Monitoring Program
for the Operation of the
Grassland Bypass Project

Phase II

October 1, 2001 - December 31, 2009

June 2002

Monitoring Plan prepared by Members of the Grassland Bypass Projects=s Data Collection and Reporting Team for the Grassland Bypass Project=s Oversight Committee

Participating Organizations

U.S. Bureau of Reclamation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Central Valley Regional Water Quality Control Board
California Department of Fish and Game
San Luis & Delta-Mendota Water Authority

Acronyms

Participating Organizations

GAF	Grassland Area Farmers
CDFG	California Department of Fish and Game
CVRWQCB	Central Valley Regional Water Quality Control Board
NMFS	National Marine Fisheries Service
SLDMWA	San Luis & Delta-Mendota Water Authority
USBR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Grassland Bypass Project Organization

GBP	Grassland Bypass Project
OC	Oversight Committee
TPRT	Technical and Policy Review Team
DCRT	Data Collection and Reporting Team

Contractors

SFEI	San Francisco Estuary Institute
BES	Block Environmental Services
SEI	Summers Engineering Inc.

Structures

SLD	San Luis Drain

Administrative Documents

EIS/EIR	GBP Environmental Impact Statement / Environmental Impact Review
CMP	Compliance Monitoring Plan for WY 1997-2001
MP II	Monitoring Plan, October 1, 2001 through December 31, 2009
QAPP	Quality Assurance Project Plan for WY 1997-2001
QAPP II	Quality Assurance Project Plan, October 1, 2001 through December 31, 2009
ROD	Record of Decision
UA	Use Agreement for WY 1997-2001
UA II	Use Agreement, October 1, 2001 through December 31, 2009

Abbreviations

WY	Water-Year, October 1 through September 30

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Monitoring Program
for Use and Operation of the
Grassland Bypass Project
Phase II

Section 1.0 Introduction

This document describes the program to monitor the progress of the U.S. Bureau of Reclamation and the San Luis & Delta-Mendota Water Authority to meet the environmental commitments agreed upon in the new Phase II Use Agreement of the Grassland Bypass Project and the Waste Discharge Requirements of the California Regional Water Quality Control Board.

Phase I of the Project occurred between October 1, 1996 and September 30, 2001.

The purposes of the GBP are to:

1. Continue the separation of unusable agricultural drainage water discharged from the Grassland Drainage Area (GDA) from Grassland wetland supply channels from October 1, 2001 through December 31, 2009, and to

2. Facilitate drainage management that maintains the viability of agriculture in the GDA and promotes improvement in water quality in the San Joaquin River.

Features of the GBP include:

1. Management and consolidation of unusable agricultural drain water from the 97,400 acre GDA, which is comprised of Broadview Water District, Camp 13 Drainage District, Charleston Drainage District, Firebaugh Canal Water District, Panoche Drainage District, Pacheco Water District, Widren Water District, and unincorporated adjacent farmland,

2. Continuation of the Grassland Basin Drainers Activity Agreement, a regional drainage entity,

3. Continued separation of GDA drain water from 93 miles of channels that supply clean water to private wetlands and State and Federal wildlife refuges,

4. Use of the Grassland Bypass Channel, a 4-mile-long earthen constructed ditch, to convey drainwater from the GDA to the San Luis Drain,

5. Continued use of approximately 28 miles of the San Luis Drain, to its northern terminus at Mud Slough (North),

6. Discharge of drain water into Mud Slough (North), a tributary of the San Joaquin River~~,~~ located 3 miles upstream of its main confluence with the Merced River,

7. Execution of the second *Agreement for Use of the San Luis Drain* from October 1, 2001 through December 31, 2009,

8. Development of the San Joaquin River Water Quality Improvement Project on up to 6,200 acres, within the GDA, and

9. Implementation of the Monitoring Plan II to evaluate the effects of the Project on the San Luis Drain, Mud Slough (North), Grassland wetland supply channels, and the San Joaquin River.

On September 7, 2001, the California Regional Water Quality Control Board, Central Valley Region (CVRWQCB), issued a Waste Discharge Requirement (WDR) specifying maximum monthly and maximum annual loads of selenium that the GBP may discharge into Mud Slough (North) and the San Joaquin River. It also calls for specific chronic toxicity testing. The WDR includes monthly monitoring for molybdenum and nutrients (nitrate, ammonia, total Kjedahl nitrogen, total phosphate, and ortho phosphate), and weekly analyses of salinity, selenium, boron, and other parameters. It also outlines a program to monitor storm water releases from the GDA into the Grassland wetland supply channels should they occur.

The U. S. Bureau of Reclamation (USBR) and the San Luis & Delta-Mendota Water Authority (SLDMWA) prepared environmental documentation under the National Environmental Policy Act and California Environmental Quality Act. The Environmental Impact Statement/Environmental Impact Report (EIS/EIR) on Phase II of the GBP was completed May 25, 2001. A Record of Decision was executed by USBR on September 28, 2001. The second Use Agreement (UA II) was also executed on September 28, 2001. The UA II establishes the terms and conditions for using the SLD and operating the GBP.

The UA II requires a monitoring program to assess project accomplishments. The new Monitoring Program (MP II) is similar to the monitoring program for Phase I of the GBP. Sampling locations, frequencies, parameters, and reporting of project findings are outlined both in this document and in the WDR. Monitoring and reporting specified in the WDR must be done in order for discharges from the SLD to continue.

The project is located within the Grasslands Subarea as defined by the San Joaquin Valley Drainage Program (SJVDP, 1990) (Figure 1). The area is a valley floor sub-basin of the San Joaquin River Basin. The Grasslands Subarea is an area of approximately 370,000 acres and is generally bounded on the north by the alluvial fan of Orestimba Creek and by the Westlands Subarea to the south. The San Joaquin River forms the eastern boundary and Interstate Highway 5 forms the approximate western boundary.

The Grasslands Subarea consists primarily of agricultural lands, Federal and State wildlife refuges, and private wetlands. The Grasslands Subarea soils are derived largely from the erosion of the marine rocks that form the California Coast Ranges. They contain abundant salt and other trace elements such as arsenic, boron, selenium and molybdenum. Depth to water can be quite shallow, often inundating the root zone of agricultural fields.

The area is a highly managed hydrologic system due to the diversion of perennial flows out of the basin. Thus, agricultural irrigation water must be supplied via supply canals. Similarly, drainage water must be managed in the absence of perennial receiving water flows and the accompanying assimilative, or dilution, capacity.

Section 2.0 Project Management

2.1 Project Organization

The monitoring and reporting efforts for the GBP are performed by private, State, and Federal agencies whose authority or activities directly overlap in one or more aspects of the project. These agencies include the Grassland Water District, the SLDMWA, the CVRWQCB, the California Department of Fish and Game (CDFG), USBR, U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (USEPA), and the National Marine Fisheries Service (NMFS). The SLDMWA represents the collection of local drainage and water districts that operate the GBP. The USBR and the SLDMWA are the responsible parties.

