



QA/QC Plan for

Implementation of the Year 2001 Napa River Fisheries Monitoring Program

May 22, 2001

Prepared by

U.S. Army
Corps of Engineers
Sacramento District

With assistance from



and



**NAPA RIVER FISHERIES MONITORING PROGRAM ELEMENT
DRAFT WORK PLAN QUALITY ASSURANCE QUALITY CONTROL PLAN
2001**

PROGRAM ELEMENT: NAPA RIVER FISHERIES MONITORING PROGRAM
PROGRAM ELEMENT NUMBER: 2001-105
PRINCIPAL INVESTIGATOR: SHARON KRAMER (STILLWATER SCIENCES), MIKE
DIETL (U.S. ARMY CORPS OF ENGINEERS)

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I. Program Element Management

I.A. Project Description/ Problem Definition

The Napa River Fisheries Monitoring Program (FMP) is primarily designed to detect the presence of fish species in the project area before and after construction of the flood protection project. Fish habitat restoration features of the Napa River Flood Protection Project will be evaluated to determine use of the area by fish species.

I.A.1. History/Background Information

The FMP is part of the Napa River/Napa Creek Fisheries Monitoring Plan which was included as a project requirement in the April 9, 1999, U.S. Fish and Wildlife Service's (USFWS) Biological Opinion for the U.S. Army Corps of Engineers' (USACE) and Napa County California, Napa River/Napa Creek Flood Protection Project.

I.A.1.a. Situation Leading to the Program Element

The FMP has been developed as a requirement of the April 9, 1999, USFWS Biological Opinion for the Napa River/Napa Creek Flood Protection Project. The Napa River/Napa Creek Flood Protection Project aims to provide flood protection by reconnecting the Napa River to its flood plain, creating wetlands throughout the area, maintaining fish and wildlife habitats, and retaining the natural characteristics of the river. The project consists of five separate contracts developed as a cooperative effort between the City of Napa, Napa County, the USACE, Community Coalition, Federal and State resource agencies and consultants. Construction of the project is currently phased over 7 years from 2000 through 2006.

The flood protection project has and will be implemented along 6.9 miles of the Napa River in Napa County, California. Project features include dike removal, channel modifications to create flood plain and marsh plain terraces, levees and floodwalls, bridge relocations, pump stations, and maintenance roads/recreation trails for the reach of the river from Highway 29 to Trancas Street.

The project also includes the Napa River Enhancement Plan for the South Wetlands Opportunity Area (SWOA). This enhancement plan will restore physical and biological processes in the Napa River estuary and the SWOA, which extends from the Newport North Marina to the Highway 29 Bridge on the west side of the river. The plan also calls for creating 104.25 acres of emergent marsh, converting 262 acres of farmland to emergent marsh, and creating and enhancing 136 acres of seasonal wetlands (USACE 1999). Lowering levees, breaching dikes, and constructing marsh plain and flood plain terraces are included in the enhancement plan. The FMP will conduct sampling to evaluate the use of some of these areas by fish species.

1.A.1.b. Significance of the Program Element

The FMP fulfills the requirement set forth by the USFWS in their April 9, 1999, Biological Opinion for the Napa River/Napa Creek Flood Protection Project. In addition, this FMP will gather information on fish habitat use within 6.9 miles of the Napa River that will potentially influence future management decisions, restoration designs, and serve to validate environmentally friendly designs in future flood control projects.

1.A.2. Purpose of Program Element

The purpose of the project is to determine fish use of the restored and created habitats (open water, marsh plain, and flood plain) created by the Napa River/Napa Creek Flood Protection Project, with special emphasis on threatened and endangered species, as required by the April 9, 1999, USFWS biological opinion.

1.A.2.a. Hypotheses

- The main hypothesis being tested is that fish, in particular delta smelt and splittail, will use habitat created or restored by the Napa River/Napa Creek Flood Protection Project.
- A secondary hypothesis is that certain life stages of fish species, in particular delta smelt and splittail, will use specific habitat types in the Napa River/Napa Creek Flood Protection Project during specific seasons and environmental conditions.

1.A.2.b. Objectives

- 1) Document presence and relative abundance of fish species (particularly delta smelt and Sacramento splittail) utilizing restored and created habitats.
- 2) Document life stages and seasonality of fish species (particularly delta smelt and Sacramento splittail) in restored and created habitats.
- 3) Determine if correlations exist between collected fish species and environmental parameters at each sampling site.

1.A.2.c. Project Success

This project will document whether flood control sites that are restored to tidal marsh habitat are used by fish species. Success will be determined by establishing whether fish species (particularly delta smelt and Sacramento splittail) are present in the restored tidal marsh. The project will additionally determine if the life stages, seasonality, and association of collected fish species vary with environmental parameters at each site. The data will be used to document restored wetland use by fish species. The public will be kept informed of the results of the monitoring through a project Internet site.

I.A.3. Data Usage

Data collected as part of this FMP will be used to guide the adaptive management decisions described in the Mitigation Monitoring Program for the Napa River/Napa Creek Flood Protection Project (Jones & Stokes 2001). It is also expected that the data collected will be used in future fisheries management decisions in the Napa River.

I.A.4. Biological Implications

Stress and potential death of fishes collected during the sampling procedures may occur. No other negative biological implications of the project are expected.

I.B. Project Organization and Responsibilities

I.B.1. Staffing

Persons responsible for project element and its implementation are listed in Table 1.

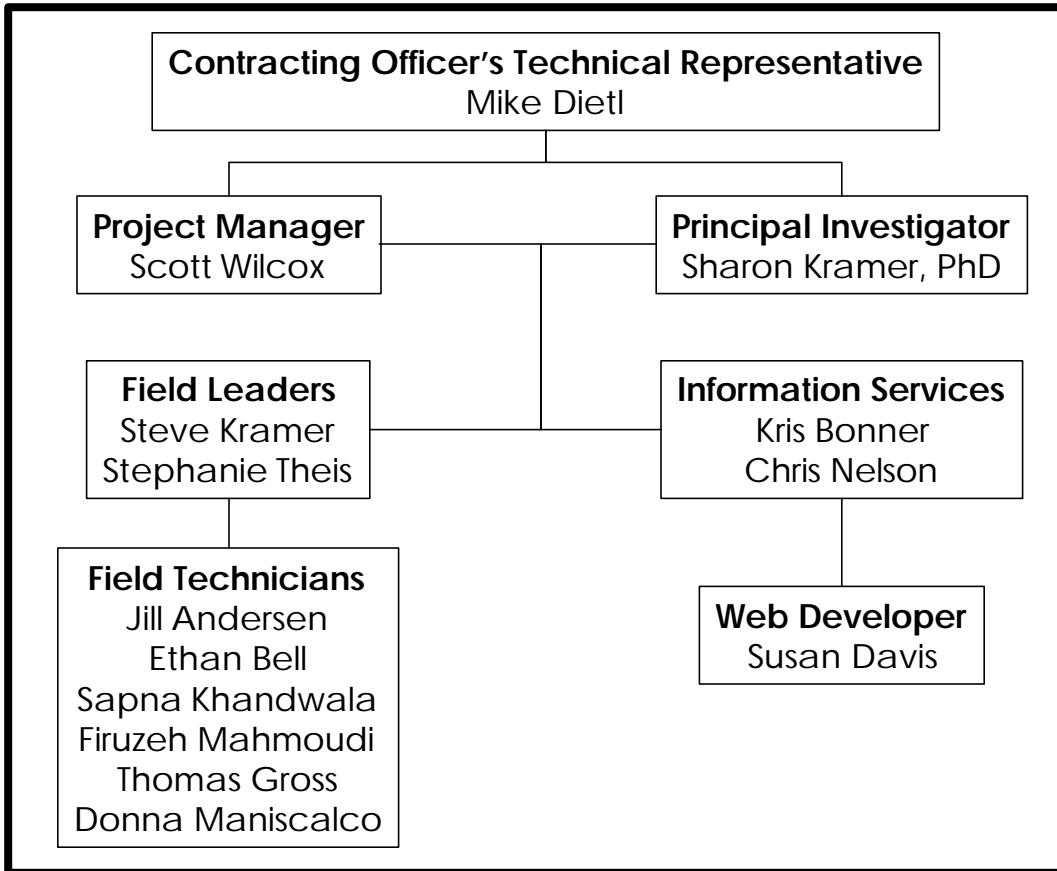
Table 1. Project Element Implementation Team

