank Case Listing
Source: California Regional Water Quality Control Board Lahontan Region (6)
Telephone: 916-542-5424
For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 09/09/03 — Date of Last EDR Contact: 12/06/04
Database Release Frequency: No Update Planned — Date of Next Scheduled EDR Contact: 03/07/05

LUST REG 6V: Leaking Underground Storage Tank Case Listing
Source: California Regional Water Quality Control Board Victorville Branch Office (6)
Telephone: 760-346-7491

Date of Government Version: 08/09/04 — Date of Last EDR Contact: 10/04/04
Database Release Frequency: No Update Planned — Date of Next Scheduled EDR Contact: 01/03/05

LUST REG 7: Leaking Underground Storage Tank Case Listing
Source: California Regional Water Quality Control Board Colorado River Basin Region (7)
Telephone: 760-346-7491

Date of Government Version: 02/26/04 — Date of Last EDR Contact: 09/27/04
Database Release Frequency: Varies — Date of Next Scheduled EDR Contact: 12/27/04

LUST REG 8: Leaking Underground Storage Tanks
Source: California Regional Water Quality Control Board Santa Ana Region (8)
Telephone: 951-782-4130
California Regional Water Quality Control Board Santa Ana Region (8). For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 11/01/04 — Date of Last EDR Contact: 11/10/04
Database Release Frequency: No Update Planned — Date of Next Scheduled EDR Contact: 02/07/05

LUST REG 9: Leaking Underground Storage Tank Report
Source: California Regional Water Quality Control Board San Diego Region (9)
Telephone: 858-467-2980
Orange, Riverside, San Diego counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 03/01/01 — Date of Last EDR Contact: 10/18/04
Database Release Frequency: No Update Planned — Date of Next Scheduled EDR Contact: 01/17/05

California Regional Water Quality Control Board (RWQCB) SLIC Records

SLIC REG 1: Active Toxic Site Investigations
Source: California Regional Water Quality Control Board, North Coast Region (1)
Telephone: 707-576-2220

Date of Government Version: 04/03/03 — Date of Last EDR Contact: 12/06/04
Database Release Frequency: Semi-Annually — Date of Next Scheduled EDR Contact: 02/21/05

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

SLIC REG 2: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
Source: Regional Water Quality Control Board San Francisco Bay Region (2)
Telephone: 510-286-0457
Any contaminated site that impacts groundwater or has the potential to impact groundwater.

Date of Government Version: 09/30/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/13/04
Date of Next Scheduled EDR Contact: 01/10/05

SLIC REG 3: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
Source: California Regional Water Quality Control Board Central Coast Region (3)
Telephone: 805-549-3147
Any contaminated site that impacts groundwater or has the potential to impact groundwater.

Date of Government Version: 11/18/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/15/04
Date of Next Scheduled EDR Contact: 02/14/05

SLIC REG 4: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
Source: Region Water Quality Control Board Los Angeles Region (4)
Telephone: 213-576-6600
Any contaminated site that impacts groundwater or has the potential to impact groundwater.

Date of Government Version: 11/17/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 10/25/04
Date of Next Scheduled EDR Contact: 01/24/05

SLIC REG 5: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
Source: Regional Water Quality Control Board Central Valley Region (5)
Telephone: 916-464-3291
Unregulated sites that impact groundwater or have the potential to impact groundwater.

Date of Government Version: 04/01/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/06/04
Date of Next Scheduled EDR Contact: 01/03/05

SLIC REG 6L: SLIC Sites
Source: California Regional Water Quality Control Board, Lahontan Region
Telephone: 530-542-5574

Date of Government Version: 09/07/04
Database Release Frequency: Varies
Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

SLIC REG 6V: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
Source: Regional Water Quality Control Board, Victorville Branch
Telephone: 619-241-6583

Date of Government Version: 04/01/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/04/04
Date of Next Scheduled EDR Contact: 01/03/05

SLIC REG 7: SLIC List
Source: California Regional Quality Control Board, Colorado River Basin Region
Telephone: 760-346-7491

Date of Government Version: 11/24/04
Database Release Frequency: Varies
Date of Last EDR Contact: 11/22/04
Date of Next Scheduled EDR Contact: 02/21/05

SLIC REG 8: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
Source: California Region Water Quality Control Board Santa Ana Region (8)
Telephone: 951-782-3298

Date of Government Version: 07/01/04
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 10/08/04
Date of Next Scheduled EDR Contact: 01/03/05

SLIC REG 9: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
Source: California Regional Water Quality Control Board San Diego Region (9)
Telephone: 858-467-2980

Date of Government Version: 09/10/04
Database Release Frequency: Annually
Date of Last EDR Contact: 11/29/04
Date of Next Scheduled EDR Contact: 02/28/05

EDR PROPRIETARY HISTORICAL DATABASES

Former Manufactured Gas (Coal Gas) Sites: The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. ©Copyright 1993 Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

Disclaimer Provided by Real Property Scan, Inc.

The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

BROWNFIELDS DATABASES

VCP: Voluntary Cleanup Program Properties
Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Contains low threat level properties with either confirmed or unconfirmed releases and the project proponents have request that DTSC oversee investigation and/or cleanup activities and have agreed to provide coverage for DTSC's costs.

Date of Government Version: 10/05/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/02/04
Date of Next Scheduled EDR Contact: 02/28/05

US BROWNFIELDS: A Listing of Brownfields Sites
Source: Environmental Protection Agency
Telephone: 202-566-2777
Included in the listing are brownfields properties addresses by Cooperative Agreement Recipients and brownfields properties addressed by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities--especially those without EPA Brownfields Assessment Demonstration Pilots--minimize the uncertainties of contamination often associated with brownfields. Under the TBA program, EPA provides funding and/or technical assistance for environmental assessments at brownfields sites throughout the country. Targeted Brownfields Assessments supplement and work with other efforts under EPA's Brownfields Initiative to promote cleanup and redevelopment of brownfields. Cooperative Agreement Recipients-States, political subdivisions, territories, and Indian tribes become Brownfields Cleanup Revolving Loan Fund (BCRLF) cooperative agreement recipients when they enter into BCRLF cooperative agreements with the U.S. EPA. EPA selects BCRLF cooperative agreement recipients based on a proposal and application process. BCRLF cooperative agreement recipients must use EPA funds provided through BCRLF cooperative agreement for specified brownfields-related cleanup activities.

Date of Government Version: N/A
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: N/A
Date of Next Scheduled EDR Contact: N/A

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Licensed Facilities
Source: Department of Social Services
Telephone: 916-657-4041

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 from the U.S. Fish and Wildlife Service.

STREET AND ADDRESS INFORMATION

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Appendix H

Draft North Delta Flood Control and Ecosystem Restoration Project Adaptive Management Plan

Appendix H
Draft North Delta Flood Control and Ecosystem Restoration Project Adaptive Management Plan

Note: *The following outline is provided with the Draft EIR to provide a general overview of the intended approach to the Adaptive Management Plan. Much of the detail remains to be developed after selection of the preferred alternative with Agency and other scientists' input.*

I. Introduction

A. Project Description

The northern region of the Delta (North Delta) faces the need to balance the same issues and multi-use objectives as the larger estuary, particularly with regard to flood control and ecosystem restoration. Specifically, runoff from the Sacramento, San Joaquin, Mokelumne, and Cosumnes Rivers during large storm events has caused flooding of homes, infrastructure, farms, and other businesses in the North Delta. Additionally, degradation and the loss of aquatic and terrestrial habitat are a primary concern in the North Delta. The California Department of Water Resources proposes to implement the North Delta Flood Control and Ecosystem Restoration Project to address some of these complex issues.

Project goals are to implement flood control improvements that encourage establishment of aquatic and terrestrial habitats, native species, and ecological processes. Flood control improvements are needed to reduce the damage to land uses, infrastructure, and the Bay-Delta ecosystem resulting from insufficient channel capacity and levee failures within the Project study area. These improvements include: (1) breaching the downstream (southwest) levee and allowing tidal water to enter the property for tidal marsh restoration and (2) lowering the upstream (eastern) levee to allow controlled overflow into the McCormack Williamson Tract (M-W Tract) and reduce associated flood damage.

There are scientific uncertainties inherent in this major ecological restoration project. This draft plan identifies these uncertainties and proposes monitoring and adaptive management strategies for each of the three potential restoration alternatives. The primary scientific uncertainties involve:

1. **Floodplain Processes**
2. **Sedimentation/Geomorphic Processes**
3. **Dendritic Intertidal Channels**
4. **Exotics Species Dominance**
5. **Fish Stranding**
6. **Effect of Flooding on Cranes**
7. **Mosquito Management**
8. **Methylmercury**
9. **Organic Carbon**

10. Subsidence Reversal

B. Project Setting and Context

The Sacramento and San Joaquin Rivers drain the Sierra, Coast Ranges, a small area of the South Cascade Range, and the lowland Central Valley—forming the largest watershed in California and producing about 40% of the State's runoff. The Sacramento and San Joaquin River systems merge in a Delta inland of San Francisco Bay. The northern part of the Delta is a transitional area between the lowland Central Valley rivers and the freshwater tidal Bay-Delta system. The California Department of Water Resources (DWR) is undertaking a program intended to implement flood control and ecosystem restoration activities in the North Delta. The North Delta project area includes the lower Mokelumne River, the M-W Tract, Staten Island, as well as other adjacent areas.

The projects and programs described below are related to environmental conditions in the Delta and in upstream areas. Some of these projects are being implemented now while others are currently in development.

1. **Cosumnes River Task Force (CRTF)** – The CRTF was formed in 1997 as a result of the flooding along Cosumnes River in January of that year. The mission of the Cosumnes River Task Force is to develop a long term strategy that will encourage restoration of watershed health and improve flood management.

2. **Interstate 5/Point Pleasant Flood Protection Project** – Sacramento County has developed a conceptual plan for improvements to increase flood protection for the residents of the Point Pleasant and Franklin Pond areas.