2.2 Oversight Committee

The GBP Oversight Committee (OC) consist of representatives from USBR, USFWS, CDFG, CVRWQCB, and USEPA. The role of the OC is to evaluate overall operations of the GBP, to assess monetary charges to SLDMWA for selenium loads exceeding those specified in the UA II, and to act on other issues brought to them by the Technical and Policy Review Team (TPRT) and/or the public. Specific charge or mission to the OC is found in the UA II.

2.3 Technical and Policy Review Team

The GBP OC created the Technical and Policy Review Team (TPRT) to assist the OC with technical issues. TPRT members include a representative from the CVRWQCB, CDFG, NMFS, USBR, USFWS, and USEPA. A representative from USGS serves as an independent technical advisor. The TPRT is responsible for obtaining and providing the necessary information, options, and recommendations to the OC for issues and decisions regarding the project. This includes the review and analysis of analytical data and reports, and obtaining appropriate peer or scientific review as necessary.

2.4 Data Collection and Reporting Team

The Data Collection and Reporting Team (DCRT) consists of the agency representatives and contractors collecting, verifying, and reporting GBP data. The DCRT meets regularly to ensure coordination of monitoring activities. The team addresses issues and concerns regarding data collection, data management, and quality assurance/quality control as the GBP progresses.

2.5 Quality Control Officer

A representative from USBR serves as the quality control officer. The quality control officer works with the cooperating agencies, to verify, validate, coordinate and update the quality control activities associated with the GBP.

Section 3.0 Monitoring Plan Approach

3.1 Introduction

The monitoring program is comprised of activities that both meet the requirements specified in the WDR for discharge from the San Luis Drain and provide additional information to evaluate the overall goals of the project. Table 1 summarizes the current activities and agencies conducting the monitoring. Activities highlighted in bold are required under the WDR. The complete WDR is included as Appendix A.

Monitoring objectives include the following:

1. to assess environmental conditions in the SLD by measuring selenium concentrations and other parameters in water and sediment,

2. to assess the changes in environmental conditions in Mud Slough (North) which are related to discharges from the SLD by measuring selenium concentrations and other parameters in water, sediment and biota,

3. to assess the changes in environmental conditions in Salt Slough by measuring selenium concentrations and other parameters in water, sediment and biota

4. to verify that agricultural drainage water from the GDA is removed from wetland water supply channels,

5. to assess the changes in environmental conditions in the San Joaquin River which are related to the GBP by measuring selenium concentrations and other parameters in water (up and downstream of the Merced River) and biota (upstream of the Merced River only).

3.2 Integration with Research/Investigations Activities

The comprehensive data collection effort undertaken in the MP II and the WDR may allow more in-depth, interagency research projects to be performed than might have been otherwise possible. The data collection, reporting and dissemination process fosters close cooperation and coordination, not only with the agencies and organizations involved in the monitoring program but also within the research community.

3.3 Procedures for Updating Monitoring Plan II

If, at any time during the life of the project, a cooperating agency is unable to complete activities specified under the WDR, the USBR and SLDMWA will immediately take over the specified monitoring. If, during the life of the project, budgetary constraints preclude continuing monitoring for other elements of the program, the effected monitoring component will be reevaluated by the DCRT and alternative recommendations will be forwarded to the TPRT for consideration. If the issue cannot be resolved by the TPRT, then it will be forwarded to the OC for consideration.

The MP II can also be modified periodically based on review of data relative to the project objectives and commitments. Recommendations for modifying the monitoring plan are presented to and discussed before the DCRT. If the DCRT reaches agreement on the suggested changes, then the recommended changes are presented in writing to the TPRT. The TPRT can choose to accept the changes or have the OC make the final decision. If the DCRT cannot agree on the suggested changes, the TPRT can review the request and can accept or deny the request. If the TPRT cannot agree on the changes, a final decision will rest with the Oversight Committee.

Section 4.0 Data Collection, Data Management and Reporting

Each entity collecting data will collect, analyze, summarize and report its data in a timely manner to meet the monthly, quarterly, and annual schedules. The ultimate responsibility for collecting and reporting of data required by the WDR rests with the USBR and SLDMWA.

4.1 Data Management

Each organization collecting data has been and remains responsible for their own data reduction (analysis), internal data quality control, data storage, and data retrieval. Each organization will provide its data to an independent organization, currently the San Francisco Estuary Institute (SFEI), for compiling, disseminating, and reporting. SFEI will provide access to project data via the world wide web. The San Francisco Estuary Institute (SFEI) was selected to compile and report project data for Phase I of the GBP, and will continue to provide their services for Phase II GBP. USBR is responsible for managing SFEI=s contract.

4.2 Reporting

A monthly report is compiled, reviewed, and released to the public 60 days following the last day of any given month by SFEI. The report consists of all available daily flows, available daily and weekly water quality results, and monthly chronic toxicity results. If certain flows and/or water quality parameters are not available for the current monthly report, values will be posted in the next quarterly report. The monthly report specifically shows the selenium loads discharged from the terminus of the SLD (Station B). After the monthly report has been reviewed by the DCRT, the report is posted on SFEI=s web site and distributed to the public.

A quarterly data report is compiled, reviewed, and released to the public 3 months following the last day of the quarter (March, June, September, or December) by SFEI. The report includes available data that was collected and analyzed during the 3-month period. The quarterly data report updates and/or revises data that was previously reported previously in the monthly or quarterly reports, when warranted. After the quarterly data report is reviewed by the DCRT, the report is posted on SFEI=s web site and distributed to the public.
An annual progress report is prepared for the CVRWQCB and for the OC 6 months after the end of the calender year

by the SFEI. SFEI compiles year-end results from information provided by participating agencies.

Individual scientific and/or technical reports authored by agency staff are encouraged. Posting of the technical documents on SFEI=s web site is done after DCRT review. Each agency has the option of summarizing their own information and posting results on their web sites with or without DCRT review.

Section 5.0 Monitoring Plan

5.1 Introduction

The MP II is designed to collect data to meet the requirements of the Use Agreement and the Waste Discharge Requirement (WDR). The data will provide information to evaluate compliance with the WDR and UA II. To this end, flow, water quality, sediment, biota, and toxicity have been identified as the parameters for assessing the GBP. Table 1 shows a matrix depicting an overview of the monitoring activities.

5.2 Monitoring Station Locations and Purposes

Monitoring stations have been established within the study area to assess changes in conditions from pre-project conditions (1985 - 1996) and from Phase I of the GBP (1997 - 2001). The stations are located within the SLD, Mud Slough, Salt Slough, the wetland channels, and the San Joaquin River. Figure 1 is a map of the Grassland Basin. Figure 2 shows the general routing of flow through the project area and the relative locations of the sampling stations.