Name/email	Affiliation/Address	Project Responsibility
Mike Dietl mdietl@spk.usace.army.mil	U.S. Army Corps of Engineers 1325 J. St. Sacramento, CA 95814 916.557.6742	Contracting Officer Representative (Federal Lead), Principal Investigator
Sharon Kramer sharon@stillwatersci.com	Stillwater Sciences 850 G Street, Suite K Arcata, CA 95521 707.822.9607	Principal Investigator
Scott Wilcox scott@stillwatersci.com	Stillwater Sciences 1477 Drew Avenue, Suite 105 Davis, CA 95616 530.756.7550	Project Manager
Steven Kramer steve@stillwatersci.com	Stillwater Sciences 850 G Street, Suite K Arcata, CA 95521 707.822.9607	Field Leader
Jill Andersen jill@stillwatersci.com	Stillwater Sciences 1477 Drew Avenue, Suite 105 Davis, CA 95616 530.756.7550	Fisheries Technician
Chris Nelson chrisn@jsanet.com	Jones & Stokes Associates 2600 V Street Sacramento, CA 95818 916.739.3026	GIS Technician
Susan Davis susand@jsanet.com	Jones & Stokes Associates 2600 V Street Sacramento, CA 95818 916.739.3026	Web Developer
Firuzeh Mahmoudi firuzeh@stillwatersci.com	Stillwater Sciences 2532 Durant Avenue, Suite 201 Berkeley, CA 94704 510.848.8098	Statistician/Biometrician

I.B.2. Chain of Command

The organizational structure and chain of command are presented in Figure 1.

Figure 1. Organizational Structure



I.C. Study Design

I.C.1. Research Questions

This project will determine the use of restored tidal marsh by fish assemblages with special focus on threatened and endangered species. Specific questions to be addressed include:

- 1) What is the distribution and relative abundance of fish species (particularly delta smelt and Sacramento splittail) utilizing restored and created habitats?
- 2) What life stages and at what times of year do fish species (particularly delta smelt and Sacramento splittail) occur in restored and created habitats?

- 3) Do correlations exist between collected fish species and environmental parameters at each sample site?

I.C.2. Approach

The study design is focused on determining presence of fish species, with emphasis on threatened and endangered species, in restored and created habitats in the Napa River Estuary. The study is not designed to determine fish population estimates, however an index of relative abundance will be determined by constructing an index of catch per unit effort (CPUE) for each habitat and gear type.

The flood protection project will be constructed along 6.9 miles of the Napa River and also includes the Napa River Enhancement Plan for the South Wetlands Opportunity Area (SWOA), which extends from the Newport North Marina to the Highway 29 Bridge on the west side of the river.

The sampling interval will be approximately monthly, with multiple samples per site for purposes of determining site-specific variability. There are six gear types (fyke nets, otter trawl, 20-mm survey, purse seine, beach seine, light traps) that will be used at each site either alone or in some combination. These gear types will insure that all life stages will be surveyed. There will be 13 sampling locations (see 2001 Sampling Schedule in Table 5) in the first year, and a total 17 sampling sites when all habitat features have been restored or created.

I.C.2.a. Statistical Methods

Research questions 1 and 2 (Section I.C.1.) are primarily descriptive, requiring only descriptive explanatory graphics. Research question 3 will require a generalized linear model approach (GLIM) to determine the influence of environmental parameters such as habitat type, site location, depth, water quality, and time of year on fish species and their relative abundance (Venables and Ripley 1994). The independent variables will be the environmental parameters, and the dependent variable will be the CPUE.

I.C.2.b. Data Required to Apply the Desired Statistical Methods

The data required to address question three include replicate sampling of the three habitat types (open channel/riverine, river margin/tidal marsh, and flood plain) during the season when the species and life stages are expected to occur. It is currently anticipated that monthly samples taken during the time periods listed in Table 5 will be sufficient to document the use of these habitats by fish, in particular delta smelt and splittail, based upon historical information (Baxter et al. 1999, Herbold et al. 1992). Historical information, in general, is not widely available for the Napa River estuary, however surveys in the San Francisco Estuary provide information on the timing and life stages anticipated for the sampling proposed in this project in the Napa River estuary (Baxter et al. 1999). Where feasible, the within and between habitat type variance will be estimated.

This will be accomplished by taking replicate samples within specific site locations and having replicate sample site locations for specific habitat types.

The geographic scope is the Napa River estuary, with three habitat types (open channel/riverine, river margin/tidal marsh, and flood plain) represented by five open water, seven river margin/tidal marsh, and one opportunistic flood plain sampling sites, thus providing some replication within habitat types. Monthly sampling at each station should be sufficient to detect species presence based upon historic sampling conducted in the area (Baxter et al. 1999, Herbold et al. 1992). Replicate samples will be taken at each site for certain gear types (otter trawl, beach seine, purse seine), whereas replication for fyke nets and light traps will be based upon single samples taken at several sites within each habitat type. In addition, the California Department of Fish and Game (CDFG) has historically and currently conducts a 20-mm tow net survey in the Bay-Delta, and their survey will be augmented to include three stations in the Napa River estuary in the project area. Larval fish processing for delta smelt, Sacramento splittail, and listed salmonids will be conducted, and the data used in this project. Although one year of sampling in the project area is presented in this QA/QC document, in order to document interannual variability in use of estuary habitats it will be necessary to sample over several years that represent different water year types (Jassby et al. 1995).

I.C.2.c. Contingency Plans

Contingency plans to assure that the research questions are answered include having a series of tides that are suitable for sampling each month, so that if there are missed field samples they can be rescheduled for a similar tide during the same month. In addition, if the gear type proposed for the habitat type does not appear to be successful in capturing target species, then we plan to test different methods or gear types for effectiveness. If the time of sampling is unsuccessful, optional day or evening sampling will be considered.

I.C.3. Defensible Data

The study should provide legally defensible data on fish presence in the habitats surveyed.

I.D. Project Resource Needs

I.D.1. Detailed Budget

Table 2 below describes the detailed budget associated with the Napa River Fisheries Monitoring Program.

Table 2. Total budget of the Napa River Fisheries Monitoring Program.

Costs	Meetings and Presentations	Work Plans, QA/QC Plans, Site Reports	Field work, Lab work, Data Analyses, Status Reports	Database Management and Web Site	Program Report	TOTAL HOURS	TOTAL COST
TOTAL HOURS	266	272	1924	714	356	3532	
TOTAL LABOR COST:	\$18,378	\$18,187	\$97,078	\$54,402	\$21,573		\$209,617
Travel Expenses	\$1,500	\$80	\$5,488	\$1,100	\$0		\$8,168
Subcontractor Expenses	\$0	\$0	\$7,000	\$0	\$0		\$7,000
Equipment Usage Expenses	\$0	\$0	\$13,905	\$0	\$0		\$13,905
Other Expenses	\$1,034	\$2,162	\$3,573	\$767	\$4,202		\$11,738
TOTAL DIRECT EXPENSES:	\$2,534	\$2,242	\$29,966	\$1,867	\$4,202		\$40,811
PROJECT COST:	\$20,912	\$20,428	\$127,044	\$56,268	\$25,775		\$250,428

I.D.2. Personnel Needs

I.D.2.a. Field Activities

Field activities will require a minimum of three people, including one staff person from the USACE to conduct fieldwork. One boat operator will be required, along with 2-3 staff to deploy and retrieve nets, process fish, and record data.