3. **Cosumnes & Mokelumne Rivers Integrated Resource Management Plan** Several local agencies including the Southeast Sacramento County Agricultural Water Authority (Lead agency), the Nature Conservancy, EBMUD, Sacramento County Water Agency, Sacramento Flood Control Agency, UC Davis, San Joaquin County Resource Conservation District, and Reclamation District 800, in a collaborative effort to improve flood management, improve riparian habitat for native wildlife, and encourage groundwater recharge.

4. **McCormack-Williamson Tract Project** – The Nature Conservancy has purchased McCormack-Williamson Tract for freshwater tidal marsh restoration and floodwater conveyance with funding through a CALFED grant supplemented by levee subvention funds.

5. **San Joaquin River Basin – South Sacramento County Streams Investigation** – The USACE performed a feasibility study in this area known as the San Joaquin River Basin South Sacramento County Streams Investigation. This investigation addressed flood problems in the Morrison Creek stream group and Beach Stone Lakes basins and led to the South Sacramento County Streams Project.

6. **South Sacramento County Streams Project** – SAFCA is currently teamed with USACE to implement the South Sacramento County Streams Project, a flood improvement project on Morrison Creek, Florin Creek, Elder Creek, Unionhouse Creek, and the North Beach-Stone Lakes area. This project will allow safe passage of floodwaters from the upstream area through the City of Sacramento and into the Point Pleasant and downstream areas. SAFCA has pledged to contribute $2 million toward a permanent solution to the flooding at Point Pleasant.

C. CEQA/NEPA

The Environmental Impact Report (EIR) is being prepared by DWR as the state lead agency under the California Environmental Quality Act (CEQA). This EIR will also comply with the procedural requirements of the National Environmental Policy Act (NEPA) in the event a federal agency will become involved in the project.

A grouped approach has been elected for this EIR to allow flexibility in implementation due to the fluid nature of project need, available funding, and project partnerships. However, this flexibility does not preclude the option of implementing a one tiered project. Both groups are analyzed at the level of detail available; yet some elements of the project may require additional CEQA analysis depending on specific details discovered through project development. Such additional analysis may be documented through a tiered negative declaration or technical addendum and may not require a supplement or subsequent EIR.

The EIR is currently in the draft version and no preferred alternative has yet been selected.

D. Why Adaptive Management is Appropriate

The North Delta Flood Control and Ecosystem Restoration Project is suitable for adaptive management because of the complex and inherently unpredictable nature of ecosystems. DWR staff, with the assistance of scientific experts and participating agencies, have developed several conceptual models to address some of the uncertainty associated with the implementation of North Delta's flood control and ecosystem restoration project. However, it is anticipated there will be surprises and the feedback loop component of adaptive management will allow DWR to adapt and respond appropriately to those unforeseen challenges. A more prescriptive adaptive management plan will be developed once a preferred alternative has been selected for the EIR.

II. Scientific Background to the AMP

A. Science Involvement

The North Delta Science Panel (NDSP) is comprised of scientific experts in a diversity of fields including hydraulics/hydrology, water quality, and terrestrial and aquatic ecology. The NDSP was convened to provide recommendations to DWR staff on the scientific efficacy of proposed alternatives to enhance ecosystems for the North Delta. The advisory role of the science panel is not intended to influence planning or policy decisions made in future DWR North Delta ecosystem restoration efforts. The NDSP has met on four occasions beginning on November 13, 2003, and ending with an evaluation of the restoration alternatives for Grizzly Slough on January, 2005.

B. Existing Information

1. HYDROLOGY IN THE DELTA

Dr. Joan Florsheim, Research Scientist at UC Davis, provided the following overview of the hydrology and hydraulics of the North Delta.

The hydrology and hydraulics of the North Delta are influenced by both fluvial and tidal processes. Areas influencing the fluvial and tidal hydrology and hydraulics of the North Delta include: the Mokelumne River, Dry Creek and Cosumnes River; Lost Slough; Morrison Creek and its tributaries via Stone Lakes Flood Basin and Snodgrass Slough; the small headwaters to Sycamore, Hog, and Beaver Sloughs; the downstream tidally influenced San Joaquin River and distributary slough channels (e.g. Georgiana Slough); and the Delta Cross Channel (DCC).

a. Tidal Hydrology

Although the North Delta is a freshwater system, tidal effects play a role in flooding, sediment transport, and tidal marsh and slough channel morphology. The North Delta experiences diurnal tides with two unequal flood and ebb tides. Table 1 reports tidal datums on the Mokelumne River at New Hope Bridge (NOAA, http://www.co-ops.nos.noaa.gov**;** Hammersmark, 2002) show the average tidal range between high MHHW and MLLW as 1.0 m.

Table 1. Tidal Datums: Mokelumne River at New Hope Bridge

Datum	NGVD (m)	NGVD (ft)
MHHW	1.01	3.31
MHW	0.89	2.92
MTL	0.54	1.77
NGVD (1929)	0.00	0.00
MLW	0.18	0.59
MLLW	0.07	0.23

b. Fluvial Hydrology and Hydraulics

Flood hazards in the North Delta include levee failure and subsequent inundation of subsided islands or lowland tracts. Factors influencing floods include increased runoff from urbanizing areas, channels confined between levees have inadequate capacity to convey large floods, backwaters occur for a number of reasons, including underlying geologic structure of the North Delta, tidal influence, differential timing of flood peaks on various sloughs and channels, or upstream of bridges. The influence of the DCC on the North Delta is potentially significant since Sacramento River water is diverted into Snodgrass Slough and the Mokelumne River. However, the DCC gates are closed when high Sacramento River flows threaten to flood the narrow Delta channels. Since 1993, agencies have also closed the gates to protect outmigrating salmon (CALFED Bay-Delta Science in Action Newsletter, June 2001). Hydraulic modeling is currently underway to define existing conditions and refine various North Delta project alternatives. A detailed peer review report on the North Delta HECRAS model is available on the North Delta website at http://ndelta.water.ca.gov/index.html under “documents” and “Hydraulic Model Peer Review Report.” Understanding model assumptions, boundary conditions, and the model's sensitivity to parameters such as channel geometry, roughness, floodplain connectivity, and flow inputs in the North Delta are critical to developing an integrative flood management and ecosystem restoration design.

The following overview of North Delta hydraulics was prepared by Gwen Knittweis, DWR (2003), for the Science Panel.

"Flows in the North Delta originate from four substantial drainage basins: the Cosumnes River, Dry Creek, Mokelumne River, and Morrison Creek. The Cosumnes River, Dry Creek, and Mokelumne River Basins are the primary source for flood flows. These streams originate in the central Sierra Nevada with a total drainage area of about 5,120 km^2 (~2,000mi^2). Flows from these streams converge just upstream of McCormack-Williamson (M-W) Tract roughly at Benson's Ferry and flow around M-W via Lost Slough, Middle Slough, Snodgrass Slough and the main stem Mokelumne River. The Morrison Creek Basin streams (Morrison, Elder, Unionhouse, and Laguna Creeks) are located in Sacramento County southeast of the city of Sacramento and northeast of the project area and flow generally westward, contributing flood flows from a total drainage area of about 180 square miles. Morrison Creek Basin flows converge in the vicinity of Beach-Stone Lakes (North of M-W), flow south through the Beach-Stone Lakes area, and discharge into Snodgrass Slough at Lambert Road. These flows then typically head south through Snodgrass Slough and into the Mokelumne River system in the vicinity of western M-W Tract and Dead Horse Island. Sacramento River flows enter the system through the Delta Cross Channel (DCC) west of the M-W Tract. However, these flows do not typically contribute to the system in flood events as the DCC is closed once the Sacramento River flows reach 20,000-25,000 cfs. However, during high magnitude floods (e.g. 1986), Sacramento River flood flows overtop the DCC.

The various basins' flood flows converging in the vicinity of the M-W Tract, have historically overtopped the eastern levee of the M-W Tract which is restricted in elevation due to legal agreement. The M-W Tract then fills up and breaches downstream levees in the southwest portion of the tract. Flows transferred south of the M-W Tract converge in the vicinity of New Hope and Miller Ferry Bridges and flow down the North and South Forks of the Mokelumne River, eventually to the San Joaquin with levees failures occurring on Tyler, Dead Horse and or New Hope Tract during large events (e.g. 1986, 1997). The flow split between the North and South Fork distributaries of the Mokelumne for the 1997 flood event has estimated as 40,000 cfs and 20,000 cfs respectively in previous HEC-RAS model runs completed by MBK.

North Delta area hydrodynamics are very complex. Topography, timing and magnitude of contributing flows from the various watersheds complicate flow patterns which may change over the course of a single flood event. For instance, Morrison Creek Basin flows are contributed from north to south across Lambert Road and down Snodgrass Slough typically early in a flood event; however, as Cosumnes/Mokelumne flows rise, a backwater may overtop the Lambert Road structure and flow may reverse direction from south to north toward Stone Lakes. Although infrequent, a backwater effect may also cause flows to reverse over the DCC into the Sacramento River, as occurred in 1997. Also, contribution of high flows in Georgiana Slough, a distributary of the Sacramento River that joins the Mokelumne River downstream of where the North and South Forks rejoin south of Staten Island, may raise upstream stage and cause a substantial backwater effect in the North and South Forks of the Mokelumne."

2. GEOMORPHOLOGY IN THE DELTA

a. Pre-Disturbance and Paleo Processes in North Delta Tidal and Fluvial Systems

The San Francisco Bay Delta formed during the late Holocene as sea level rose and flooded low lying areas. Delta soils are composed of peat formed from decaying marsh vegetation and sediment derived from upstream rivers. Prior to watershed-scale anthropogenic changes beginning in the 1800's, sediment deposition from upstream Central Valley watersheds and accumulation of organic material approximately kept pace with sea level rise and tectonic basin subsidence. Delta geomorphology was characterized by distributary and abandoned channels and the natural levees of the Sacramento and San Joaquin Rivers along with marshes with dendritic slough channel systems, ponds, and mudflats in the associated freshwater tidal marshes. During even small floods, Delta Island marshes were inundated, as they were by high tides. Progressive levee construction in the Delta led to development of narrow river distributary channels separated from island interiors. Atwater (1982) mapped a circuitous freshwater tidal-fluvial transition boundary dependent on locations of sloughs and natural alluvial levees. Staten Island is underlain by peat soil whereas the M-W Tract contains areas underlain by both peat and by mineral soil.