Stations in the SLD are located at the drain inlet (A) and drain outlet (B). Data from these stations are used to assess flows, selenium loads, water quality, selenium concentrations in the sediment, as well as the amount of sediment in the drain. Chronic toxicity is measured at Site B. Substations are identified in the SLD to measure sediment volume and chemistry. These substations are identified by their locations: between Checks 17 and 18, between Checks 14 and 15, between Checks 10 and 11, and between Checks 1 and 2. Estimates of selenium concentrations in the sediment are made to determine if levels reach the hazardous material criteria established by California Department of Health Services.

Stations in Mud Slough (North) are located upstream of the discharge from the SLD (C), downstream of the discharge from the SLD (D), upstream of the confluence with the San Joaquin River (E), and in a backwater area (I2). Data from these stations is used to assess flows, selenium loads, water quality, sediment quality, tissue concentrations, and chronic toxicity.

Station F is the only station located in Salt Slough. Data from this station is used to assess flows, selenium loads, monthly averages of selenium concentrations, other water quality parameters, sediment quality, tissue concentrations, and chronic toxicity.

Stations in the wetland channels are located in Camp 13 Ditch (J), Agatha Canal (K), San Luis Canal (L2), and the Santa Fe Canal (M2). Data from these stations is used to compute monthly averages of selenium concentrations.

The data is used to evaluate environmental improvement from removal of agricultural drain water from Salt Slough and the Grassland wetland supply channels.

Stations on the San Joaquin River are located at Fremont Ford (Site G), which is upstream of the confluence with Mud Slough (North), at Hills Ferry (Site H), downstream of the confluence with Mud Slough (North) but upstream of the main Merced River confluence, and at Crows Landing (Site N), downstream of the confluence with the Merced River. Data from these stations is used to assess flows, selenium load (Site N, only), water quality (Sites G, H, and N), and tissue concentrations (Sites G and H). Selenium loads and water quality have been identified as indicators of change to the San Joaquin River system resulting from GBP. Tissue concentrations will provide indicators of system health. Sampling in the San Joaquin River is intended to serve as both compliance with the

CVRWQCB objectives for the river (Site N) and trend monitoring.

Water quality and flow data from the SLD outlet (B), Mud Slough (North) (D), Salt Slough (F), and the San Joaquin River near Crows Landing (N) is used to compute selenium, boron, and salt loads. Load analysis are made to evaluate project impacts to the San Joaquin River.

Section 6.0 Flow Monitoring

6.1 Purpose

Flow is a required parameter in the measurement of selenium, boron, and salt loads in the Grassland Basin. Loads are calculated by multiplying the concentration of the contaminant of concern (expressed in mg/L or Φg/L) by the flow (in cubic feet/second) and then multiplying by an appropriate constant to convert the mass flux into pounds or tons, depending on the constituent. Flows within the basin can fluctuate quite widely and are especially susceptible to storm events. Table 2 summarizes the flow monitoring program.

6.2 Sampling Locations and Data Uses

Flow data at the following stations is used for load calculations, and to perform comparative analyses with historic selenium, boron, and salt loads in Mud and Salt Slough as well as the San Joaquin River:

Station A	SLD near South Dos Palos, California
Station B	SLD terminus, near Gustine, California
Station D	Mud Slough (North) downstream of SLD discharge
Station F	Salt Slough at Highway 165
Station G	San Joaquin River at Fremont Ford
Station N	San Joaquin River at Crows Landing

6.3 Frequency of Sampling

Stage measurements are taken every fifteen minutes and converted into a mean daily flow in cubic feet per second.

The flow of water in Mud Slough (North) upstream of the SLD discharge (Site C),are estimated as the difference in flows passing Stations D and B.

Flow is measured daily at Stations J, K, L2, and M2 (Camp 13 Ditch, Agatha Canal, San Luis Canal, and Santa Fe Canal, respectively) using a stage over the weir boards to compute discharge. Reported flow measurements will coincide with the weekly water quality grab samples. The purpose of reporting the flow value corresponding to the day the water quality sample is taken is to determine if the sample is taken during low or no flow periods.

6.4 Field Sampling Techniques

The methods for measuring flow are summarized in Table 2.

6.5 Analytical Techniques

Stage measurements can be converted to discharge values and current shifts in station flow rating curves can be used to correct estimated discharge using standard analytical techniques. These techniques can be found in the USGS Open File Report 96-618 (USGS, 1996).

6.6 Quality Assurance

Flow measurement quality assurance focuses on verification of the stage-discharge relationship at the monitoring station and checking and re-calibration of the sensors deployed at each station.

The relationship of stage to discharge is rated regularly at Stations A, B, D, F, G, and N using USGS protocols (USGS, 1996). The frequency of calibration and station maintenance depends on the characteristics of the station and the flow conditions. Frequent calibration is performed for stations in unlined earthen channels susceptible to backwater effects and where sedimentation or stream bed erosion is likely.

Tasks to be performed during routine station maintenance include cleaning and re-calibration of sensors, comparing flow data with conventional current meter measurements taken from a bridge, or in -stream (by wading and by boat), and computation of shifts in the stage-discharge rating.

At Stations J, K, L2, and M2, the height of water passing over the weir boards is related to canal discharge. A standard rating curve has been developed for each station using current meter readings.

Section 7.0 Water Quality Monitoring

Water quality has been closely monitored in the lower San Joaquin River, its tributaries, and the Grassland wetland supply channels since 1985. The historic data have been used to develop regulatory programs for the control of agricultural drainage discharges. This MP II will document the progress of the GBP to meet the load objectives specified in the WDR along with other objectives specified in the WDR and UA II.

7.1 Purpose

Water quality monitoring is designed to compare analytical results to the stated water quality objectives and commitments addressed in the WDR and the Use Agreement II. These commitments include meeting monthly and annual selenium loads, not degrading water quality in the San Joaquin River relative to the pre-project condition (including the salinity standard at Vernalis), and ensuring that drain water discharges do not violate applicable State, Federal, and local laws and regulations.

7.2 Sampling Locations and Data Uses

Water quality sampling locations are depicted in Figure 2. The stations include data from the SLD, Mud Slough (North), Salt Slough, San Joaquin River, and the wetland channels.

Station A	SLD near South Dos Palos, California
Station B	SLD terminus, near Gustine, California
Station C	Mud Slough (North), upstream of SLD discharge
Station D	Mud Slough (North) downstream of SLD discharge
Station I2	Mud Slough (North), about 1 mile downstream of SLD discharge
Station F	Salt Slough at Highway 165
Station J	Camp 13 Ditch
Station K	Agatha Canal
Station L2	San Luis Canal
Station M2	Santa Fe Canal
Station G	San Joaquin River at Fremont Ford
Station H	San Joaquin River at Hills Ferry
Station N	San Joaquin River at Crows Landing

Station B is used to assess compliance with selenium load objectives specified in the UA II and the WDR. Water quality data is evaluated along with flow to assess selenium loads.