I.D.2.b. Laboratory and Office Activities

Laboratory sorting and processing will require two technicians. The samples will be processed using existing lab facilities at the Jones & Stokes office in Sacramento. Database and Internet work will require 2-3 people to provide programming support, data entry, and database management.

I.D.3. Equipment Needs

All equipment is either currently available, or will be purchased or rented.

I.D.3.a. Boats

The type of boat needed is noted in Table 3.

I.D.3.b. Major Equipment

Major equipment needs are itemized in Table 3.

Table 3. Major Equipment List

Gear/ Sampling Technique	Dimensions	Mesh Size	Number Needed	Deployment
Boat - Boston Whaler	Length: 22 ft Width: 7 ft	N/A	1	For all survey work
Fyke Nets	Opening: 3-4 ft Length: 20-30 ft Leads: 10-20 ft	¼ inch	8	Set at selected stations, during the daytime high tides of each month. Set at high tide-retrieved at low tide
Otter Trawl	Opening: 1 x 2.5m Length: 5.3 m	¼ inch	2	2-3 trawls at selected stations, during daytime high tide slack water of each month. Trawls will last approx. 10-15 minutes.
Purse Seine	Length: 100 ft Depth: 10 ft	¼ inch	1	2-3 purse seines at the levee breach location at Horseshoe Bend during daytime high tide slack water each month.
Beach Seine	Length: 100 ft Depth: 6 ft	¼ inch	2	2-3 seines at selected stations, during the daytime high tide slack water each month.
Light Traps	Aquatics Research Instruments' specifications	2.5 mm-slits, 505µ bottom mesh	11	1 evening per month, during evening high tide

I.D.4. Coordination Needs

The USACE has contracted with CDFG to conduct 20-mm tow net sampling at three sites in the Napa River for the 2001 season. These samples will be transferred to the USACE shortly after collection and processed at the Jones & Stokes laboratory.

I.E. ESA Considerations

I.E.1. Take of Listed Species

Take of Federally listed Delta smelt, Sacramento splittail, and/or central California coast steelhead are anticipated. If chinook are captured it is unlikely that the ESU will be known and the USACE will immediately begin formal consultation with the National Marine Fisheries Service and CDFG. Specimens will be retained, as necessary, for identification at a later date.

I.E.2. Estimate of the Number per Species/Race Caught

The number of listed species that may be caught and the mortality will be provided in the USACE take permit(s). For the FMP, the USFWS allotted the USACE take permits for 500 delta smelt and 500 splittail.

On December 5, 2000 NMFS issued an incidental take permit allowing collections of the California coastal steelhead under the FMP because there are so few specimens expected.

It is anticipated that take of the State listed delta smelt will occur. The USACE has requested that CDFG adopt the Federal take permit under CDFG code 2080.1.

I.E.3. IEP Biological Opinions

Take of Federal and State listed species collected during CDFG's 20-mm tow net surveys are covered under the IEP permit.

I.F. Due Dates and Products

I.F.1. Program Element Timeline

The time line for this program element is 2001 through 2009. Additional sampling past 2009, the approximate termination of USACE involvement in the project, is not forecast at this time. The program element timeline for 2001 includes monthly sampling and reporting.

I.F.2. Products and Deliverables

Due dates and products for 2001 are specified in Table 4. Similar deliverables will be provided annually until 2009.

Table 4. Program Element Products and Due Dates

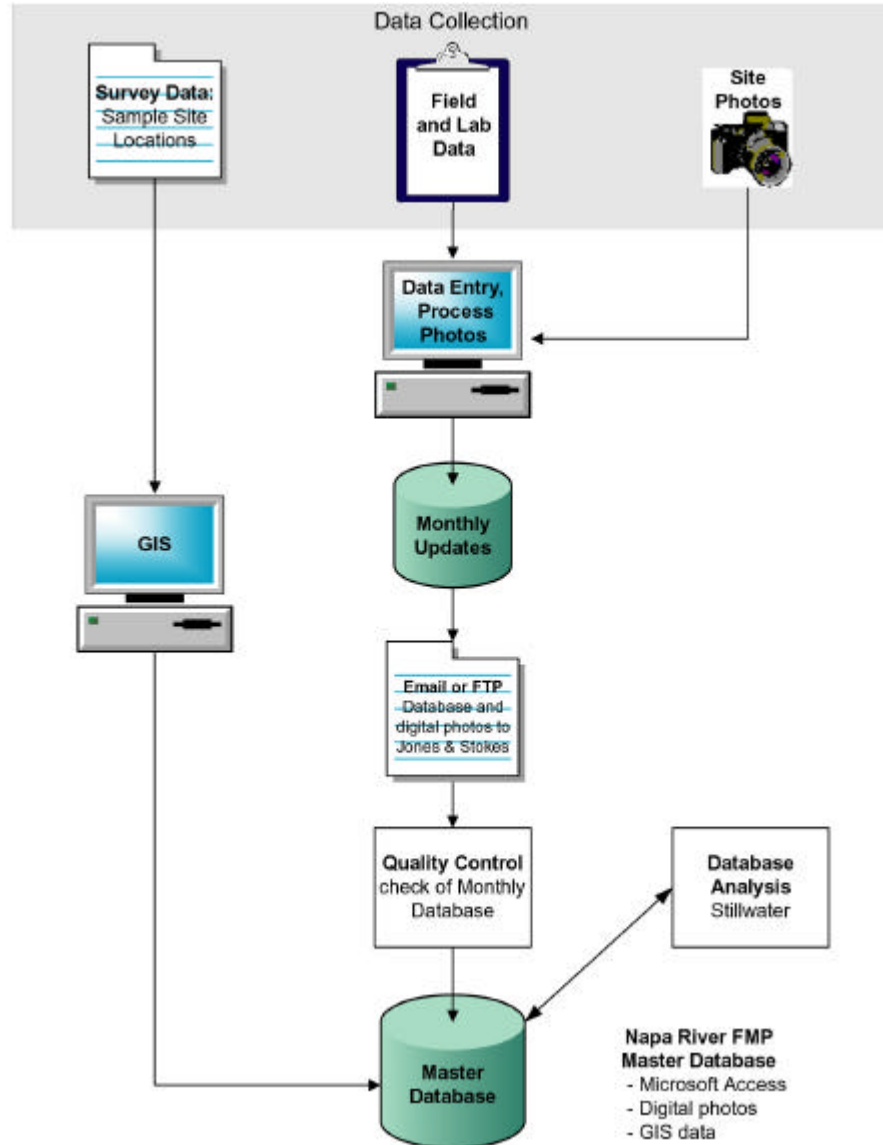
2001 Schedule of Deliverables		
	Draft Work Plan and QA/QC Plan	April 13, 2001
	Circulate draft work/quality control plans for comment, internet proposal	April 16, 2001
	Work/Quality control plan, database presentation, Internet presentation	April 24, 2001
	Final Work and QA/QC Plan	T.B.D.
	Draft Site Location Map and Report	T.B.D.
	Final Site Location Map and Report	T.B.D.
Database and Internet Site		
	Database	T.B.D.
	Internet Site	June 7, 2001
Status Reports		
	Monthly Status Reports	April 7, 2001 May 7, 2001 June 7, 2001 July 7, 2001 August 7, 2001 September 7, 2001 October 7, 2001 November 7, 2001 December 7, 2001 January 7, 2002
Program Reports		
	Table of Contents Napa River FMP Report	October 1, 2001
	Administrative Draft Napa River FMP Report	November 1, 2001
	Draft Napa River FMP	December 1, 2001
	Final Napa River FMP	December 31, 2001

I.F.3. Databases

Implementation of the Napa River Fisheries Monitoring Program will result in the collection and development of large quantities of data and information over a time period that could span 5 years or more. The data will be used to perform analyses and generate tables, figures, and maps necessary to create annual monitoring reports. The proposed database system will support the entry, storage, analysis, and access of the data and related information.