Brown and Pasternack suggest that fluvial processes dominated the area of the M-W Tract for a majority of the time. The wetlands in Delta Meadows are less than 100 years old, and such wetlands have occurred periodically in the past on the MW Tract, but are not necessarily persistent or sustainable. Based on analysis of Holocene core stratigraphy, Pasternack suggests that wetland restoration emphasizing a tidal gradient would likely shift to a floodplain condition with limited tidal influence, except to enhance the long-term fining upward process already under effect due to depletion of accommodation space.

b. Flood Basin Geomorphology

Upstream of the Delta margin, the Sacramento Flood Basin includes the lowland area between the natural levees of the Sacramento River and the Pleistocene fans emanating from the Sierra Nevada (Gilbert, 1917; Bryan, 1923). The flood basin extends south from the City of Sacramento and includes Stone Lake, Snodgrass Slough, and the confluence area of the Cosumnes and Mokelumne Rivers before joining the North Delta. Prior to anthropogenic changes, dominant geomorphic processes in the flood basin included overbank flow from the Sacramento, Mokelumne and Cosumnes River systems, and deposition of levees and sand splay complexes resulting from episodic avulsion through breaches in the natural levees along anastomosing lowland rivers (Florsheim and Mount, 2003). This area was drained by multiple anastomosing channels, and contained natural levees and sand splays that enhanced topographic variation with floodplain ponds and abandoned channels (Florsheim and Mount, 2001; 2003). Moreover, lowland areas on the eastern side of levees along the South Fork of the Mokelumne were also seasonally inundated (e.g. New Hope, Bract, Terminous Tracts). Combined flooding in the Delta and upland areas seasonally inundated all but the levee tops (Bryan, 1923; Commissioner of Public Works, 1861).

c. Anthropogenic Alteration of Tidal Marshes and Lowland Flood Basins

Anthropogenic transformation of the North Delta included deposition of sediment following hydraulic mining and other land uses prevalent during the mid-1800. Progressive changes included levee construction atop existing natural riparian levees for flood control, removal of woody debris for navigation, and floodplain and marsh plain clearing and development for agriculture. The levee system imposed near complete isolation of floodplains and the interiors of Delta Islands from their adjacent river and slough channels and eliminated off-channel areas for sediment storage. Significant upstream land uses that affect North Delta geomorphic processes include flow regulation and water diversion. Recent restoration activities on the Cosumnes River floodplain provide an example of potential for rehabilitation of dynamic geomorphic processes in lowland floodplain rivers such as once existed in the Sacramento Flood Basin (Florsheim and Mount, 2003).

Formation of a functioning tidal marsh in the M-W Tract requires ground surface elevation-sea level relationships that allow for slough channel development, marsh plain accretion as marsh vegetation is established. This may be possible in portions of the M-W Tract where elevations are relatively low. The strategic location of the M-W Tract between tidal and fluvial influences also provides the opportunity to restore a fluvially dominated environment. The merging of dynamic tidal and fluvial systems in a restoration area will be an interesting experiment for restoration science and practice.

d. Subsidence

Organic soils form in wetlands where plant litter such as roots, stems, and leaves accumulate faster than they can fully decompose (Galloway et al., 1999). The levee construction and draining of the freshwater marshes for agriculture led to significant subsidence in some areas of the Delta. Subsidence of drained organic soils primarily occurs due to oxidation—conversion of organic carbon in the plants to carbon dioxide gas and water. Deverel and Rojstaczer (1996) found that land elevation changes are significantly affected by water level changes but that carbon loses in the form of gaseous CO_2 fluxes account for the majority of permanent subsidence. Other causes of subsidence may include compaction, desiccation, and erosion by wind and water, or fire (Galloway et al., 1999). A recent Lidar survey of Staten Island shows that Island elevations inside the levee have subsided since the mid 1800's and currently have elevations between –0.6 m (-2 ft) and –6 m (-20 ft) below sea level. Further upstream, the M-W Tract is slightly higher in elevation ranging from 1.5 m (5 ft) in the north to 0.8 m (2.5 ft) below sea level in the southern portion of the island. Subsidence reversal would require keeping the substrate wet, and deposition or inorganic sediment through natural processes or placement of dredged material, and/or by growing wetland vegetation that subsequently becomes peat.

e. Sediment Processes, Supply, Storage and Yield: the Sediment Budget

A conceptual model for sediment in the North Delta utilizes the sediment budget framework. A sediment budget is an accounting of sediment inflow, outflow and changes in storage. For the North Delta, the sediment budget must consider sediment inflow from local rivers, yield to the San Joaquin River, export through dredging, inflow and outflow through tidal exchange, and changes in storage in river and slough channels through scour and fill. Currently, sediment input to the North Delta is dominated by input from the Cosumnes River, Dry Creek and the Mokelumne River. Because of the dams and flow regulation, relatively little sediment is expected to be produced from the Mokelumne River. In contrast, unregulated flow on the Cosumnes River and Dry Creek supply relatively large quantities of sediment. Sediment loads are highly episodic and depend on climate variation. Moreover, sediment storage in newly restored floodplain sand splays between upstream gaging stations and the North Delta affect sediment transport to the North Delta. Subsequent discussion describes elements of the sediment budget in the North Delta.

A current estimate of total average annual sediment input from the Cosumnes River, Dry Creek and Mokelumne system is ~142,000 tons/year, or about 2% of the total input to the Delta was calculated by NHC (2003) in the following manner. Suspended load relationships based on limited measurements between 1965 and 1974 at Michigan Bar gaging station and between 1965-1974 at McConnell are used to show that annual suspended sediment load in the Cosumnes River varies from 50 to 1,900,000 tons with a long-term average of 120,000 tons. Bedload was calculated using the Levi formula (1957)—a transport equation appropriate for sand bed streams, that performed the best for data collected on the Sacramento River at Freeport. Using this same method for the gravel bed Cosumnes River at Michigan Bar, annual bed load varies from 0-90,000 tons, with an average annual bedload transport of 4,000 tons (NHC, 2003: Sediment transport monitoring in the Cosumnes River at Michigan Bar. Draft Report prepared for JSA, Sacramento, California, 2003). Suspended sediment loads for the Mokelumne River at Woodbridge are estimated as an order of magnitude smaller than those on the Cosumnes, with an average annual load of 14,000 tons based on USGS data collected at Woodbridge between 1974 and 1994. No measurements of bedload on the Mokelumne are available. Sediment input from Dry Creek, Snodgrass Slough, Lost Slough, Georgiana Slough and sediment from tidal exchange also remain to be measured.

Since 1994 changes in North Delta sediment storage have been monitored on the North and South forks of the Mokelumne River adjacent to Staten Island and McCormack Williamson Tract in the immediate vicinity in Snodgrass slough, the DCC, and Beaver, Hog, and Sycamore sloughs (DWR, 1998; 2000). Results are variable; however there is a recent lowering trend in channel thalwegs (on the order of ~1 m), except in the lower Mokelumne channel downstream of where the North and South forks merge. NHC (2002) suggests that an earlier trend may have been channel aggradation based on a comparison with NOAA's 1932 cross sections data contained within DWR's Cross Section Development Program (CSDP) data.

Sediment storage was measured upstream of the North Delta on floodplain sand splay complexes at the Cosumnes River Preserve restoration area (Florsheim and Mount, 2002), but downstream of the location of sediment transport measurements on the Cosumnes River. A measure of sediment storage calculated as difference between cumulative deposition and scour was 9445 m^3 at the Accidental Forest floodplain (between 1995 and 2000 (1889 m^3/yr)) and 7369 m^3 at the Corps Breach floodplain (between 1998 and 2000 (2456 m^3/yr) during a relatively wet period. Thus, the total annual sediment load calculated in the Cosumnes River should be decreased by about 12,400 tons/yr, the average annual amount of sediment stored on the floodplain. On-going monitoring at the Cosumnes River preserve will help refine long-term estimates of sediment storage.

Historic export of sediment from the North Delta system has occurred by dredging. A Corps of Engineers Map (1934) shows dredging plans for the lower Mokelumne River as ranging between about 3 m below MLLW near the confluence with the Sacramento River to about 1 m below MLLW near the Galt-New Hope Bridge—enabled by "the 1884 act of July 5, 1884 for removal of snags and dredging of shoals." It is likely that aggradation as a consequence of hydraulic mining in the North Delta was the impetus for the snagging and dredging act and that materials dredged from channels were utilized to construct or augment North Delta levees. Recent dredging activities are reported by NHC (2002) based on their review of a DWR map "Sacramento San Joaquin Delta Levee Maintenance Subventions Program." This map shows six locations on the North and South Forks and Snodgrass, Hog, and Sycamore Sloughs that were dredged during the 6 years between 1987 and 1993. The estimated volume of material dredged during this period was about 53,500 m^3 (210,000 yd^3; ~8,900 m^3/yr or 25.450 tons/yr).

The final component of the sediment budget, sediment yield from the North Delta to the Sacramento System, has not been measured. In the absence of other data sources, previous sediment budgets for the Central Delta assume that inflow to the North Delta is approximately the same as the outflow from the North Delta, or that the North Delta simply passes sediment provided by upstream rivers, without local changes in storage. Given the importance of sediment input, storage and yield within the North Delta to tidal marsh restoration at the M-W

Tract, more detailed long-term local data are required in order to quantify the sediment budget relationship. A sediment monitoring and modeling effort is currently underway by UC Davis and DWR to address some of these issues.