Station N is a compliance point specified in the WDR.

7.3 Frequency of Sampling

Table 3 summarizes the parameters and frequency of sampling at each station.

San Luis Drain
Samples are collected at Stations A and B for selected parameters. A daily composite sample consisting of six sub-samples is collected for total selenium and boron at Station B (outflow of the SLD) using an automatic sampler. Daily monitoring of selenium loads discharged is required for compliance evaluation. Continuous electrical conductance (EC), and temperature are also being recorded at these sites. An automatic sampler is also used at Station A to collect daily samples that are composited into a weekly composite sample.

Mud Slough (North)
Water quality samples are collected weekly at Stations C, D, and I2. Station D is monitored continuously for EC and temperature.

San Joaquin River
The San Joaquin River at Fremont Ford (Station G) is sampled on a weekly basis. Continuous EC and temperature is recorded at this site.

A daily composite sample is collected from the river at Crows Landing (Station N). This frequency is necessary for evaluation of compliance with water quality objectives. A weekly grab sample is also collected for quality control purposes and during times when composite sampling is not possible due to unforseen conditions. Continuous EC and temperature will also be recorded at this site.

Wetland Channels and Salt Slough
The wetland channels monitoring Stations, J, K, L2 and M2, along with Salt Slough, are sampled weekly. Sites J and K are visually inspected each week to survey potential drainage diversions. A log of conditions will be maintained. If, at any time, drainage diversions are noted in these channels, the storm water monitoring program specified in the WDR will be initiated.

7.4 Sampling Methods

Several sampling techniques are used to collect samples, including grab, time and depth integrated. The techniques used at each location are summarized on Table 3. Because of the remoteness of the region and staffing limitations, auto-samplers are used to collect time-composite samples at Stations A, B and N.

Grab samples are collected using a stainless steel sampling device. This device is a 6-foot stainless steel pole with a cage at one end which holds the sampling bottle. Grab samples are collected from the stream bank. This technique is for samples collected at a frequency equal to or less than once per week.

Depth integrated samples are collected by accessing the center of the channel and collecting samples from mid-stream. Depth integrated sampling is utilized at sites with parameters which may not be evenly mixed in the channel. This technique is used at Stations A and B for total suspended solids (TSS) characterization.

Time composite samples are collected using an auto-sampler. Daily (2 or 6 sub-samples per day) composite is collected at Stations A, B, and N. Samples must be taken at a greater frequency than once per week because water quality objectives for selenium are based on a 4-day average for Mud Slough (North) and the San Joaquin River at Crows Landing.

Continuous EC and temperature are recorded at Stations A, B, D, F, G, and N with sensors connected to digital data-

loggers connected to a telephone. Station G is equipped to send data via satellite to the California Data Exchange Center.

7.5 Storm Water Monitoring

The WDR contains specifications for notification and monitoring should storm water from the GDA be discharged into the Camp 13 Ditch and/or Agatha Canal. The monitoring program is conducted at five sites immediately prior to diversion of storm water into the Camp 13 Ditch and/or Agatha Canal; daily during the diversion, and one week after the diversion ceases.

The five sites are:

Station F	Salt Slough at Highway 165
Station J	Camp 13 Ditch
Station K	Agatha Canal
Station L2	San Luis Canal
Station M2	Santa Fe Canal

The daily grab samples are analyzed for pH, EC, temperature, selenium, boron, and molybdenum. Daily average flow is also be measured at each site.

Section 8.0 Biological Monitoring

8.1 Purpose

The purposes for tissue sampling in biological specimens are to assess the potential for adverse biological impacts to fish and wildlife resources and to assess public health risks. For the GBP monitoring plan, food chain (aquatic plants, invertebrates, and whole body fish) samples are analyzed for contaminant residues to assess impacts to fish and wildlife resources, while gamefish fillet samples are analyzed for contaminant residues to assess human health risks. Recommended ecological risk guidelines for selenium and boron are used to interpret selenium body burdens in assessing impacts to fish and wildlife resources. Table 4 summarizes the biological monitoring activities for the MP II.

Collecting food chain samples for analysis is important since contaminant levels along the Mud Slough (North) corridor may reach the recommended ecological risk guidelines toxicity thresholds for selenium in represented biota. Biota contaminant residues in food chain compartments can be used to evaluate ecosystem health. For example, since selenium bioacccumulates, elevated concentrations at lower trophic levels can be an indicator of elevated concentrations at higher trophic levels. Effects of elevated selenium at higher trophic levels are well documented, such as teratogenic effects on avian embryos. Collecting edible portions (fillets) of gamefish to evaluate the potential for adverse public health risks is important, since recreational and subsistence fishing are known to occur in Mud Slough (North) and the San Joaquin River.

8.2 Sampling Locations

Biological monitoring are performed at the following stations:

Station C	Mud Slough (North), upstream of SLD discharge
Station D	Mud Slough (North), downstream of SLD discharge
Station E	Mud Slough (North), about 3 miles downstream of SLD discharge
Station I2	Mud Slough (North), about 1 mile downstream of SLD discharge
Station F	Salt Slough in the San Luis National Wildlife Refuge (NWR)
Station G	San Joaquin River at Fremont Ford
Station H	San Joaquin River at Hills Ferry

Station C:
Located in Mud Slough, upstream of the discharge point from the SLD into Mud Slough. Water passing this site

comes from adjacent wetlands and wildlife refuges, and represents the baseline condition in the Slough.

Station D:
Located in Mud Slough downstream of the discharge point from the SLD. This Station represents conditions existing immediately downstream of the discharge point.

Station I2:
Located in a backwater area on Mud Slough downstream of the SLD discharge. This Station represents conditions in a low flow depositional habitat relatively close to the point of discharge into Mud Slough.

Station E:
Located in Mud Slough between the discharge point from the SLD and the San Joaquin River. This Station represents the conditions existing within the system prior to discharge to the San Joaquin River.

Station F:
This site is located in Salt Slough within the San Luis NWR. Like Station C, water in the slough comes from wetlands and wildlife refuges. This site represents conditions within the Grassland Basin without drain water from the GDA.

Station G:
Located on the San Joaquin River upstream of the Mud Slough confluence.

Station H:
Located on the San Joaquin River downstream of the confluence with Mud Slough (North) but upstream of the main Merced River confluence.