Figure 2 shows an overview of the data management plan for the Napa River project.

Figure 2. Overview of the Data management plan for the Napa River project.



The Napa River fisheries monitoring data will include:

- A relational database (Microsoft Access) that will include electronic forms for data entry and data tables for storage. Separate data tables will be included for:
 - fish sampling data,
 - fish larval data,
 - sample site environmental parameter data, and
 - sample site photo log metadata.

Field data will be collected using a double-entry system. First, monitoring data will be recorded on paper data collection forms. Second, the data from the completed data

collection forms will be entered into the database with a data entry screen, called a form, in Microsoft Access. Electronic data entry forms are used to improve efficiency and quality by assisting the user in entering repeated information, using standard codes or values, and checking data validity (for example, ranges and values). Data will be entered into the relational database in a timely manner (e.g., within three days after completion of sampling), except for larval fish data, which will be entered as soon as practical after the sampling period.

While some analysis can be done in the relational database software, some of the analysis can best be performed with specialized software, including statistical software packages such as SAS, SPLUS, and GIS software such as ArcInfo. By basing the Napa River fish monitoring system on a relational database that is Object Database Connectivity (ODBC)-compliant, the monitoring data can easily be used by these statistical-analysis and GIS software systems.

I.F.4. Internet Access to Database and Web Site Maintenance

The data will be uploaded to the USACE server beginning in July 2001. The Napa River project Web site will be located on the USACE Sacramento District's Web site. The FMP Implementation Team will also provide assistance to link the USACE Web site to the IEP Web site.

The specific technologies used will include a combination of static pages (for project history, for example) and database-driven dynamic pages that are generated in response to user queries that retrieve and display portions of the project database. Project documents, such as the MMP, FMP, and annual reports also will be included as portable document format (PDF) documents on the Web site, to add important information without unduly adding pages. The project Web site will include project information, data, and documents including:

- project history,
- annual monitoring reports in PDF,
- tables, graphs, figures, maps, and photos as separate files, and
- database search and viewing function.

The FMP Implementation Team will provide updated project Web sites and associated files to the USACE every six months and will assist the USACE in installing these updates. After initial development of the Web site, there will be two updates during the first year of the project. The team will provide documentation on the Web site maintenance to the USACE.

II. Program Element Measurement and Data Acquisition

II.A. Sample Site Selection

II.A.1. Study Area and Sampling Sites

The Napa River/Napa Creek Flood Protection Projects proposes to provide flood protection by reconnecting the Napa River to its flood plain. In the process, wetlands and fish and wildlife habitat will be maintained and created, and natural characteristics of the river will be restored. The Project will be implemented along 6.9 miles of the Napa River from Highway 29 to Trancas Street in Napa County, CA. The project includes dike removal, channel modifications to create flood plain and marsh terraces, levees and floodwall construction, bridge relocations, and pump station, a maintenance road and recreation trail construction. The plan also includes an enhancement plan for the South Wetlands Opportunity Area (SWOA). The SWOA extends from the Newport Marina to the Highway 29 Bridge on the West side of the river. Lowering levees, breaching dikes, and constructing marsh plain and flood plain terraces are included in the enhancement plan.

Thirteen sample sites in the Napa River project area will be permanently marked in 2001; additional sites will be marked and sampled in out years as additional habitat is created. The general locations of the sites are provided in Figures 3a and 3b. Specific locations for Contract 2 and 3 sampling sites have not been finalized and are not shown in the figures. The specific locations of the sites will be documented using Corps approved survey techniques, to be accurate within 1-foot tolerance for latitude and longitude, and 6 inches in elevation. The survey will be conducted by Horizon Land Surveys (Jeff Dillberg) or Chaudhary and Associates of Napa, California. Both are licensed surveyors in the State of California. The FMP Implementation Team will then plot the sample sites on geo-referenced maps of the project area.

Figure 3a. Sample site locations for the Napa River Fisheries Monitoring Program (downstream)