3. ECOLOGIC PROCESSES

Prior to anthropogenic disturbances during the past two centuries that radically changed the ecology of the Delta, floods deposited nutrient rich sediment on the Delta Islands, promoting growth of dense tule marshes with high biological productivity. The shallow water of the Delta marshes and sloughs provided habitat for an abundance of resident and anadromous fish and migratory birds. The delta was significantly impacted by hydraulic mining sedimentation, levee construction, land clearing for agriculture, subsidence, navigation and flood control dredging, clearing of large woody debris, and flow regulation and water diversions. Changes to the ecology also included over fishing, introduction of exotic species, and habitat alteration and loss. Today the Delta resource is managed primarily for water supply and agriculture.

a. Fish

Native fishes of concern include chinook salmon, delta smelt, Sacramento splittail, and steelhead. Four runs of chinook migrate upstream through the Delta and out-migrate back to the Pacific Ocean each year: the fall, late-fall, winter, and spring-runs; and thus are moving through the Delta during most of the year. Currently, the winter-run salmon is listed as endangered, and the spring run is listed as threatened. Adult salmon migrate up Central Valley rivers to spawn in gravel riffles. Shallow water of freshwater tidal marshes and floodplains provide feeding and rearing habitat for juvenile anadromous fish, and are important habitat during migration back to the Pacific Ocean. Riparian vegetation on Delta levees is important both for providing shade to reduce water temperatures and to provide insects as a food source.

Delta smelt are endemic to the San Francisco Bay-Estuary and historically were one of the most common species in the estuary. Currently they are listed as a threatened species. Delta smelt can spawn between February and July, but most spawn during April through May, varying from year to year with flow conditions. Spawning generally occurs in shallow, fresh or slightly brackish slough channels or channel margins in the upper Delta and Sacramento River upstream of Rio Vista (Moyle, 2002) and fish eggs are adhesive, sticking to hard substrate via a stalk, cattails and tules, tree roots, or submerged branches where there is a current. Delta smelt drift downstream, thriving where the freshwater-brackish mixing zone broadly covers area with shallow water habitat less than 1.2 m deep (Federal Register 1993) where phytoplankton and zooplankton are dense. Delta smelt populations have declined primarily due to freshwater diversions (Moyle, 1992), pollutant runoff, exotic species, and loss of habitat.

Splittail migrate upstream in January-February and spawn on seasonally inundated floodplains in March-April. They migrate back downstream in May and rear in shallow, brackish water habitat for one to two years before beginning the migratory cycle again. Physical elements important to the success of splittail include flooded floodplains for spawning, safe migration channels, brackish water rearing habitat with an invertebrate food source. Splittail populations benefit from wet-year flows. These observations are provided in a review of the biology and population dynamics of Sacramento splittail by Moyle et al., (2003).

b. Cranes

The North Delta and adjacent areas were historically part of the Central Valley sandhill crane population. Prior to anthropogenic disturbances, these migratory cranes utilized seasonal shallow water floodplain and freshwater tidal wetlands for winter foraging for invertebrates and for loafing with minimal threats from predators. Habitat loss through wetland drainage, agricultural development, urbanization, and hunting are thought to be the primary factors that affected crane habitat during the 18th and 19th centuries (Littlefield and Ivey, February 2000). Today critical wintering habitat depends on remaining or newly restored wetlands and grain grown on Staten Island and adjacent tracts and islands. A recent study reports that sandhill cranes use Staten Island for a five to six month period from September through March, and during that time roost and forage within a home range of about 1.7 km^2 (Ivey and Herziger, 2003). Connectivity between adjacent areas was documented during December and January when thousands of cranes flew between Staten and Bract, Canal Ranch, and New Hope Tracts, and Tyler, Bouldin, Dead Horse, Andrus and southern Grand Islands. From Northern Grand Island and New Hope Tract, cranes flew toward the Cosumnes River floodplain and Stone Lakes (Ivey and Herziger, 2003).

Marked greater sandhill cranes, a subspecies listed as threatened in the State of California, primarily use the Staten Island, Bract Tract, and the Stone Lakes areas. Staten Island has increased in importance relative to adjacent areas due to modification of farming practices such as seasonal flooding and wheat farming, that promote crane habitat and Staten Island was the only site monitored to show high numbers of cranes through the winter. Moreover, many marked greater sandhill cranes used Staten exclusively (Ivey and Herziger, 2003). Adding to the importance of the Island is the continuing loss of habitat in adjacent islands and floodplain tracts lost to urban development or non-compatible agricultural practices such as vineyards.

c. Exotics

Egeria densa submerged aquatic vegetation is one of the exotic species of concern in the Delta where it covers over 1,500 hectares (3,900 ac; Pennington and Sytsma, http://www.clr.pdx.edu/projects/egeria/egeria.html). Grimaldo et al., (2000) suggest that the problem associated with E. Densa is that it is preferentially used by exotic fish over natives and provides habitat for another invasive species, the Chinese Mitten Crab. *E. Densa* is spreading in the Delta, but its coverage within the North Delta is unknown. Only male plants have colonized in the USA, and dispersal is by vegetative fragmentation. The California Department of Boating and Waterways has attempted to remove *E. Densa* using herbicides which has initiated lawsuits, whereas mechanical removal tends to leave fragments that re-establish (Pennington and Sytsma). Current research questions center on the effects of light and nutrients and effective management strategies.

4. WATER QUALITY

Dissolved organic carbon (DOC) and mercury methylation are important water quality issues in the North Delta. Numerous other water quality issues exist in the Delta that are beyond the scope of the Science Panel to address. In saturated anaerobic conditions, peat decomposes slowly and releases carbon dioxide (CO_2) and methane (CH_4). However, in drained and leveed Delta Islands, aerobic conditions accelerate decay of peat silts. Organic matter is converted mainly to CO_2 as the soil decomposes, whereas DOC accounts only for a small percentage of the carbon loss (Deverel and Rojstaczer, 1996). Subsidence of peat soil is one factor that decreases levee stability, increasing the flood control challenge and potentially changing salinity and water quality, an important water supply issue.

Methylmercury (MeHg) is an organic form of mercury that results from biogeochemical transformation of elemental mercury. First, elemental mercury is transformed to oxidized mercury, and then oxidized mercury is transformed to MeHg in a process controlled by sulfate reducing bacteria and other microbes that thrive in anoxic conditions. Factors that control methylation and the reverse process, demethylation, include temperature, dissolved organic carbon, salinity, pH, oxidation-reduction conditions, and the form and concentration of sulfur in the water and sediment. The problem associated with mercury in the Delta is biotic exposure to MeHg, particulary the mechanism by which it magnifies as it moves up each step in food chain, becoming a threat to human consumption and fish-eating wildlife (USGS, 2000). Documented sources of elemental mercury in the Delta include mines in the Coast Ranges and the legacy of gold mining practices in the Sierra Nevada. Weiner (2003) suggests two approaches to evaluating the effects of restoration on mercury cycling: 1) evaluate effect of restoration on bioavailability of inorganic mercury for methylation; and 2) the microbial production of methyl mercury. Understanding these processes is important in understanding to what extent floodplain or freshwater tidal marsh restoration or rehabilitation can cause increased MeHg production.

C. Expectations for the Ecosystem

Overall project objectives based on objectives of the CALFED Ecosystem Restoration Program are:

Restore ecological processes, including hydrologic, geomorphic and biologic processes, to the extent practicable in the North Delta Flood Control and Ecosystem Restoration Project area.

1. Promote natural flooding processes, tidal action and appropriate salinity regime.
2. Improve river floodplain connectivity
3. Allow channel migration where practicable.
4. Promote sediment deposition, especially to increase elevations in areas of subsidence due to agricultural activities.
5. Promote Delta foodweb productivity and water exchange with adjacent channels.
6. Restore self-sustaining habitats including freshwater tidal marsh, seasonal floodplain, and riparian.
7. Support special status species in the area.
8. Limit exotic species establishment to the extent practicable.
9. Limit methylmercury introduction into the food-chain to the extent practicable.
10. Specific objectives have been developed for each of the three potential restoration options for the M-W Tract described below:

1. Restoration Option 1, Fluvial Maximum/Minimum Control:

a. Promote sedimentation through flooding, riverine and tidal processes
b. Promote natural flooding processes
c. Improve river floodplain connectivity
d. Allow channel migration
e. Promote foodweb productivity and water exchange with adjacent channels
f. Restore freshwater tidal marsh, seasonal floodplain, and riparian habitats
g. Support special status species
h. Limit exotic species establishment

2. Restoration Option 2, Fish Ecological Maximum-Maximum Control:

a. Provide annual floodplain spawning habitat
b. Limit aquatic exotic species establishment by drying the M-W Tract during summer months (July-December)
c. Promote annual flooding and associated sedimentation
d. Reconnect Mokelumne river and associated M-W Tract floodplain
e. Promote foodweb productivity on floodplain and water exchange with adjacent channels with annual flooding events
f. Restore seasonal floodplain and riparian habitats
g. Support special status species
h. Limit terrestrial exotic species establishment with weed control

3. Restoration Option 3, Hybrid Floodplain/Subsidence Reversal:

a. Provide annual floodplain spawning habitat
b. Limit aquatic exotic species establishment by drying the M-W Tract during summer months (July-December)
c. Promote annual flooding and associated sedimentation
d. Reconnect Mokelumne river and associated M-W Tract floodplain
e. Promote foodweb productivity on floodplain and water exchange with adjacent channels with annual flooding events
f. Restore seasonal floodplain and riparian habitats
g. Support special status species
h. Limit terrestrial exotic species establishment with weed control
i. Advance application and understanding of subsidence reversal techniques
j. Increase elevations on southern M-W Tract to intertidal elevations elevations (near sea level) that would support native species but discourage colonization by warmwater exotic species
k. Determine whether *S. californicus* or *S. acutus* persists in an annually flooded environment, which species captures the most sediment during flooding events, and which species is associated with the most bioaccretion
l. Capture Mokelumne sediment bedload through siphon in southern M-W Tract
m. Research dissolved organic carbon and THMFP production in wetland
n. Beneficial reuse of dredged material in subsidence reversal demonstration project
o. Potential for mercury mesocosm experiment in subsidence reversal demonstration wetland