8.3 Frequency of Sampling

Fish and invertebrates samples are collected from all stations quarterly. Sampling will occur in March (high flow), June (early Summer irrigation), August (late Summer irrigation), and November (low flow). Because aquatic insects are a major source of food for certain avian species during the breeding season, insect samples are collected in the Spring. Egg samples are collected in the Spring along the Mud Slough and Salt Slough for analysis and inclusion for the Lemly Index. Also, aquatic vegetation is sampled in late Summer (August) to evaluate contaminant loading in plants known to be consumed by waterfowl.

8.4 Field Sampling Techniques

Procedures and protocol for biota sampling to determine contaminant body burdens in fish, invertebrates, and vegetation is standardized to complement recent or current studies conducted by USFWS and CDFG.

Non-game Fish:
Monitoring of non-game fish is essential for the program because of their importance in wildlife food chains. Mosquitofish (*Gambusia affinis*) is selected for monitoring, as it represents the most prevalent fish inhabiting both sloughs. Mosquitofish may not be sufficiently abundant for sampling at the San Joaquin River stations, in which case another small species such as fathead minnows (*Pimephales promelas*), red shiners (*Cyprinella lutrensis*), or inland silversides (*Menidia beryllina*) are sampled. All of these species are important as forage for piscivorous fish and birds inhabiting the areas adjacent to Mud and Salt Sloughs. Changes in fish species can be made in the monitoring program if it is ascertained that other species are found more consistently at certain sites. Selection of fish species to be sent for trace element analysis is dependent on numbers and species collected at each sampling location during each sampling quarter. Fish specimens are collected at all biological monitoring stations by dipnetting, seining or electrofishing. To conserve analytical resources, five or more individuals (whole body) of approximately similar size and of the same or closely related species may be composited in each sample. To the extent practicable at least three replicate samples of each species from each sampling site are analyzed. Samples

include sufficient tissue mass to enable selenium and boron analysis. Currently minimum mass for selenium wet weight analysis is about two grams. Minimum mass for selenium dry weight analysis (including percent moisture determination) is about two grams.

Gamefish:
Gamefish species are expected to vary among project stations and time periods, but the most common species of larger fish and those most sought for human consumption is selected for analysis (at each collection location and time). Species likely to be collected include channel catfish (*Ictalurus punctatus*), white catfish (*Ameiurus catus*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), Sacramento blackfish (*Orthodon microlepidotus*), and common carp (*Cyprinus carpio*). Selection of fish species sent for selenium and boron analysis is dependent on numbers and species collected at each sampling location during each sampling quarter. Gamefish is collected at all biological monitoring stations where they are available by dipnetting, seining or electrofishing. Samples consist of skinless fillets to best represent tissue likely to be consumed by humans. To conserve analytical resources, fillets of approximately the same mass from five or more individuals of the same or closely related species are composited in each sample. To the extent practicable, at least three replicate samples of each species from each sampling site is analyzed. Samples include sufficient tissue mass to enable both selenium and boron analysis on a wet weight basis (minimum two grams, preferably five or more grams).

Crustaceans:
Crayfish (*Procambarus sp.*), which represent an omnivorous epibenthic foraging species, are collected at all biological monitoring stations where they are available by dipnetting, seining or electrofishing. Crayfish samples consist of whole bodies, including carapace, to best represent exposure to wildlife. To conserve analytical resources, five or more individuals of approximately the same mass are composited in each sample. To the extent practicable at least three replicate samples from each sampling site is analyzed. Samples will include sufficient tissue mass to enable selenium and boron analysis (see ANon-game Fish@ above).

Aquatic Insects
Aquatic insects such as water boatman (Corixidae), dragonflies (Odonata), damselflies (Odonata), and back swimmers (Notonectidae), which represent important food items for breeding waterfowl, is collected from all biological monitoring stations; insects are collected opportunistically using dip nets, kick nets, and seines. Aquatic insect samples comprise enough individuals, composited by species, to enable both selenium and boron analysis (see ANon-game Fish@ above). To the extent practicable, at least three replicate samples of each species from each sampling site will be analyzed.

Vegetation:
In-stream and/or stream-side vegetation such as widgeon grass (*Ruppia maritima*), sago pondweed (*Potamogeton pectinatus*), smartweed (*Polygonum sp.*), swamp timothy (*Heleochloa schoenoides*), knotgrass (Paspalum distichum) and bulrush (*Scirpus sp.*) are collected once per year in the fall from all biological monitoring stations. The most appropriate vegetative species selected at each site on the basis of its potential for consumption by birds, is its abundance, and its expected long term occurrence there. Since interpretation of monitoring data depends more on temporal trends than spatial differences among sites, it is not necessary to monitor the same plant species at all locations. The same species need to be sampled consistently at each individual station once a species has been selected for that station. Vegetation samples analyzed consist of those portions of the plants (seedheads in most species) most likely to be consumed by waterfowl. Each sample includes plant material samples, composited by species, from enough specimens to enable selenium and boron analysis. (see ANon-game Fish@ above). To the extent practicable at least three replicate samples of each species from each sampling site will be analyzed.
Five grams of sampled material is needed for analysis.

8.5 Analytical Techniques

Biological specimens are analyzed for body burden concentrations of selenium and boron. analytes. Selenium residues in tissue is analyzed using hydride generation atomic absorption spectrophotometry. Boron residues in tissues is analyzed using inductively coupled plasma emission spectroscopy. Because fish and waterfowl foraging

on insects, other macro invertebrates, and fish would consume the entire organism, chemical analyses are performed on whole-body composite food chain samples for fish and wildlife effects assessment. However, for public health risk assessment purposes, fillets from the more common gamefish species is analyzed. Concentrations of selenium and boron are reported on dry-weight basis in all samples, and they also will be reported on wet-weight basis in gamefish.

Section 9.0 Toxicity Testing

9.1 Objectives

The objectives of the laboratory toxicity testing program are to evaluate the potential toxicity of the SLD discharge and the receiving waters after discharge. Tests are conducted using standardized bioassay protocols under controlled environmental conditions. The toxicity testing program evaluates potential toxicity of agriculture drain water as it is conveyed through the SLD to Mud Slough (North). Table 5 summarizes the toxicity testing for the MP II.

9.2 Sampling Locations

Water samples are collected at the following stations for use in laboratory bioassays:

Station B	SLD at the foot bridge
Station C	Mud Slough (North), upstream of the SLD discharge
Station D	Mud Slough (North), downstream of the SLD discharge
Station F	Salt Slough at Highway 165
Control	Delta-Mendota Canal (Hwy 152) near Santa Nella, California

The Delta-Mendota Canal (DMC) station is selected as a control site because it is the nearest freshwater source to the project area. The DMC water is considered to be of good quality which can be used as a dilution water in the event that definitive bioassays are required.

9.3 Frequency of Sampling

Initially, monitoring is performed monthly. The first 9-months= data will be reviewed by a sub-committee of the DCRT in a timely manner to determine whether a recommendation to reduce the frequency of testing should be made to the full committee.