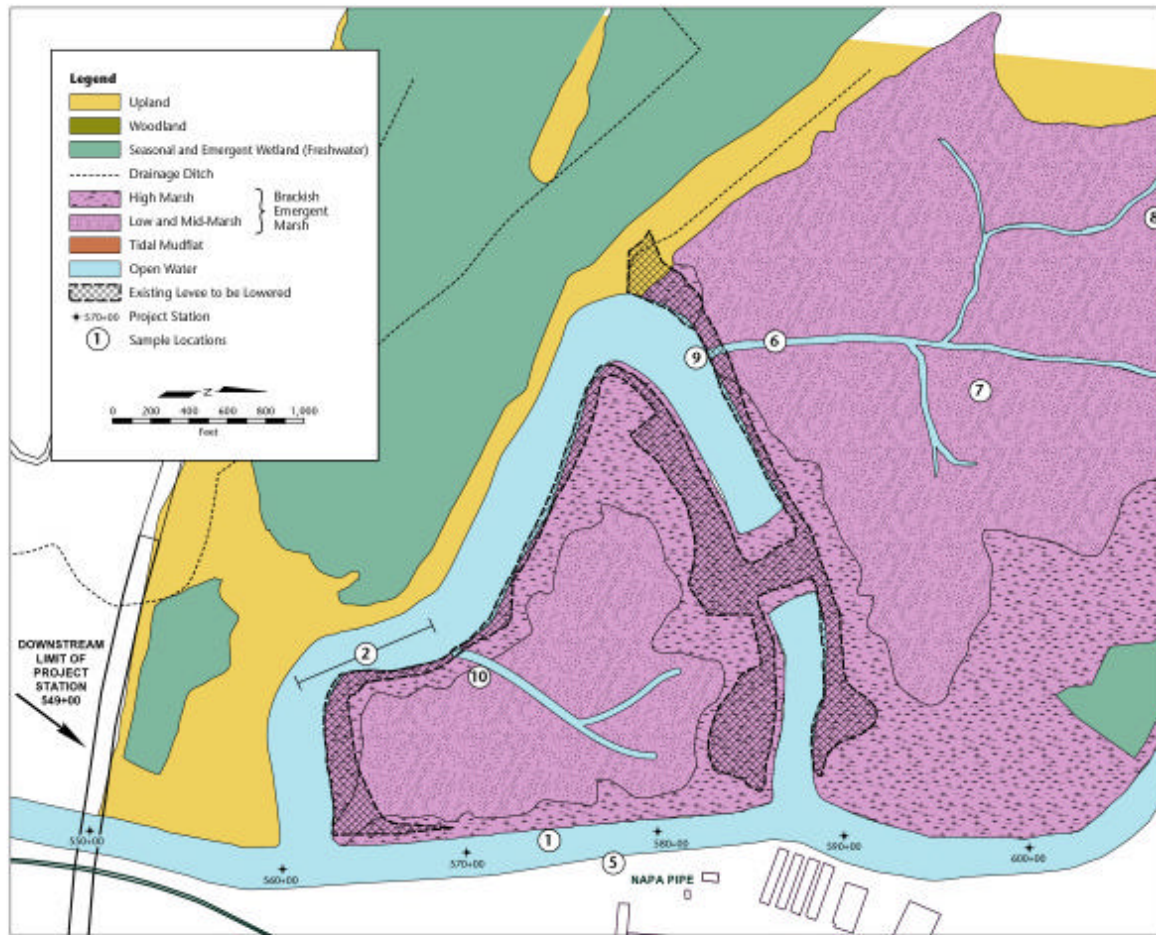
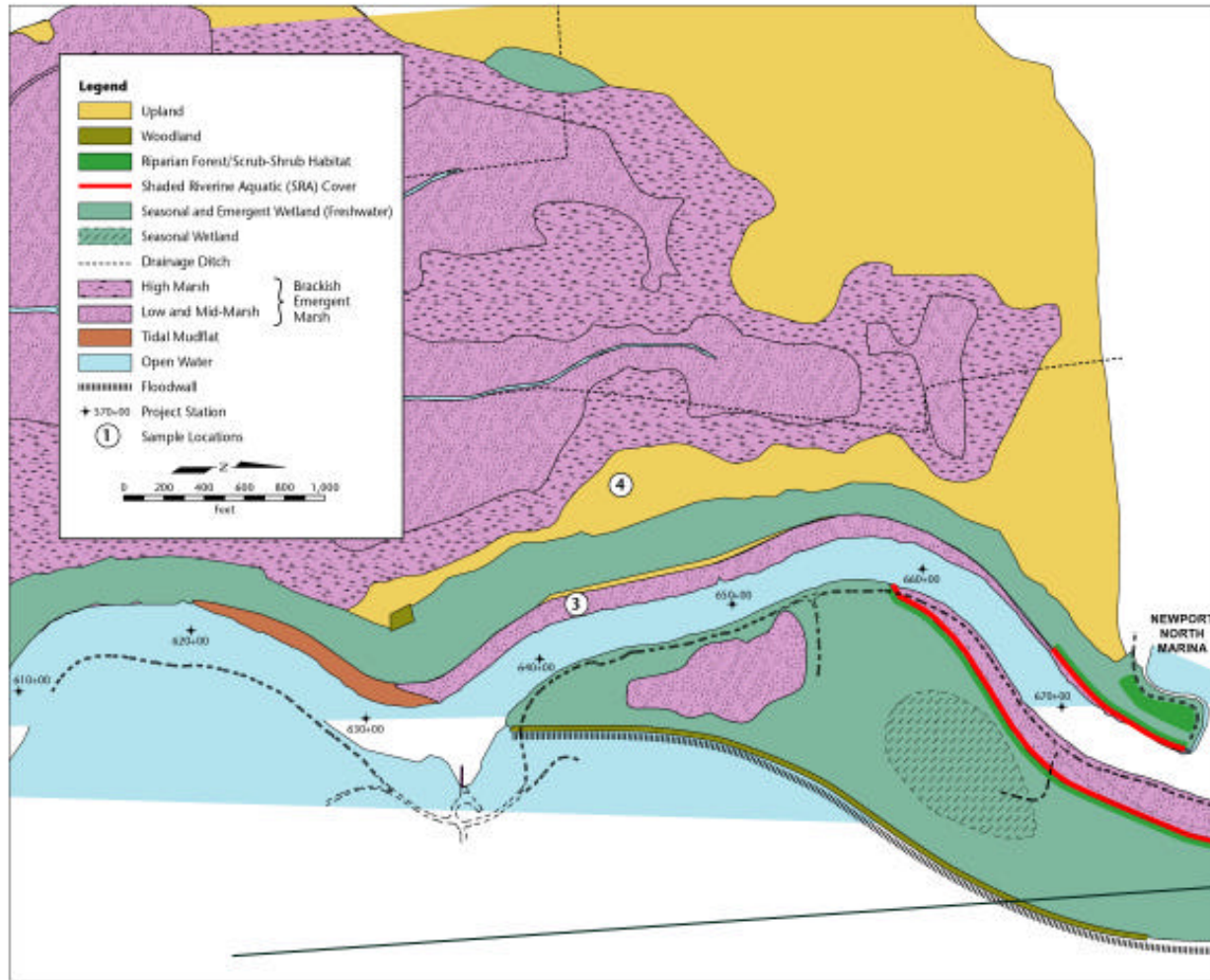


Figure 3b. Sample site locations for the Napa River Fisheries Monitoring Program (upstream)



II.A.2. Sample Site Selection Rationale

The USACE project affects three main habitat types along 6.9 miles of the Napa River and Napa Creek: marsh plain terrace, flood plain terrace, and open water habitat. Once selected, the 13 sample site locations will represent the three habitat types which are currently present or will be created in the project area. The FMP focuses on potential habitat types that may attract breeding and rearing delta smelt and Sacramento splittail. The 13 sites will be sampled using the gear that is most effective for detecting the fish species (delta smelt, Sacramento splittail) in each particular location.

Gear selectivity and site location will be matched so that each gear type will have a higher probability of effectively detecting fish at an individual site. Six gear types were identified that would be most effective in the three habitat types. Fyke nets will be fished statically in small channels in the marsh plain terrace where fish are likely to be concentrated during a falling tide. The otter trawl and the purse seine will be fished actively in the open water sites, during high tide slack water, where they are most effective. The beach seine will be fished opportunistically and in a roving manner in the marsh plain terrace and flood plain terrace sites at varying high tide heights and during flood periods, when safe to do so. Light traps will be deployed statically, at night, and during high tide slack water, in the open water and marsh plain terrace sites where larval fish are likely to occur and are prone to capture. CDFG will fish the 20-mm tow net in open water, where larval fish may occur.

The FMP Implementation Team expects that given the monthly year-round sampling, the multiple year program, the variety of gear types employed, and variety of habitat types sampled, it would be highly unlikely that this monitoring effort would not detect the target species if they are present. Sampling in out years will cover additional months and newly created habitat (USACE 2000) with the same sampling gears (fyke net sample, otter trawl, light traps, etc.) as will be deployed this year. A potential 74 sampling events will take place in 2001, not including replicate samples. The total number of samples with replicates (for appropriate gear types) in 2001 is 142. As more habitat is created and sampling expands to 12 months per year, sampling will increase to a potential 112 annual sampling events by 2005 (full project implementation), for a total of 1,085 samples over 5 years. Sampling effort peaks in the spring with the deployment of larval light traps and the use of the CDFG 20-mm survey to detect larval fishes. Sampling effort is lower in the fall and winter when targeted larval fish are not likely to be present.

II.A.3. Sample Site – Parameter Matrix

The parameters to be measured at each sample site are presented in Table 5.

II.B. Sampling Procedure (Standard Operating Procedures)

II.B.1. Parameters to be Measured

II.B.1.a. Frequency

The FMP Implementation Team will measure the following environmental parameters prior to conducting sampling at each individual sampling site on each individual sampling day during the monthly sampling period (see Table 5).

- Dissolved Oxygen (milligrams per liter)
- Temperature (Celsius), surface and bottom
- Salinity (parts per thousand), surface and bottom
- Turbidity (Secchi disk)
- Tidal elevation (metric and English units); stage will be estimated from the nearest tidal gage until the USACE installs a tidal gauge in the project area
- Average water depth (metric and English units) for the otter trawl sites
- Vegetation (presence/absence will be noted)
- Digital photos:
 - At each sample site to describe vegetation conditions
 - At the sampling sites each time the site is sampled; a photo log of the area sampled and fishes collected during sampling will be maintained

Table 5. Sample Site - Parameter Matrix

LOCATION AND GEAR TYPE			ENVIRONMENTAL PARAMETERS									FISH DATA				
Site #	Location	Gear Type	Dissolved Oxygen (mg/L)	Temperature (C)	Salinity (ppt)	Turbidity (cm)	Tide	Veg- etation	Sample Water Volume	Photos	Flood Plain Water Velocity	Species	Fork Length (mm)	Weight*(g)	Repro- ductive State**	Lesions
1A-1	Open Water (River)	Otter Trawl, Larval light trap	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
1A-2	Open Water (HB)	Otter Trawl, Larval light trap	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
1A-3	Marsh Plain Terrace	Fyke, Larval light trap	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
1A-4	Flood Plain Terrace	Beach Seine	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1A-5	Emergent Marsh	Fyke, Larval light trap	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
1A-6	SWOA Slough	Fyke, Larval light trap	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
1A-7	SWOA Marsh	Fyke, Larval light trap	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
1A-8	SWOA Marsh	Fyke, Larval light trap	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
1A-9	SWOA Levee Breach	Purse Seine, Larval light trap	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
1A-10	SWOA HB Marsh	Fyke, Larval light trap	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
1B-1	Open Water	20mm, Larval light trap, Otter Trawl	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
2-1	Open Water	20mm, Larval light trap, Otter Trawl	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
3-1	Open Water	20mm, Larval light trap, Otter Trawl	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓

*A random sample of weights will be taken for delta smelt and splittail.