4. Conceptual Models

Conceptual models for the restoration alternatives, habitats, species, ecosystem processes and stressors have been developed. The following diagrams show the integration of the different conceptual models for different restoration options:

5. Project Design

M-W Tract

a. Fluvial Maximum (minimum control)

Habitat (in acres)								
Floodplain	Riparian	Scrub-shrub	Channel aquatic	Dendritic Intertidal	Shallow-water habitat	Emergent Marsh	Mudflat	Grassland
400	250*	100	200	100	500	250	50	150

*Likely to increase over time to floodplain acreage.

b. Fish Ecological Maximum (maximum control)

Floodplain	Riparian	Scrub-shrub	Emergent Marsh	Mudflat	Grassland
1450*	50**	50	50***	50	1400

*Nekton gates provide some tidal circulation in South.
**Likely to increase over time to floodplain acreage
***Emergent marsh may be seasonal (may not sustain itself year-round with only 5 mos. Inundation)

c. Hybrid Floodplain/Subsidence Reversal

Floodplain	Riparian	Scrub-shrub	Emergent Marsh	Isolated Wetland	Mudflat	Grassland
1150*	50**	30	50***	250	50	1150

*Nekton gates provide some tidal circulation in South.
**Likely to increase over time to floodplain acreage
***Emergent marsh may be seasonal (may not sustain itself year-round with only 5 mos. Inundation)

These alternatives are paired with various downstream options to address stage increases including detention basins on Staten Island. Also setback levees and associated habitat on Staten Island.

III. Restoration Targets

A. Performance Measures

The inherent uncertainty associated with the implementation of each of the three restoration alternatives requires a monitoring program to assess project performance. The direction and scale of the monitoring program for each alternative can be determined by answering the following questions:

M-W Tract

1. Fluvial Maximum (minimum control)

a. Floodplain Processes

- i. Frequency of flooding by way of east levee and through secondary channel? Expect annual flood frequency by way of secondary channel.
- ii. Floodplain area (area flooded). Expect 400 acres. Does riparian habitat (starting with 200 acres along channel) increase over time to replace grassland (an additional 150 acres)?
- iii. Does scour and deposition occur? Especially by water through floodplain channel?
- iv. How do flooding and tidal processes interact?

b. Sedimentation/Geomorphic Processes

- i. Sedimentation rates in and around secondary channel, floodplain, dendritic intertidal wetlands and southern shallow-water habitat area?

c. Dendritic Intertidal Channels

- i. Do they form as expected? Expect approximately 150 acres of intertidal habitat at elevations -1’ msl to 1’ msl.
- ii. Do channels dry out on tidal cycle?
- iii. Does exotic aquatic vegetation predominate? Exotic fish? Native fish?

d. Exotic Species Dominance

- i. Does aquatic exotic vegetation dominate perennial channel?
- ii. Does aquatic exotic vegetation dominate intertidal wetlands? (same question as C.iii.)
- iii. Does aquatic exotic vegetation dominate subtidal area in south? If so, does the subtidal area serve as a propagule source for exotic vegetation in the intertidal dendritic channels?
- iv. Does terrestrial exotic vegetation predominate along permanent channel?
- v. Does terrestrial exotic vegetation dominate floodplain? Is it related to the flooding frequency?
- vi. Does terrestrial exotic vegetation predominate on wildlife-friendly levees? Which part of wildlife-friendly levee (emergent marsh, scrub-shrub or riparian habitat)?
- vii. Do exotic fish predominate in channel?
- viii. Do exotic fish predominate in intertidal dendritic wetlands? (same as question C.iii.)

ix. Do exotic fish dominate subtidal area in south? Do they serve as a source for exotic fish in the intertidal dendritic wetlands?

e. Fish Stranding

i. Do fish strand in northern floodplain area after flooding events? Expect fish to navigate to aquatic areas in south; however natural levees that form along starter channel may present a barrier to fish.
ii. Are fish stranded during the outgoing tide in the dendritic intertidal channels?

f. Mosquito Management

i. Is there significant mosquito production in floodplain? During what months of year? Is mosquito production associated with presence of vegetation?
ii. Is there significant mosquito production in permanent channel? During what months of year? Is mosquito production associated with presence of vegetation?
iii. Is there significant mosquito production in dendritic intertidal wetlands? During what months of year? Is mosquito production associated with presence of vegetation?
iv. Is there significant mosquito production in subtidal area in south? During what months of year and what flow conditions? Is mosquito production associated with presence of vegetation?
v. Is there significant mosquito production in floodplain when flooded (dry June-December)? During what months of year? Is mosquito production associated with presence of vegetation?

g. Methylmercury

i. Is mercury methylation on floodplain significant?
ii. Is mercury methylation in dendritic intertidal wetlands significant?
iii. Is mercury methylation in subtidal area significant?

h. Organic Carbon

i. Is organic carbon on floodplain exported to channels during flood events? Are there water quality (disinfection by-product precursor) effects at SWP or other drinking water diversions? Are there ecological benefits to biota in surrounding channels?
ii. Organic carbon production and export from permanent channel? Are there water quality (disinfection by-product precursor) effects at SWP or other drinking water diversions? Are there ecological benefits to biota in surrounding channels?
iii. Organic carbon production and export in dendritic intertidal wetland area? Are there water quality (disinfection by-product precursor) effects at SWP or other drinking water diversions? Are there ecological benefits to biota in surrounding channels?

i. Subsidence Reversal

i. Does accretion occur in the emergent marsh area? At what rate?

2. Fish Ecological Maximum (maximum control)

a. Floodplain Processes

i. Frequency of flooding? Expect annual flood frequency over east levee (degraded to 8.5' msl).
ii. Floodplain area (area flooded). Expect 1450 acres. Riparian habitat should develop over time to replace grassland (up to 1400 acres).
iii. Scour? Deposition? Does this occur? Does floodplain topography become more complex over time?

b. Sedimentation/Geomorphic Processes

i. What are the sedimentation rates?

c. Exotic Species Dominance

i. Does exotic aquatic vegetation dominate when floodplain is flooded (January-June)?
ii. Does terrestrial exotic vegetation dominate floodplain during dry periods (July-December)?
iii. Does terrestrial exotic vegetation predominate on wildlife-friendly levees? Which part of wildlife-friendly levee (emergent marsh, scrub-shrub or riparian habitat)?
iv. Do exotic fish dominate when floodplain is flooded (January-June)?

d. Fish Stranding

i. Do fish strand in northern floodplain area after flooding events?
ii. Can water ponded in southern area be drained through the use of nekton gates and pumps without harming fish? Is there resultant fish stranding?

e. Mosquito Management

i. Is there significant mosquito production in floodplain when flooded (January-June)? During what months of year? Is mosquito production associated with presence of vegetation?
ii. Is there significant mosquito production in southern area where self-regulating tidal gates circulate water? Is mosquito production associated with presence of vegetation?

f. Methylmercury

i. Is mercury methylation on floodplain significant during flooded months (January-June) and/or during dry months (July-December)?
ii. Does mercury methylation vary by area of floodplain (water depth) during times when floodplain is flooded?

g. Organic Carbon

i. Is organic carbon on floodplain exported to channels during flood events? Are there water quality (disinfection by-product precursor) effects at SWP or other drinking water diversions? Are there ecological benefits to biota in surrounding channels?
ii. How do self-regulating tidal gates and tidal circulation during flooded months (January-June) affect organic carbon production and export into adjacent channels? Are there water quality (disinfection by-product

precursor) effects at SWP or other drinking water diversions? Are there ecological benefits to biota in surrounding channels?

h. Subsidence Reversal

i. Does accretion occur on the floodplain? At what rate?

3. Hybrid Floodplain/Subsidence Reversal

a. Floodplain Processes

i. Frequency of flooding? Expect annual flood frequency over east levee (degraded to 8.5' msl).
ii. Floodplain area (area flooded). Expect 1000 acres. Riparian habitat should develop over time to replace grassland (up to 1000 acres).
iii. Scour? Deposition? Does this occur? Does floodplain topography become more complex over time?

b. Sedimentation/Geomorphic Processes

i. What are the sedimentation rates?

c. Exotic Species Dominance

i. Does exotic aquatic vegetation dominate when floodplain is flooded (January-June)?
ii. Does terrestrial exotic vegetation dominate floodplain during dry periods (July-December)?
iii. Does exotic aquatic vegetation dominate in subsidence reversal demonstration project area? During what months of year? Does subsidence reversal demonstration project area serve as a propagule source of exotic vegetation to areas downstream?
iv. Does terrestrial exotic vegetation predominate on wildlife-friendly levees? Which part of wildlife-friendly levee (emergent marsh, scrub-shrub or riparian habitat)?
v. Do exotic fish dominate when floodplain is flooded (January-June)?
vi. Do exotic fish dominate in subsidence reversal demonstration project area?

d. Fish Stranding

i. Do fish strand in northern floodplain area after flooding events? Can the floodplain be drained through gravity draining and pumping without stranding or harming fish?
ii. Do fish strand in the subsidence reversal project area after flooding?

e. Mosquito Management

i. Is there significant mosquito production in floodplain when flooded (January-June)? During what months of year? Is mosquito production associated with presence of vegetation?
ii. Is there significant mosquito production in the subsidence reversal demonstration project area? Is mosquito production correlated with density of vegetation?

f. Methylmercury

i. Is mercury methylation on floodplain significant during flooded months (January-June) and/or during dry months (July-December)?

ii. Does mercury methylation vary by area of floodplain (water depth) during times when floodplain is flooded?

iii. Is mercury methylation significant in subsidence reversal demonstration project area (tule wetlands)? Is there bioaccumulation in Sacramento perch?

g. Organic Carbon

i. Is organic carbon on floodplain exported to channels during flood events? Are there water quality (disinfection by-product precursor) effects at SWP or other drinking water diversions? Are there ecological benefits to biota in surrounding channels?

ii. Is organic carbon produced and exported from subsidence reversal demonstration project area? At what rates? During what months of the year? Are there water quality (disinfection by-product precursor) effects at SWP or other drinking water diversions? Are there ecological benefits to biota in surrounding channels?

h. Subsidence Reversal

i. Does accretion occur on the floodplain? At what rate?

ii. Which techniques are responsible for what accretion rates in the subsidence reversal demonstration project area?