9.4 Field Sampling

Field sampling techniques will follow the protocol described in AShort-Term Methods for Estimating the Chronic Toxicity for Effluents and Receiving Water to Fresh Water Organisms@ 3rd Ed (EPA-600-4-91-022) for fathead minnows and algae. The *Daphnia magna* 7-D test protocol is found in EPA-600-D87-080. The protocol is included in the QAPP.

Water from each station is collected in a one-gallon bucket. The sample is transferred to a 2.5 gallon cubitainer, stored in a cooler and transported back to the laboratory. Before sampling, the bucket and sample containers are rinsed with station water. Samples for chemical analysis are transferred directly from the bucket to the appropriate sample container. Nitric acid is added to the 500 mL container for selenium analysis.
Water for the laboratory study is collected 3 times during the 7-day testing period; on test days 0, 2, and 4. The first sample is used for test initiation and for test solution renewal on day 2. The second sample is used for test solution renewal on days 3 and 4. The third sample is used for test solution renewal on days 5, 6, and 7.

9.5 Species Selection

Test species include the larval fathead minnow, *Pimephales promelas* (less than 24 hours old), the cladoceran, *Daphnia magna* (10-day old) and the alga *Selenastrum capricornutum* (4-7 days old). The day to day species were selected for their sensitivity to selenium, diazinon and chlorpyrifos and their tolerance to usual water quality of the study area. Fathead minnows are sensitive to selenium; *Daphnia magna* is sensitive to pesticides.

9.6 Laboratory Techniques

Laboratory techniques selected for toxicity testing include USEPA methods using the short term chronic bioassay protocol. These methods are generally used to evaluate the toxicity of an effluent to receiving water. Specific methods for culturing and conducting toxicity tests using fathead minnows and *Selenastrum* may be found in (EPA 600/4-91-022). All tests have chronic end points, either growth or reproduction. In addition, fathead minnows and *Daphnia* are scored for survival (acute end point). All testing is conducted at the screening level, comparing the control against 100 percent test water.

Culturing and testing protocols for *Daphnia* will follow those found in "Short-Term Chronic Toxicity Test Using *Daphnia magna@* (EPA 600-D87-080). This test exposes ten-day-old females to the effluent for seven days. Three broods are expected during this period.

9.7 Chemical Analysis

Water quality and chemical analysis are performed on each water sample collected. Analyses include pH, electrical conductivity, dissolved oxygen, alkalinity, hardness (as calcium carbonate), and selenium. Selenium is analyzed by laboratories contracted by USBR.

Section 10.0 Sediment Monitoring (Quality)

10.1 Purpose

Sediment monitoring for the Grassland Bypass Project focuses on measuring selenium and organic carbon in the San Luis Drain (SLD), Mud Slough, and Salt Slough. The purpose of the monitoring is to assess the selenium concentrations in the sediment samples. The measurements within the SLD provide selenium concentration estimates for comparison with California Department of Health Services= hazardous waste criterion. The measurements in Mud and Salt Sloughs provide selenium concentrations for comparison with USFWS thresholds for ecological risk. Tables 6 and 7 summarize the sediment monitoring plan in the sloughs and the SLD.

10.2 Sampling Locations

Station C	Mud Slough (North), upstream of SLD discharge
Station D	Mud Slough (North), downstream of SLD discharge
Station E	Mud Slough (North), about 3 miles downstream of SLD discharge
Station F	Salt Slough in the San Luis NWR
Station I2	Mud Slough (North), about 1 mile downstream of SLD discharge

Sediment is measured at five locations in the San Luis Drain: Stations A and B, within Checks 17 and 18, within Checks 14 and 15, within Checks 10 and 11, and within Checks 1 and 2.

10.3 Frequency of Sampling

The monitoring will correspond with the biological monitoring schedule at Station F (within Salt Slough), Stations C, D, E, and I2 (within Mud Slough). Annual measurements are made for all locations in the SLD.

10.4 Field Sampling Techniques

Sediment samples are collected using an acrylic coring device (42 cm diameter, 38 cm internal length). After collecting the sediment, sections of the core, 0-3 cm and 3-8 cm, are slowly extruded using a non-metallic internal pushing device and placed in distinct quart size mixing bowls. An additional sample is collected near the same spot for the whole-core sample and placed into a third mixing bowl. The process is continued until three samples along a transect are completed. Material from the 2nd and 3rd samples are placed in the corresponding 0-3 cm, 3-8 cm and whole-core mixing bowls containing the 1st samples. Each of the mixing bowls contain material from the transect. The 0-3 cm, 3-8 cm, and whole core samples are then mixed well in their mixing bowls in a manner similar to kneading bread. The mixing objective is to get one homogeneous sample in each of the bowls. Composited samples are then placed in a wide-mouth polyethylene container and stored in an ice chest at 4°C.

10.5 Chemical Analysis

Laboratory analysis will include total selenium concentrations (wet weight), total organic carbon, and per cent moisture. Analysis is performed on all three levels of samples, 0-3 centimeters, 3-8 centimeters, and whole core.

Section 11.0 Sediment Quantity Monitoring in the San Luis Drain

11.1 Purpose

The purpose of this aspect of the Grassland Bypass Monitoring Program is to determine the changes in quantity and movement of sediment in the San Luis Drain (SLD). This is accomplished by conducting an annual survey measuring the sediment and using total suspended solids measurements at the inlet and outlet of the SLD to determine sediment volumes. Table 8 compares the new sediment quantity monitoring plan.

11.2 Sampling Locations

Four reaches of the SLD, 1, 10, 14, and 17 are measured for volume estimates. The sediment is not uniformly deposited along the length of the SLD. In general, sediment tends to build up near the check structures. To obtain an accurate determination of sediment deposition, it is necessary to take additional readings near these structures. Sediment thickness measurements are taken at the locations that were used in the Summers Engineering survey (March 1987). The distances from the structures and locations at which measurements were taken are documented, and the sites can reliably be re-sampled.

11.3 Frequency of Sampling

The sediment volume survey is done annually.

11.4 Field Sampling Techniques

Cross-sections of the SLD from Check 19 to the terminus are used for volume estimates. There will be water flowing in the SLD during the sediment surveys. In order to obtain an accurate thickness measurement, it is proposed that, at any given location, a measurement be taken along the length of the slope of the lining from the top of the lining to the water surface on each side of the drain, and then, a probe be used to take the measurement from the water surface to the sediment at the intersection of the sediment and the canal lining on each side of the SLD. This cross-sectioning method should help account for variations in the sediment thickness across the width of the SLD. The thickness of sediment is measured and determined arithmetically.