**Reproductive state or spawning state for delta smelt and splittail will be assessed.

II.B.1.b. Replicate Samples

The FMP Implementation Team anticipates that replicate samples will be taken at certain sites. However, initial sampling needs to be conducted prior to determining the number of replicates that are feasible at each sampling site. Please refer to Table 6 (Proposed 2001 Monthly Sampling Schedule and Gear Type) for preliminary estimates of replicates.

Replicate samples will be obtained by the following methods:

- Multiple hauls of the otter trawl
- Multiple hauls of the beach and purse seines
- Use of multiple fyke nets
- Use of multiple larval light traps

In addition, multiple sites will be sampled for each of the three main habitat types (open channel/riverine, river margin/tidal marsh, and flood plain).

Table 6. Proposed 2001 Monthly Sampling Schedule and Gear Type.

Site	Location	May 15-19	Jun 15-19	Jul 14-19	Aug 12-17	Sep 10-15	Oct 8-12	Nov 7- 11 or 21-24	Dec 7- 10 or 22-25	Number of sampling events	Number of gear types	Number of tows (replicates), where applicable	Total number of samples
1A-1	Open Water (River)	20mm/LT	20mm/LT	20mm	Otter	Otter	N/A	Otter	N/A	6	3	2	14
1A-2	Open Water (HB)	Otter/LT	Otter/LT	Otter	Otter	Otter	N/A	Otter	N/A	6	2	2	14
1A-3	Marsh Plain Terrace	Fyke/LT	Fyke/LT	Fyke	Fyke	N/A	N/A	Fyke	N/A	5	2	--	7
1A-4	Flood Plain Terrace	Beach	Beach	Beach	Beach	Beach	Beach	Beach	Beach	8	1	2	16
1A-5	Emergent Marsh	Fyke/LT	Fyke/LT	Fyke	Fyke	N/A	N/A	Fyke	N/A	5	2	2	7
1A-6	SWOA Slough	Fyke/LT	Fyke/LT	Fyke	Fyke	N/A	N/A	Fyke	N/A	5	2	--	7
1A-7	SWOA Marsh	Fyke/LT	Fyke/LT	Fyke	Fyke	N/A	N/A	Fyke	N/A	5	2	--	7
1A-8	SWOA Marsh	Fyke/LT	Fyke/LT	Fyke	Fyke	N/A	N/A	Fyke	N/A	5	2	--	7
1A-9	SWOA Levee Breach	Purse/LT	Purse/LT	Purse	Purse	Purse	N/A	Purse	N/A	6	2	2	14
1A-10	SWOA HB Marsh	Fyke/LT	Fyke/LT	Fyke	Fyke	N/A	N/A	Fyke	N/A	5	2	--	7
1B-1	Open Water (River)	20mm/LT	20mm/LT	20mm	Otter	Otter	N/A	Otter	N/A	6	3	2	14
2-1	Open Water (River)	20mm/LT	20mm/LT	20mm	Otter	Otter	N/A	Otter	N/A	6	3	2	14
3-1	Open Water (River)	Otter/LT	Otter/LT	Otter	Otter	Otter	N/A	Otter	N/A	6	2	2	14
TOTALS										74	--	--	142

II.B.2. Methodology and Standard Operating Procedure

II.B.2.a. Sample Preservation, Transportation, Storage and Disposal

The only samples to be transported and preserved are larval fish samples. The samples will be kept in plastic containers, and preserved in 10% formalin. They will be transported via car to the Jones and Stokes laboratory in Sacramento. The samples will be stored in cabinets at the lab until the conclusion of the study, at which time they will be transferred to the USACE or disposed of in accordance with applicable regulations. During sample processing, formalin will be recycled and reused.

All fish samples will be placed in glass specimen jars and preserved in 10% formalin and cataloged to include date, time, location, and collector of the sample. Sample preservation will be in accordance with the AFS *Fisheries Techniques* (Snyder 1983). Alternatively, in order to facilitate handling of samples in the field, specimens may be placed in plastic bags in the field, properly labeled, refrigerated, and transported to the lab prior to preservation in 10% formalin.

II.B.2.b. Preparation of Equipment

All equipment will be prepared and calibrated prior to use each month. The following list itemizes equipment preparation procedures:

- YSI 85 meter (DO, Salinity, Temperature, Conductivity) - calibrate to manufacturer's specifications prior to use each month (YSI 1998).
- General Oceanics flow meter – Initially calibrate the number of revolutions to the distance traveled through the water. Recheck calibration prior to use each month.
- Digital Camera – operating instructions for survey site photo points and camera settings will be communicated prior to monthly surveys.
- All nets will be maintained, checked for damage, and repaired prior to use each month.
- The boat, related gear, and safety equipment will be checked and maintained for use each month or daily as necessary.

II.B.2.c. Sample and Data Collection

Environmental Data Collection at Sampling Sites

The environmental parameters previously listed in Section II.B.2.a. will be measured as follows:

- Dissolved oxygen will be measured with a YSI Model 85 D.O./conductivity/salinity/temperature meter , following manufacturer's specifications (YSI 1998)
- Water temperature will be measured with a YSI Model 85 D.O./conductivity/salinity/temperature meter at the surface and at the bottom of each site, following manufacturer's specifications (YSI 1998)
- Salinity will be measured with a YSI Model 85 D.O./conductivity/salinity/temperature meter at the surface and at the bottom of each site, following manufacturer's specifications (YSI1998)
- Turbidity will be measured using a secchi disk. The disk will be lowered into the water column on a cable or rope, and the greatest depth (cm) at which the disk can be observed will be recorded
- Tidal elevation will be read off of a gage established near the site
- Water depth will be measured off of demarcations on the YSI Model 85 sensor cable, or via marks on a depth or stadia rod, depending on depth
- Photos will be taken with an Olympus D-460 digital camera (resolution 1280x960), using manufacturer's specifications (Olympus 2000)

The FMP Implementation Team will take photos at the sampling sites each time the site is sampled and maintain a photo log of the area sampled and fishes collected during sampling. The photo log and digital photos will be included as a CD enclosure to the program report.

Fish Sampling

The FMP Implementation Team will obtain or modify a California Department of Fish and Game Scientific Collection Permit in order to sample fish populations that may be present during the sampling year in the selected locations. The sampling will occur monthly. The FMP Implementation Team will use the appropriate gear types and mesh sizes to target desired species and life stages. The FMP Implementation Team will conduct fish sampling once monthly in the locations and with the gear types specified below in Table 7.

Table 7. Gear Specifications and Sampling Effort.