B. Success Criteria

The criteria for success for each of the alternatives have not yet been fully developed. Once a preferred alternative has been selected, more defined criteria will be developed. The following provide general indicators of success for each scenario and will be used as a starting point to develop more refined criteria.

M-W Tract

1. Fluvial Maximum (minimum control)

a. Floodplain Processes

i. Appropriate frequency of flooding to achieve multiple ecosystem restoration objectives

ii. Appropriate flood plain area to achieve multiple ecosystem restoration objectives

iii. Scour and deposition are occurring at the site at an acceptable rate without damaging wildlife-friendly levees, etc.

iv. Flooding and tidal processes are compatible (e.g., flooding does not destroy formation of tidal channels or conversely filling of the M-W Tract with water from tidal processes does not inhibit riverine processes').

b. Sedimentation/Geomorphic Processes

i. Sedimentation is occurring but not at rates that are higher than expected in secondary channel.

c. Dendritic Intertidal Channels
  i. Dendritic intertidal channels form as expected.
  ii. Channels dry out on tidal cycle.
  iii. Native aquatic vegetation and fish predominate.

d. Fish Stranding
  i. Fish do not get stranded in northern floodplain area after flooding events.
  ii. Fish do not get stranded during the outgoing tide in the dendritic intertidal channels.

e. Mosquito Management
  i. Insignificant mosquito production in floodplain when flooded.
  ii. Insignificant mosquito production in southern area where nekton gates circulate water.

f. Methylmercury
  i. Mercury methylation on floodplain is insignificant and not affected by hydrology.
  ii. Mercury methylation does not vary by area of floodplain (water depth) during times when floodplain is flooded.

g. Organic Carbon
  i. Organic carbon on floodplain is not exported to channels during flood events unlikely to increase organic carbon levels at SWP pumps.
  ii. Self-regulating tidal gates and tidal circulation during flooded months (January-May) does not affect organic carbon production and export into adjacent channels.

h. Subsidence Reversal
  i. Accretion is occurring on the floodplain at an appreciable rate.

2. Fish Ecological Maximum (maximum control)

a. Floodplain Processes
  i. Appropriate flood plain area to achieve multiple ecosystem restoration objectives
  ii. Scour and deposition are occurring at the site at an acceptable rate without damaging wildlife-friendly levees, etc.
  iii. Flooding and tidal processes are compatible (e.g., flooding does not destroy formation of tidal channels or conversely filling of the M-W Tract with water from tidal processes does not inhibit riverine processes').
  iv. Appropriate frequency of flooding to achieve multiple ecosystem restoration objectives

b. Sedimentation/Geomorphic Processes
  i. Sedimentation is occurring but not at rates that are higher than expected in secondary channel.

c. Dendritic Intertidal Channels

i. Dendritic intertidal channels form as expected.
ii. Channels dry out on tidal cycle.
iii. Native aquatic vegetation and fish predominate.

d. Fish Stranding

i. Fish do not get stranded in northern floodplain area after flooding events.
ii. Fish do not get stranded during the outgoing tide in the dendritic intertidal channels.

e. Mosquito Management

i. Insignificant mosquito production in floodplain when flooded.
ii. Insignificant mosquito production in southern area where nekton gates circulate water.

f. Methylmercury

i. Mercury methylation on floodplain is insignificant and not affected by hydrology.
ii. Mercury methylation does not vary by area of floodplain (water depth) during times when floodplain is flooded.

g. Organic Carbon

i. Organic carbon on floodplain is not exported to channels during flood events unlikely to increase organic carbon levels at SWP pumps.
ii. Self-regulating tidal gates and tidal circulation during flooded months (January-May) does not affect organic carbon production and export into adjacent channels.

h. Subsidence Reversal

i. Accretion is occurring on the floodplain at an appreciable rate.

3. Hybrid Floodplain/Subsidence Reversal

a. Floodplain Processes

i. Appropriate frequency of flooding to achieve multiple ecosystem restoration objectives
ii. Appropriate flood plain area to achieve multiple ecosystem restoration objectives
iii. Scour and deposition are occurring at the site at an acceptable rate without damaging wildlife-friendly levees, etc.
iv. Flooding and tidal processes are compatible (e.g., flooding does not destroy formation of tidal channels or conversely filling of the Tract with water from tidal processes does not inhibit riverine processes').

b. Sedimentation/Geomorphic Processes

i. Sedimentation rates are significant over time (raising the middle and southern parts of the Tract above sea level) allowing natural drainage.

C. Monitoring

A monitoring plan will be developed after a preferred alternative among the three conceptual models has been selected.

IV. Adaptive Management Decision Making

A. Adaptive Management Responses.

The following section outlines possible adaptive management responses for the various alternatives. Adaptive management responses will be developed in more detail once a preferred alternative is chosen.

M-W Tract

1. Fluvial Maximum (minimum control)

a. Floodplain Processes

i. If need to change frequency of flooding, can adjust height of east levee and/or inflatable dam. Raise to increase frequency water shunted to Mokelumne River breach. Lower to increase frequency M-W Tract floods over east levee, though may be restricted from lowering east levee below 8.5’ msl due to access issues.

ii. If floodplain area is too small or too large, change factors that affect hydrology (east levee height, channel configuration).

iii. If scour and deposition are not occurring, change factors that affect hydrology (east levee height, channel configuration) to increase hydraulic energy. If scour and deposition are occurring too violently (such that the wildlife-friendly levees are threatened, for example), change factors that affect hydrology to lessen hydraulic energy or put in erosion protection.

iv. If flooding and tidal processes are incompatible (e.g., flooding destroys formation of tidal channels that are not reformed for many years, or conversely filling of the M-W Tract with water from tidal processes inhibits riverine processes), decide whether to preserve flooding (and raise southern levee to height inhibiting tidal action) or preserve tidal processes and inhibit flooding by raising east levee or closing off secondary channel.

b. Sedimentation/Geomorphic Processes

i. If sedimentation rates are higher than expected in secondary channel, is it still functioning to bring water onto the floodplain? If not, consider excavating channel further into the M-W Tract. If sedimentation is occurring in the northern portion of the M-W Tract, consider strategies (such as hydrologic changes or physical transfer) to transfer sediment to the southern portion of the M-W Tract.

c. Dendritic Intertidal Channels

i. If dendritic intertidal channels do not form as expected and instead there is emergent marsh or floodplain habitat, for example, consider adjusting goals for that region to be the habitat that develops. If lack of channel formation is due to insufficient hydraulic energy, consider changes in the southern levee breach size and elevation or excavating starter channels that would increase the hydraulic energy. If elevations are not appropriate for formation of dendritic intertidal channels, consider relocating breaches.

ii. If channels do not dry out on tidal cycle, consider raising southern levee to eliminate the formation of tidal habitat and associated exotics or aggressive exotic species control. Install one-way flow gates or self-regulating tidal gates to facilitate draining of tidal channels.

iii. If exotic aquatic vegetation and fish predominate, consider aggressive exotic control measures or eliminating habitat by raising southern levee or installing water control gates.

d. Exotic Species Dominance

i. If aquatic exotic vegetation dominate perennial channel, consider strategies to increase flow, use vegetation control methods or eliminate habitat by closing breach which allows channel formation.

ii. If aquatic exotic vegetation dominates intertidal wetlands, consider strategies to increase flow, use vegetation control methods or eliminate habitat by raising southern levee.

iii. If aquatic exotic vegetation dominates subtidal area in south, consider leveeing off southern area. If subtidal area serves as a propagule source for exotic vegetation in the intertidal dendritic channels, levee off subtidal area or use aggressive exotic vegetation control methods in subtidal area (may need to contain areas for treatment).

iv. If terrestrial exotic vegetation predominates along permanent channel, remove by cutting or other control methods, consider closing channel, changing factors that affect hydrology (increasing or decreasing water levels, for example), by changing breach or weir configuration.

v. If terrestrial exotic vegetation dominates floodplain and related to flooding frequency, change factors that affect hydrology/flooding frequency. Or use vegetation control methods.

vi. If terrestrial exotic vegetation predominates on wildlife-friendly levees (emergent marsh, scrub-shrub or riparian habitat), use vegetation control methods (including herbicides, goats, for example) and/or plant native species to displace exotic species.

vii. If exotic fish predominate in channel related to flow, increase flow by changing breach dimensions or use exotic fish control strategies. If necessary, eliminate habitat by closing breach.

viii. If exotic fish predominate in intertidal dendritic wetlands, control fish or hydrology by installing water control weirs, self-regulating tidal gates. Eliminate habitat by raising southern levee.

ix. If exotic fish dominate subtidal area in south, try control strategies (may have to isolate areas for treatment). If related to hydrology, change factors that affect hydrology. If the subtidal area serves as a source for exotic fish in the intertidal dendritic wetlands, levee off the southern subtidal area.

e. Fish Stranding

i. If fish strand in northern floodplain area after flooding events, consider filling in low areas where stranding occurs. Change flooding area by changing factors that affect hydrology. If secondary channel facilitates fish stranding, consider eliminating secondary channel by closing breach.

ii. If fish stranded during the outgoing tide in the dendritic intertidal channels, consider grading to facilitate drainage into the channels, eliminating low areas where ponding might occur or changing factors that affect hydrology (perhaps installing gates to mute tides).