11.5 Volume Estimation

a. Water Level Calculations

The level of the water is determined by measuring along the lining above the water level on the left (X_{lt}) and right bank (X_{rt}) of the SLD. The actual water level (h) is determined by subtracting the average of the X_{lt} and X_{rt} (X_{avg}) from the total length of lining (X1) and converting it into a vertical distance, $h = 0.55 * (X1 - X_{avg})$.

b. Depth of Sediment

The depth of sediment (d) is determined by taking the average of the difference between the two readings (y_1 and y_2) obtained from the sediment probe and the water level (h), $d = h - y_{avg}$.

c. Cross-Sectional Area of Sediment

The cross-sectional area of the sediment is determined by assuming that the upper surface of the sediment is flat and that it occupies a trapezoidal area. The formula for finding the area of sediment is as follows:
Area = 2 * (8 + (8 + 2 * d * 1.5)) * d.

d. Volume of Sediment

The volume of sediment in the SLD is calculated by averaging the cross sectional area between readings and multiplying by the length. The formula for the sediment volume is as follows:

Volume = (Average Area) * Length * 0.037,

where length is the distance between probe readings and 0.037 is the factor by which cubic feet are converted to cubic yards.

Section 12.0 References

12.1 Technical Documents

California Regional Water Quality Control Board, Central Valley Region. *Water Quality of the Lower San Joaquin River: Lander Ave to Vernalis*. Individual Annual Reports, Water-years 1985 through 1999. CVRWQCB, Sacramento, CA.

California Regional Water Quality Control Board, Central Valley Region. *Agricultural Drainage Contribution to Water Quality in the Grassland Watershed of Western Merced County, California.* Individual Annual Reports, Water-years 1985 through 1999. CVRWQCB, Sacramento, CA.

SFEI. Grassland Bypass Project, Monthly Report. Individual Reports. Water-years 1997, 1998, 1999, 2000. San Francisco Estuary Project, Richmond, CA.

SFEI. Grassland Bypass Project, Quarterly Data Report. Individual Reports. Water-years 1997, 1998, 1999, 2000. San Francisco Estuary Project, Richmond, CA.

SFEI. Grassland Bypass Project, Quarterly Narrative and Graphical and Report. Individual Reports. Water-years 1997, 1998, 1999, 2000. San Francisco Estuary Project, Richmond, CA.

SFEI. Grassland Bypass Project, Annual Report. Individual Reports, Water-year 1997, 1998, 1999, 2000. San Francisco Estuary Project, Richmond, CA.

U. S. Department of Interior. *A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley*. Final Report of the San Joaquin Valley Drainage Program. September 1990. Sacramento, CA.

U. S. Geological Survey. *Surface-Water Quality Assurance Plan for the California District of the U. S. Geological Survey*, Open-File Report 96-618. 1996. Sacramento, CA.

12.2 Administrative Documents

California Regional Water Quality Control Board, Central Valley Region. September 7, 2001. Waste Discharge Requirements for San Luis & Delta-Mendota Water Authority and United States Department of the Interior Bureau of Reclamation Grassland Bypass Channel Project (Phase II) - Fresno and Merced Counties. Sacramento, CA.

U.S. Bureau of Reclamation and San Luis & Delta-Mendota Water Authority, November 1995. Agreement for the Use of the San Luis Drain. Sacramento, CA.

U.S. Bureau of Reclamation and San Luis & Delta-Mendota Water Authority. May 25, 2001. Grassland Bypass Project Final Environmental Impact Statement/Environmental Impact Report. Volume 1, Main Text, Appendices A & I; Volume 2 - Technical Appendices. Sacramento, CA.

U.S. Bureau of Reclamation and San Luis & Delta-Mendota Water Authority, September 2001. Agreement for the Use of the San Luis Drain. Sacramento, CA.

U.S. Bureau of Reclamation. September 1996. Compliance Monitoring Program for Use and Operation of the Grassland Bypass Project. Sacramento, CA.

U.S. Bureau of Reclamation. September 2001. Record of Decision - Grassland Bypass Project. Sacramento, CA.

U.S. Bureau of Reclamation, et. al. September 2001. Quality Assurance Project Plan for the Monitoring Plan of the

Grassland Bypass Project (Phase II). Sacramento, CA.

Table 1: Monitoring Stations, Parameters, and Frequencies

Station / Site / Location		Water 1/							2/	2/				
		Flow	**Temp**	**pH**	**EC**	**TSS**	**Se**	**B**	**Nutrients**	**Mo**	**Sediment Quality**	**Sediment Quantity**	**Biota**	**Chronic Toxicity**
San Luis Drain	A	C	C		C	W	W	W			A	A		
	B	**C**	C / **W**	**W**	C / **W**	**W**	**D**	**D / W**	**W / M**	**W / M**	A	A		M / **Q**
	checks 1-2										A	A		
	checks 10-11										A	A		
	checks 14-15										A	A		
	checks 17-18										A	A		
Mud Slough	C		**W**	**W**	**W**		**W**	**W**	**W / M**	**W / M**	Q		Q	M / **Q**
	D	**C**	**C**	**W**	**C**		**W**	**W**	**W / M**	**W / M**	Q		Q	M / **Q**
	E										Q		Q	
	I2		W	W	W		W	W			Q		Q	
Salt Slough	F	C	C	W	C		W	W			Q		Q	**3/**
Wetland Channels	J	D	W	W	W		W	W						
	K	D	W	W	W		W	W						
	L2	D	W	W	W		W	W						
	M2	D	W	W	W		W	W						
San Joaquin River	G	**C**	**C / W**	**W**	**C**		**W**	**W**	**W / M**	**W / M**			Q	
	H		W	W	W		W	W					Q	
	N	**C**	**C / W**	**W**	**C**		**D**	**W**	**W / M**	**W / M**				

Key
C = Continuous
D = Daily
W = Weekly
Q = Quarterly
A = Annually
M = Monthly

Letters in Bold indicate a requirement within the WDR

1/ See Table 3, notes 1, 2 and 3
2/ Weekly sampling, March through August
Monthly sampling, September through February
3/ see Table 5, Station F

Table 2: Flow Monitoring Specifications

Station	Station Description	WDR	Sampling Frequencies and Parameters
A	San Luis Drain @ Check 17		Continuous (15 minute) recorder, Stage, SLDMWA
B	San Luis Drain between Check 1 and terminus	**Y**	Continuous (15 minute) recorder, Stage, USGS
C	Mud Slough (North), upstream of SLD terminus		Flow derived from daily data from Stations B and D
D	Mud Slough (North), downstream of SLD terminus	**Y**	Continuous (15 minute) recorder, Stage, USGS
F	Salt Slough @ HWY 165		Continuous (15 minute) recorder, Stage, USGS
G	San Joaquin River @ Fremont Ford	**Y**	Continuous (15 minute) recorder, Stage, USGS
J	Camp 13 Ditch, north of Main Canal		Daily stage, Grassland Water District
K	Agatha Canal		Daily stage, Grassland Water District
L2	San Luis Canal at the splits		Daily stage, Grassland Water District
M2	Santa Fe Canal at the weir		Daily stage, Grassland Water District
N	San Joaquin River @ Crows Landing	**Y**	Continuous (15 minute) recorder, Stage, USGS