Gear/ Sampling Technique	Dimensions	Mesh Size	Site Locations	Sampling Duration	Number of Samples
Fyke Nets	Opening: 3-4 ft Length: 20-30 ft Leads: 10-20 ft	¼ inch	Marsh Plain Terrace (1A-3), Emergent Marsh (1A-5), SWOA Slough (1A-6), SWOA Marsh (1A-7), SWOA Marsh (1A-8), SWOA HB Marsh (1A-10)	4-6 hours	1 set
Otter Trawl	Opening: 1 x 2.5m Length: 5.3 m	¼ inch	Open Water-HB (1A-2), Open Water-River (1A-1), Open Water-River (1B-1), Open Water-River (2-1), Open Water-River (3-1)	10-15 minutes per tow	2-3 tows at 1-2 knots
Purse Seine	Length: 100 ft Depth: 6-8 ft	¼ inch	SWOA Levee Breach (1A-9)	20-30 minutes per set	2-3 sets
Beach Seine	Length: 100 ft Depth: 4-6 ft Plus bag	¼ inch	Flood Plain Terrace (1A-4)	20-30 minutes per set	2-3 sets
Light traps	Aquatic Research Instruments specifications	.25cm slits, 505: bottom	Open Water-River (1A-1), Open Water-HB (1A-2), Open Water-River (1B-1), Open Water-River (2-1), Open Water-River (3-1), Marsh Plain Terrace (1A-3), Emergent Marsh (1A-5), SWOA Slough (1A-6), SWOA Marsh (1A-7), SWOA Marsh (1A-8), SWOA Levee Breach (1A-9), SWOA HB Marsh (1A-10)	60-120 minutes	1 set

Fish sampling will occur using five different gear types: otter trawl, fyke net, purse seine, beach seine, and light trap. General methods for each gear type are discussed below.

Otter Trawl

Otter trawls are bag shaped nets dragged along the bottom or through the water column by boat. Samples are strained from the water column over a period of 5-10 minutes. The mouth of the trawl is wider than it is high and is held open by outward forces generated by water pressure and friction against door shaped boards (otter boards) attached to the sides of the net mouth and towed at an angle to the net direction (Hayes 1983). Water volume through the trawl is calculated via use of a velocity meter in front of the net, and the known area of the net opening.

Fyke Net

Fyke nets are cylindrical or conical nets distended by a series of hoops or frames, having at least one internal funnel shaped throat directed inward to capture fish (Hubert 1983). Wings or a leader of webbing attract fish to the net and intercept their movement. Fyke nets are generally set in shallow water no deeper than the height of their wings or leader and first hoop. The net is pulled taught by anchors or poles driven into the substrate. Used to sample fish in streams, sloughs, and sluggish sections of rivers with moderate current velocity, fyke nets can also be used in highly vegetated areas by cutting paths in the vegetation. Fykes are selective for mobile species.

Purse Seine

Purse seines are encircling nets that are most effective in open water. The net is played out in a circle and the bottom edges are then drawn together to enclose the fish present in that area of water (Hayes 1983). The top of the net is connected to flotation devices adequate enough to support the weight of the net when left to float in open water. A rope strung through rings attached along the bottom of the net is used to pull the bottom of the net together like a drawstring.

Beach Seine

The beach seine is an encircling net that is most effective in shallow water, so that the net wall extends from the surface to the bottom of the water column. Mesh panels hang from a floated line with a heavy lead line on the lower edge and a pole on either side (Hayes 1983). The lead line must always remain in contact with the bottom to prevent fish from escaping. Pulled through the water by hand or a boat, beach seines select for small, slow moving or schooling fish whose habitat is shallow water. Beach seines are best used in water bodies with smooth bottoms, along shorelines, or in streams with slow currents. After sweeping through the water, the seine is pulled up on the beach and the contents examined. In water bodies with no natural beach, such as on tidal flats, the seine is set in a circular fashion and is closed by drawing the moving walls of webbing past an end held in place. This herds fish into the bag of the net, located at the fixed end, as the circle of webbing becomes smaller.

Light Traps

Light traps are constructed of plexiglass. Dimensions of traps used in this study are 10 inches tall and 12 inches by 12 inches wide. Traps are illuminated using 1-2 Cyalume light sticks. Light traps are set at night at each station, prior to high tide slack water. Photo-positive fish larvae are attracted to the light and entrapped by the trap baffles. Traps are retrieved after 60-90 minutes or after the tide begins to ebb. Fish larvae will be removed from each trap and will be preserved in jars in 10 percent formalin in preparation for processing.

Fish Sampling Data

The following data will be recorded for fishes collected at the sampling site locations:

- Identification of all fish captured to species level
- Fork length (mm), for all non-larval fish (if excessive numbers of a non-listed fish species are captured [e.g., threadfin shad], then fish will be counted and a representative sample of size ranges will be measured)
- A random sub-sample of weight (delta smelt and splittail)
- Reproductive state or how close to spawning (delta smelt and splittail)
- Noticeable lesions
- The volume of water sampled in trawls and seines to extrapolate fish densities
- All fish sampling data (non-larval) will be collected and recorded in the field
- All collected fish specimens will be returned to the water as soon as possible

II.B.2.d. Sample and Data Acceptability

There will be replicate samples (tows or sets) at the sites where the otter trawl, purse seine and beach seine will be used. Two to three replicate samples will be attempted at each sample site as time and safety permit.

There will be no replicates during monthly sampling at individual fyke net sites. Individual fyke nets will be set once at each site, beginning at high slack water and retrieved near low water. There will be also be no replicates at individual light trap sites. Individual light traps will be set during high slack water at each site and retrieved once the current begins to run.

The acceptability of the data will simply be based on completeness and accuracy of the field data collection and subsequent transcription into the computerized database.

II.B.3. Personnel Training

The Project Manager and Field Leader will be responsible for overseeing sampling and data collection, and all personnel training, as well as fish handling. There will be a fish identification session during initial sampling, with a taxonomic key to identify expected species.

There will be two technicians conducting the larval and 20-mm sampling and processing. Johnson Wang will provide staff supervision, additional training, and oversight for this task. Dr. Wang is the recognized leader in larval fish identification for Delta species, having published taxonomic keys and other landmark technical documents on this subject (Wang 1986). Dr. Wang will process a number of samples himself, creating a reference collection to which future samples can be compared.

II.B.4. Personnel Safety

The Project Manager and Field Leader will be responsible for overseeing all aspects of personnel and field safety, such as boat safety procedures and all other equipment and field operations. Safety procedures will be as described in *AFS Fisheries Techniques* (Barry et al. 1983). A checklist of safety equipment will be used for each field effort.

II.C. Sample Custody for Field and Laboratory

The Field Leader or Field Technician will be custodians of larval samples, fish samples, and data. Samples will be labeled, clarifying the date and station where samples were collected. The outside of the sample containers will be labeled with the date, sample location, collector, and type of sample, using pencil or waterproof ink on 100% rag paper. Stephanie Theis and Donna Maniscalco will be handling the larval samples at the Jones & Stokes lab facilities in Sacramento. Data sheets will be copied immediately upon returning to the office.

II.D. Calibration Procedures and Frequency

All calibrations will be to manufacturer's specifications. Calibrations will be checked prior to each monthly sampling effort. If appropriate, calibrations will be confirmed prior to each day's sampling effort.

II.D.1. Instrument and Sample Calibration

Dissolved oxygen, temperature, salinity, and velocity meters will be calibrated or checked according to manufacturer's specifications at each outing. A checklist will be developed for documentation of calibration checks and will be attached to the sampling forms.

II.D.2. Frequency and Timing of Calibration

Calibration will occur at the beginning of each field outing.

II.D.3. Documentation of Calibration Checks

Calibration checks will be documented on the calibration checklist that will be attached to the data sheets.

II.D.4. Instrument, Equipment and Supplies Inspection and Maintenance

Instruments, equipment, and supplies will be checked prior to each field outing. During each field effort, notes will be made of needed repairs or equipment malfunctions.