f. Mosquito Management

i. If significant mosquito production in floodplain, consider mosquito control methods (such as insecticide), eliminating low areas where ponding might occur, improving drainage by grading. If associated with specific vegetation, consider controlling/changing vegetation. If hydrologic changes would lessen mosquito production without undue ecological effects, consider changing factors that affect hydrology.

ii. If significant mosquito production in permanent channel, consider control methods in channel (may have to isolate treatment areas). If this occurs during certain flow conditions (such as low flow), consider changes to channel geometry (narrowing channel, for example) to increase flow. If associated with presence of vegetation, consider removing or altering vegetation.

iii. If significant mosquito production in dendritic intertidal wetlands, consider control methods (insecticide), changing factors that affect hydrology (perhaps specific to certain seasons when mosquitoes are most problematic). If mosquito production associated with presence of vegetation, consider vegetation control.

iv. If significant mosquito production in subtidal area in south, use mosquito control measures, make changes that affect hydrology (perhaps increasing flow rates by creating additional breaches, removing vegetation or other obstructions to flow), controlling vegetation if mosquitoes are associated with vegetation, or building levees to isolate the subtidal area.

v. If significant mosquito production in floodplain when flooded, use mosquito control (insecticide), increase circulation through additional breaches, control vegetation, or reduce area of floodplain habitat.

g. Methylmercury

i. If mercury methylation on floodplain significant and affected by hydrology (east levee height or secondary channel dimensions), adjust factors that affect hydrology. Eliminate habitat by raising east levee or closing Mokelumne River breach that forms secondary channel.

ii. If mercury methylation in dendritic intertidal wetlands significant and affected by hydrology, adjust factors that affect hydrology. Eliminate habitat.

iii. If mercury methylation in subtidal area significant and affected by hydrology, change factors that affect hydrology. Eliminate habitat.

h. Organic Carbon

i. If organic carbon on floodplain exported to channels during flood events and likely to increase organic carbon levels at SWP pumps and other drinking water diversions, consider holding water on-island and treatment or modifications to hydrology/flow paths that might lessen organic carbon export. Weigh against ecological benefits in channels due to organic carbon export.

ii. If organic carbon production and export from permanent channel significant, consider eliminating permanent channel, in-channel treatment, or preventing permanent channel from draining from island during certain time periods. (Since organic carbon loads are greatest during winter and time of most significant diversions, unlikely to be able to control organic carbon export during this time due to flooding conditions).

iii. If organic carbon production and export in dendritic intertidal wetland area, consider raising southern levee to eliminate habitat (assuming water quality effects outweigh ecological benefits).

i. Subsidence Reversal

If accretion is not occurring in the emergent marsh area, consider other strategies such as adding brush boxes, changing hydrology by modifying the southern levee opening to enhance settlement.

2. Fish Ecological Maximum (maximum control)

a. Floodplain Processes

i. If need to change frequency of flooding, adjust height of east levee correspondingly. May not be able to decrease levee height below 8.5' msl due to access issues. Could then consider flooding M-W Tract by a breach along southeast levee (along Mokelumne River).

ii. If floodplain area is too small, change factors that affect hydrology (such as lowering east levee) or creating a breach along the Mokelumne River. Not likely to have a floodplain area too large. Should be O.K. to flood entire Tract. However, if problems with flooding lower portion of Tract, consider strategies such as leveeing off southern portion of Tract.

iii. Scour and deposition are not necessary for the floodplain's success as floodplain habitat. However if excessive scour or deposition are occurring such that draining of the floodplain does not occur in specific areas, resulting in fish stranding, can make changes that affect hydrology to lessen scouring or deposition. Perhaps necessary to utilize only part of the floodplain. Levee off or otherwise isolate other parts of the floodplain.

b. Sedimentation/Geomorphic Processes

i. If sedimentation rates are significant over time (raising the middle and southern parts of the Tract above sea level) may eventually not be necessary to pump out the M-W Tract, may drain naturally. If significant erosion, may need to reconsider use of the M-W Tract as floodplain. May need to close levee breaches, allow forest succession in the north, perhaps subsidence reversal wetland development in the south. Allow elevations to increase before opening the M-W Tract to floodwaters.

c. Exotic Species Dominance

i. If exotic aquatic vegetation dominates when floodplain is flooded, consider strategies to increase flow, use vegetation control methods or eliminate habitat by raising east levee height.

ii. If terrestrial exotic vegetation dominates floodplain during dry periods, consider vegetation control strategies. If related to flooding frequency, consider raising east levee to allow less frequent flooding. However, likely that exotic plants may be surviving with groundwater and annual rain (may not necessarily be correlated to flooding). Consider planting native species to displace exotic plant species.

iii. If terrestrial exotic vegetation predominates on wildlife-friendly levees (emergent marsh, scrub-shrub or riparian habitat), use vegetation control methods (herbicides, goats, for example) and/or consider planting native species to displace exotic species.

iv. If exotic fish dominate when floodplain is flooded, revisit assumption that floodplain benefits native fish. Consider raising east levee and discontinuing ecological goal of using M-W Tract as floodplain.

d. Fish Stranding

i. If significant fish stranding in northern floodplain area after flooding events, consider excavation/contouring to improve drainage from the M-W Tract. Can also increase/decrease the east levee height if changing the hydrology would make stranding less likely.

ii. If nekton gates and/or pumps harm fish, discontinue use of gates and/or pumps. Use alternative technology one-way flow valves or fish friendly pumps to drain island. May need to leave some water on the M-W Tract and remove fish by capture and release or other strategy.

e. Mosquito Management

i. If significant mosquito production in floodplain when flooded, consider use of insecticide, controlling vegetation, or reducing area flooded by changing factors that affect hydrology. If mosquito production is limited to specific conditions (season, temperature), consider draining the M-W Tract during the most problematic times.

ii. If significant mosquito production in southern area where nekton gates circulate water, consider insecticide application, controlling vegetation or increasing circulation via additional gates or other technology.

f. Methylmercury

i. If mercury methylation on floodplain significant and affected by hydrology, adjust factors (east levee height) that affect hydrology. Eliminate habitat by raising east levee.

ii. If mercury methylation varies by area of floodplain (water depth) during times when floodplain is flooded, consider changing factors that affect hydrology to change flooded area, eliminating areas where methylation is greatest. Regrade land such that water depths are those least likely to enhance methylation.

g. Organic Carbon

i. If organic carbon on floodplain exported to channels during flood events and likely to increase organic carbon levels at SWP pumps and other drinking water diversions, consider holding water on-island and treatment, before draining Tract.

ii. If nekton gates and tidal circulation during flooded months (January-May) affect organic carbon production and export into adjacent channels in a negative way, consider not using nekton gates, holding water on-island, perhaps using treatment before draining the M-W Tract.

h. Subsidence Reversal

i. If accretion is not occurring on the floodplain at an appreciable rate, consider incorporating subsidence reversal strategies to increase elevations, enhancing sedimentation by changing factors that affect hydrology or adding topographic features or other technologies (such as brush boxes) to promote sedimentation. Note that subsidence reversal is not a major goal of this alternative, but that increasing elevation may reduce fish stranding possibilities and make draining the Tract easier.

3. Hybrid Floodplain/Subsidence Reversal

a. Floodplain Processes

i. If need to change frequency of flooding, adjust height of east levee correspondingly. May not be able to decrease levee height below 8.5' msl due to access issues. Could then consider flooding M-W Tract by a breach along southeast levee (along Mokelumne River).

ii. If floodplain area is too small, change factors that affect hydrology (such as lowering east levee) or creating a breach along the Mokelumne River. Not likely to have a floodplain area too large. Should be O.K. to flood entire M-W Tract. However, if problems with flooding lower portion of the M-W Tract, consider strategies such as leveeing off southern portion of Tract.

iii. Scour and deposition are not necessary for the floodplain's success as floodplain habitat. However if excessive scour or deposition are occurring such that draining of the floodplain does not occur in specific areas, resulting in fish stranding, can make changes that affect hydrology to lessen scouring or deposition. Perhaps necessary to utilize only part of the floodplain. Levee off or otherwise isolate other parts of the floodplain.

b. Sedimentation/Geomorphic Processes

i. If sedimentation rates are significant over time (raising the middle and southern parts of the Tract above sea level) may eventually not be necessary to pump out the Tract, may drain naturally. If significant erosion, may need to reconsider use of the Tract as floodplain. May need to close levee breaches, allow forest succession in the north, perhaps subsidence reversal wetland development in the south. Allow elevations to increase before opening Tract to floodwaters.

B. Applied Studies for Advancing Project Design and Management.

The adaptive management plan for the North Delta Ecosystem Restoration Project is intended to improve management of the current action and not in designing future restoration studies.

V. Adaptive Management Structure and Processes

A. Roles and Responsibilities, including Stakeholder Participation

A preferred alternative has not yet been selected, therefore logistical considerations such as which agency or entity is responsible for project construction, regulatory compliance, post-construction site management have not yet been identified.

B. Decision Criteria and Tools

The development of decision trees and or Decision Analysis and Adaptive Management models to simulate costs, biological effects, etc., will be developed after a preferred alternative has been selected.

C. Dispute Resolution

The development of a process for resolving disputes among participants in the project will be developed prior to the implementation of the preferred alternative.

D. Timelines for Decision-Making

A preferred alternative has not yet been selected. Schedules for project construction, monitoring, and performance evaluation will be determined after a preferred alternative has been identified and the EIR finalized.

E. Science Support for Adaptive Management

Technical experts will be engaged after a preferred alternative is selected, and the EIR finalized. It is anticipated that DWR staff will continue working with the NDSP in the implementation of the preferred alternative.

F. Reporting

An outreach program to inform interested stakeholders of the project progress, findings, etc., will be developed with the implementation of the preferred alternative.

G. Data Management and Public Availability

The decision on how to store monitoring data and integrate study findings with other monitoring efforts has not been determined. Plans will be developed for the storage and sharing of monitoring data for the project after preferred alternative has been selected for the EIR.

VI. Budget and Funding

A. Monitoring

A budget for the monitoring component of the ecosystem restoration project will be determined after a preferred alternative has been selected and the EIR finalized.

B. Management and Maintenance

A preferred alternative has not yet been selected. Funding and implementation of maintenance activities such as levee inspection, weed management, etc., subsequent to project completion will be determined at a later date.

References

Project Descriptions

DWR, 1990. Draft EIR/EIS North Delta Program, November 1990. 619 p.

DWR, 2002. North Delta Improvements Project, Critical Uncertainties, (Tuesday, November 5, 2002), 2 p.

DWR, 2003. Chapter 1., Introduction. DWR admin_ch1_04290 Draft EIR/EIS, 13 p.

DWR, 2003. North Delta Ecosystem Restoration and Flood Control Project Ecological Coordination Meetings Idea Summary. July 29, 2003, 2 p.

DWR, 2003. Draft Screening Document. North Delta Flood Control and Ecosystem Restoration Proposed Alternatives Development Process. June 19, 2003, 8 p.

CALFED Bay-Delta Program., 2000. White Paper on North Delta Improvements. Draft. July 19, 2000, 20 p.

Hydrology and Hydraulic Modeling

Blake, S.H. 2001, An Unsteady Hydraulic Surface Water Model of the Lower Cosumnes River California for the Investigation of Floodplain Dynamics. Masters Thesis, University of California, Davis. 78 p.

Hammersmark, C.T. 2002. Hydrodynamic Modeling and GIS Analysis of the Habitat Potential and Flood Control Benefits of the Restoration of a Leveed Delta Island. Masters Thesis, University of California, Davis. 102 p.

Knittweis, G. 2003. North Delta Area Hydraulics Summary. 8/26/2003. 2 p.

Corps of Engineers, 1990. Mokelumne River, California. 1% Flood at Franklin Road. Hydrology. Office Report, May 1990. 55 p.

Guay, J.R., Harmon, J.G. and McPherson, K.R., 1998. Flood Inundation Map and Water Surface Profiles for Floods of selected Recurrence Intervals, Cosumnes River and Deer Creek, Sacramento County, California. U.S. Geol. Survey Open File Report, 98-283, one sheet.

Simpson, R.G., 1972. Determination of channel capacity of the Mokelumne River downstream from Camanche Dam San Joaquin and Sacramento Counties. USGS Water Resources Division Open-File Report 6428-05, 44p.

DWR, 1996. North Delta Channel Seepage Monitoring. Central District Memorandum Report, 72 p. (groundwater levels)

DWR, 1994. North Delta Region Two-Year Flood Plain. Memorandum Report, North Delta Management, Delta Planning, Branch, Division of Planning. January 1994. 45p.

MBK, 2003. Memorandum-Alternative Review. To North Delta Team Members, February 4, 2003.

Author Unknown, 1988. Office Report, Downstream Flood Impacts from the Proposed Lambert Road Outlet Facility, January 25, 1988. 8p.

Geomorphology

Anderson, M.L. 1994. Historic Sediment Loads in the Sacramento-San Joaquin Delta. Report prepared for Delta Planning Branch, Department of Water Resources. October 1994. 27 p.

Bryan, K., 1923. Geology and groundwater resources of the Sacramento Valley, CA. U.S. Geol. Surv. Water-Supply Paper 495, 285 pp.

Commissioner of Public Works, Sacramento Cal., 1861. Outline Map of the Sacramento and Lower San Joaquin Valleys Showing Swamp Land Districts, 1861.

Deverel, S.J. and Rojstaczer, S., 2006. Subsidence of agricultural lands in the Sacramento San Joaquin Delta, California: Role of aqueous and gaseous carbon fluxes.

DWR, 1998. North Delta Scour Monitoring Program 1995-1997. Central District Memorandum Report, 4 p.

DWR, 1998. North Delta Scour Monitoring Program 1995-1997. Central District Memorandum Report, 4 p.

DWR, 1995. Environmental Study for the Interim North Delta Program Water, Sediment and Soil Quality Report. Prepared by DWR Division of Planning Division of Local Assistance, May 1995. 201 p.

Florsheim, J.L., and Mount, J.F., 2003. Changes in lowland floodplain sedimentation processes: pre-disturbance to post-rehabilitation, Cosumnes River, California, *Geomorphology*, In Press doi:10.1016/S0169-555X(03)00158-2

Florsheim, J.L., and Mount, J.F., 2002. Restoration of floodplain topography by sand splay complex formation in response to intentional levee breaches, lower Cosumnes River, California. *Geomorphology*, 44(1-2):67-94.

Galloway, D., Jones, D.R., and Ingebritsen, S. E. Land Subsidence in the United States. USGS Circular 1182. 176 p.

Gilbert, G.K., 1917. Hydraulic Mining in the Sierra Nevada. U.S. Geol. Surv. Prof. Pap. 105, 154 pp.

Jones & Stokes, 2003. Cosumnes River watershed inventory and assessment, Phase II Draft Report. July. (J&S 02-287), Sacramento, CA.

Mount, J.M., 1995. California Rivers and Streams: the conflict between fluvial process and land use. University of California Press, Berkeley, CA, 359 p.

Northwest Hydraulic Consultants, 2002. North Delta Improvement Program Preliminary Sedimentation Investigation. Memo to Curt Schmutte, DWR, from Ed Wallace, Rob Odell, November 26, 2002. 14 p.

Northwest Hydraulic Consultants, 2003. Assessment of Sediment Budget of the Sacramento San Joaquin Delta. July 2003, 36p.

Reed, D., 2002. Constructing Tidal Marshes with Dendritic Channels to Benefit Native Fishes: an adaptive management experiment. A product of the CALFED ISB Adaptive Management Workshop 19-20 March, 2002 Delta Habitats Group, 9 p.

Wright, S., 2002. Review of “North Delta Improvement Preliminary Sedimentation Investigation.” 2p.

Zemitis, C., 2003. MW Tract Dendritic Intertidal Wetland Restoration Justification. background paper for project planning.

Water Quality

CVRWQCB, Dredge data: DREDGE.mdb.

CV Regional Water Quality Control Board, DFG and Delta Protection Commission, 2002 Delta Dredging and Reuse Strategy. A Report prepared for CALFED Bay-Delta Program. Volume 1, June. Sacramento CA. Volume II appendices.

CVRWQCB, no date. Central Valley Region order no. 5-00-183. Waste Discharge Requirements General Order for Department of Water Resources South Delta Dredging Project, Alameda, Contra Costa, and San Joaquin Counties.

DWR, 1994. Environmental Study for the Staten Island SRAH Test Project Phase II, water, Sediment and Soil Quality Report. 68.

Slotton, D.G., Ayers, S.M., Suchanek, T.H., Weyand, R.D., Liston, A.M., Asher, C., Nelson, D.C., and Johnson, B. 2003. The Effects of Wetland Restoration on the production and bioaccumulation of methylmercury in the Sacramento-San Joaquin Delta, CA. Draft Final Report Subject to Revision, do not cite. Report to CALFED. 49 p.

USGS, 2000. Mercury Contamination from Historic Gold Mining in California. Fact Sheet FS-061-00.6p.

Wiener, J.G., Gilmour, C.C., and Krabvbenhoft, D.P., 2003. Mercury Strategy for the Bay-Delta Ecosystem: A Unifying Framework for Science, Adaptive Management and Ecological Restoration. Revised Draft Report to the California Bay Delta Authority. June 26, 2003. 62 p.

Wiener, Strategies for Reducing Exposure to Methylmercury (MeHg) conceptual model diagram ppt

Zematis, Collette, 2003. Notes on dredging requirements from related projects that may be applicable to the North Delta Improvements Program, 4p.

Ecology

Bennett, in prep. A white paper summarizing the state of knowledge and research needs for delta smelt, Hypomesus transpacificus.

Grimaldo, L., R. Miller, C. Peregrin, Z. Hymanson, and J. Toft. 2000. How does Brazilian waterweed (Egeria densa) influence the fish assemblage in the Sacramento-San Joaquin Delta (CA)?: Potential conflicts with ecosystem restoration. Abstract from the 2000 Missouri Chapter of the American Fisheries Society, St. Louis, MO.

Ivey, G.L., and Herziger, C. P., 2003. Sandhill Crane Monitoring at Staten Island, San Joaquin County, CA, 2002-03. A survey for The Nature Conservancy as subcontractors for May and Associates, Inc., 54 p.

Littlefield, C.D., and Ivey, G.L., 2003. Conservation Assessment for Greater Sandhill Cranes Wintering on the Cosumnes River Floodplain and Delta Regions of California. Report to The Nature Conservancy. 26 p.

Moyle, P.B., Baxter, R.D., Sommer, T., Foin, T.C. and Matern, S.A., 2003. Biology and Population Dynamics of Sacramento Splittail (Pogonichthys macrolepidous) in the San Francisco Estuary: A Review. 16 June, 2003. Draft document in Peer Review. 67 p.

Moyle, P.B., 2002. Inland fishes of California: revised and expanded. University of California Press, Berkeley, California. 502 pp.

Sytsma, M., and Pennington, T., http://www.clr.pdx.edu/projects/egeria/egeria.html

Zemitis, C., 2003. Exotic Species List. 1 p.

Adaptive Management

DWR, 2003. North Delta Ecosystem Restoration and Flood Control Project Adaptive Management Plan-Ecological Emphasis, DRAFT-For ERP Discussion only. July 23 and 30 2003, Poster-3 sheets.

Healey, Adaptive Mgmt diagram.

Northwest Hydraulic Consultants, 2003. Field Data Collection Plan for North Delta Improvement Project, Draft. 12 p.

Weinstein, Michael P. and others. Success Criteria and Adaptive Management for

Williams, John. “Thoughts on Adaptive Management” Interagency Ecological Program for the Sacramento-San Joaquin Estuary Newsletter. 11(3):5-11 1998.