II.E. Sample Processing and Analysis

The only sample processing for the project involves larval fish processing.

The USACE has contracted with the CDFG to conduct 20-mm tow net sampling at three sites in the Napa River for the 2001 season. These samples, and the larval light trap samples, will be transferred to the USACE shortly after collection and processed at the Jones & Stokes' laboratory. The lab includes stereomicroscopes for larval fish identification, and the necessary processing and safety equipment for analyzing the samples, including new fume hoods to provide adequate ventilation when using formalin. Chemical sink traps are installed for appropriate disposal of formalin and other chemicals.

All specimens in the samples other than Delta smelt, Sacramento splittail, and listed salmonids will be ignored. Delta smelt and Sacramento splittail will be preserved and separated from the rest of the sample.

To begin processing, 200 larval fish will be removed from each sample and set aside in vials for identification to species. If after reaching 200 fish it is estimated that there are less than 400 total fish in the sample, the entire sample will be processed. If it is estimated that more than 400 total fish are present, then 200 fish will be set aside in vials and the remainder of the sample will be stored for future reference.

Fish will be separated from samples by pouring one sample at a time through a strainer and depositing the strained contents into a light colored pan. Water will be added to cover and evenly distribute the sample and will reduce the severity of formalin fumes. Forceps will be used to extract individual fish and place them in labeled, formalin filled vials. To promote random sampling, technicians will work back and forth through the contents of the pan and will not remove fish from only one area.

To key fish to species, fish will be removed from the vials one at a time and placed under a dissecting microscope. Wang's key (Wang 1986) will assist in the identification of Delta smelt, Sacramento splittail, and listed salmonids with only these fish being counted. Species being considered in this project will be returned to their vials after identification.

II.F. Data Reduction, Analysis, and Reporting

II.F.1. Data Reduction and Analysis Staffing

Data entry and reduction will be conducted by several team members, including:

- Steve Kramer
- Jill Andersen
- Chris Nelson
- Susan Davis
- Firuzeh Mahmoudi
- Stephanie Theis
- Donna Maniscalco

Data analysis, QA/QC, and statistical analysis will be conducted by team members that include:

- Mike Dietl
- Sharon Kramer
- Scott Wilcox
- Steve Kramer
- Stephanie Theis
- Ethan Bell
- Thomas Gross
- Donna Maniscalco
- John Anderson

II.F.2. Quality Control Procedures

The first quality control procedure will be checking of field data before leaving the site. Field data will be collected on standard forms to minimize the potential for missing values. Where appropriate, check boxes will be used to ensure consistency. Field checking will occur daily, with the Field Leader, or other crew member who did not record the data, reviewing the datasheets for the following:

- 1) Completion of all data fields
- 2) Reasonableness of measurements
- 3) Legibility of recorded data.

The reviewer will then initial each data sheet as having been reviewed. Quality control of data processing is described in Section III.A. The next quality control procedure will be a review of the summarized data for reasonableness by the Field Team Leader. To confirm statistical assumptions are reasonable, checked appropriately and are not violated, statistical results will be reviewed by the FMP Implementation Team's statistician and Principal Investigator.

II.F.3. Peer-Reviewed Articles and Reports

The Principal Investigator, Sharon Kramer, will oversee preparation of peer-reviewed articles and/or reports.

III. Data Assessment and Oversight

III.A. QC Data Checks

III.A.1. Data Check Methods

Data checks will be made at three different levels: 1) in the field, as described previously under Section II.F.2.; 2) during data entry and summary, as described in Section III.A.2. below; and 3) during statistical analysis, as described in Section II.F.2.

The field data collection methods and forms will be designed so that complete and correct data is recorded. Although there is always the potential for errors to occur during both data collection and data entry, the FMP Implementation Team will utilize data management methods that will prevent, detect, and correct errors to ensure a high level of data quality. During data entry into the relational database, the database software is able to prevent or detect and notify many types of errors with the following methods:

Mandatory Fields. Although not all fields must be entered for every record, there are many mandatory fields, such as sampling-site identification number and date. Mandatory data elements will be defined so that the data entry record cannot be saved until a value is entered.

Data Format Checks. The data entry form prevents the wrong type of data from being entered into a field. For example, text cannot be entered into numeric fields, numeric data is entered with the correct decimal placement, and data is stored in the correct format.

Lookup Tables. Many data elements have unique values that must be used, such as fish sample method and sampling plot identification number. Rather than enter values for these fields and risk making a typographical error, lookup tables will be used with data entry drop-down menu lists, so that only a valid value on the list can be selected.

Numeric Range Tests. For numeric data elements, such as fish counts, the value entered is tested against preset minimum and maximum values, to ensure that the data entered is within the valid range.

Incomplete or Illegible Data. If the field data collection forms have illegible or missing mandatory data, the data entry staff will return the forms with the errors noted to the field monitoring team member for correction.

Data Entry Report and Field Form Comparison. At the completion of each data entry session, the data entry technician will print out a report of the data entered. This printout will be compared to the field data entry forms. The following checks are made, and any errors found are corrected:

- Were all field data forms entered into the database?
- Do the number of lines completed on the forms match the number of database records entered?
- Were the data values on the forms correctly entered into the database?

III.A.2. Data Check Criteria

The data checking criteria will be: 1) reasonableness, as determined by the Field Leader or other knowledgeable reviewer; 2) appropriate format and range, as specified in Section III.A.1.; and 3) completeness, as determined during the field checking and data entry process (Section II.F.2).

III.A.3. Person(s) Conducting Data Checks and Reporting Results

Data checks will be performed by a variety of staff, and results reported to and corrections made by the data analysis team. Any remaining problems will be reported to the Project Manager and Principal Investigator.

III.B. Field and Laboratory Performance and Systems Audit

III.B.1. Audit Methods

Monthly reports will be provided to USACE contact for the purposes of ongoing auditing. In addition, an USACE representative will be in the field to assess field performance.

III.B.2. Audit Criteria

III.B.3. Person(s) Conducting Audit(s) and Reporting Results

The audits will be conducted by the USACE Principal Investigator, Mike Dietl.

III.C. Corrective Action

III.C.1. Potential Problems and Corrective Actions

The Principal Investigator (Sharon Kramer) and Project Manager (Scott Wilcox) will address corrective actions.

IV. Data Validation and Usability

IV.A. Error Checking of Raw Data

IV.A.1. Error Checks

Error checks will be conducted as described in Section III.A.

IV.A.2. Criteria Used

Criteria for error checking will be as described in Section III.A.

IV.A.3. Person(s) Conducting Error Checks and Reporting Results

Error checking staff and reporting will be as described in Section III.A.3.

IV.B. Data Limitations

The limitations of the data are that we will not be able to calculate species population sizes in the created and restored habitats, but we will be able to document their presence. Catch per unit effort will be used to compare gear types, time (months), and habitat types, but we will not be able to prove species absence nor will we be able to provide a population estimate with this method. Given the level of sampling effort (142 samples in 2001, 1,085 over 5 years), we expect that we should be successful at documenting presence of fish species, particularly threatened and endangered species.

The statistical analyses based on the data collected will likely be a generalized linear model approach, assuming that assumptions necessary for other methods (such as analysis of variance) are unlikely to be met. Variability in CPUE within and between habitat types and gear types will be considered by having replicate samples within habitat types and at different sites.

In addition, it is likely that the survey will be continued in future years, which will provide information on the intra- and interannual variability of species utilization of the Napa River Estuary, which may be influenced by flows from the Sacramento and San Joaquin rivers.

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QA/QC Review

QA/QC Review Team Member

date

QA/QC Review Team Member

date

QA/QC Review Team Member

date

QA/QC Plan Accepted by Management Team

IEP Program Coordinator

date