Table 3: Water Quality Monitoring Specifications

Station	Station Description	WDR	Sampling Frequencies and Parameters
A	San Luis Drain @ Check 17		Continuous (15 minute) recorder, EC, Temperature, SLDMWA Weekly, EC, Selenium, Boron, Total Suspended Solids, SLDMWA
B	San Luis Drain between Check 1 and terminus	 **Y** **Y** **Y**	Continuous (15 minute) recorder, EC, Temperature, USGS Daily, EC, Selenium, Boron, CVRWQCB Weekly, pH, EC, Temperature, Selenium, Boron, Total Suspended Solids, CVRWQCB Monthly, Molybdenum, Nutrient Series, CVRWQCB, Notes 1, 2
C	Mud Slough (North), upstream of SLD terminus	**Y** **Y**	Weekly, pH, EC, Temperature, Selenium, Boron, CVRWQCB Monthly, Molybdenum, Nutrient Series, CVRWQCB, Notes 1, 2 , 3
D	Mud Slough (North), downstream of SLD terminus	 **Y** **Y**	Continuous (15 minute) recorder, EC, Temperature, USGS Weekly, pH, EC, Temperature, Selenium, Boron, CVRWQCB Monthly, Molybdenum, Nutrient Series, CVRWQCB, Notes 1, 2, 3
I2	Mud Slough (North), backwater		Weekly, EC, Selenium, Boron, USBR
F	Salt Slough @ HWY 165		Continuous (15 minute) recorder, Temperature, EC, USGS Weekly, Temperature, pH, EC, Selenium, Boron, CVRWQCB
J	Camp 13 Ditch, north of Main Canal		Weekly, EC, Selenium, Boron, SLDMWA
K	Agatha Canal		Weekly, EC, Selenium, Boron, SLDMWA
L2	San Luis Canal at the splits		Weekly, EC, Selenium, Boron, SLDMWA
M2	Santa Fe Canal at the weir		Weekly, EC, Selenium, Boron, SLDMWA
N	San Joaquin River @ Crows Landing	 **Y** **Y**	Continuous (15 minute) recorder, EC, Temperature, USGS Weekly, pH, EC, Temperature, Selenium, Boron, CVRWQCB Monthly, Molybdenum, Nutrient Series, CVRWQCB, Notes 1, 2
G	San Joaquin River @ Fremont Ford	 **Y** **Y**	Continuous (15 minute) recorder, EC, Temperature, USGS Weekly, pH, EC, Temperature, Selenium, Boron, CVRWQCB Monthly, Molybdenum, Nutrient Series, CVRWQCB, Notes 1, 2
H	San Joaquin River @ Hills Ferry		Weekly, EC, Selenium, Boron, SLDMWA

Note 1: Parameters included in the Nutrient Series are Nitrate, Ammonia, Total Kjeldahl Nitrogen, Total Phosphate, and Ortho Phosphate (required by the Waste Discharge Permit).
Note 2: Nutrient Series sampling increases to every other week during irrigation season (March through August) (required by the Waste Discharge Permit).
Note 3: During sampling of the receiving waters, a log shall be kept of the receiving water conditions throughout reach bounded by Stations C and D;

attention shall be given to the presence or absence of: a. floating or suspended matter, b. discoloration, c. bottom deposits, and d. aquatic life (required by the Waste Discharge Permit).

Table 4: Biological Monitoring Specifications

Station	Station Description	WDR	Sampling Frequencies and Parameters
C	Mud Slough (North), upstream of SLD terminus		Seasonal (March, June, August, November), selenium concentrations in tissues, diversity, USFWS
D	Mud Slough (North), downstream of SLD terminus		Seasonal (March, June, August, November), selenium concentrations in tissues, diversity, USFWS
E	Mud Slough (North) @ HWY 140		Seasonal (March, June, August, November), selenium concentrations in tissues, diversity, CDFG
I2	Mud Slough (North), backwater area		Seasonal (March, June, August, November), selenium concentrations in tissues, diversity, USFWS See Note 1.
F	Salt Slough @ HWY 165		Seasonal (March, June, August, November), selenium concentrations in tissues, diversity, USFWS
G	San Joaquin River @ Fremont Ford		Seasonal (March, June, August, November), selenium concentrations in tissues, diversity, CDFG
H	San Joaquin River @ Hills Ferry		Seasonal (March, June, August, November), selenium concentrations in tissues, diversity, CDFG

Note 1. Station I has been relocated to represent a better backwater condition and renamed to I2, and is monitored quarterly.

Table 5: Toxicity Monitoring Specifications

Station	Station Description	WDR	Sampling Frequencies and Parameters
B	San Luis Drain between Check 1 and terminus	**Y 1/**	Monthly, larval survival and growth for fathead minnows, larval survival and reproduction for *Daphnia magna*, and *Selenastrum capricornutum*, BES; water quality in sampled waters, selenium concentrations, USBR, and total suspended solids, BES
C	Mud Slough (North), upstream of SLD terminus	**Y 1/**	Same as Station B
D	Mud Slough (North), downstream of SLD terminus	**Y 1/**	Same as Station B
F	Salt Slough @ HWY 165	**Y 2/**	When sampled, same as Station B
DMC	Delta Mendota Canal	**Y 1/**	Same as Station B

1/ WDR requires quarterly monitoring 2/ WDR requires this site for flood event only

Table 6: Sediment Monitoring Specifications (Quality, in association with biological monitoring)

Station	Station Description	WDR	Sampling Frequencies and Parameters
C	Mud Slough (North), upstream of SLD terminus		Seasonal (March, June, August, November), Selenium, Total Organic Carbon, Per Cent Moisture, 0-3 cm, 3-8 cm, whole core, USBR
D	Mud Slough (North), downstream of SLD terminus		Seasonal (March, June, August, November), Selenium, Total Organic Carbon, Per Cent Moisture, 0-3 cm, 3-8 cm, whole core, USBR
E	Mud Slough (North) @ HWY 140		Seasonal (March, June, August, November), Selenium, Total Organic Carbon, Per Cent Moisture, 0-3 cm, 3-8 cm, whole core, USBR
I2	Mud Slough (North), backwater area		Seasonal (March, June, August, November), Selenium, Total Organic Carbon, Per Cent Moisture, 0-3 cm, 3-8 cm, whole core, USBR.
F	Salt Slough @ HWY 165		Seasonal (March, June, August, November), Selenium, Total Organic Carbon, Per Cent Moisture, 0-3 cm, 3-8 cm, whole core, USBR

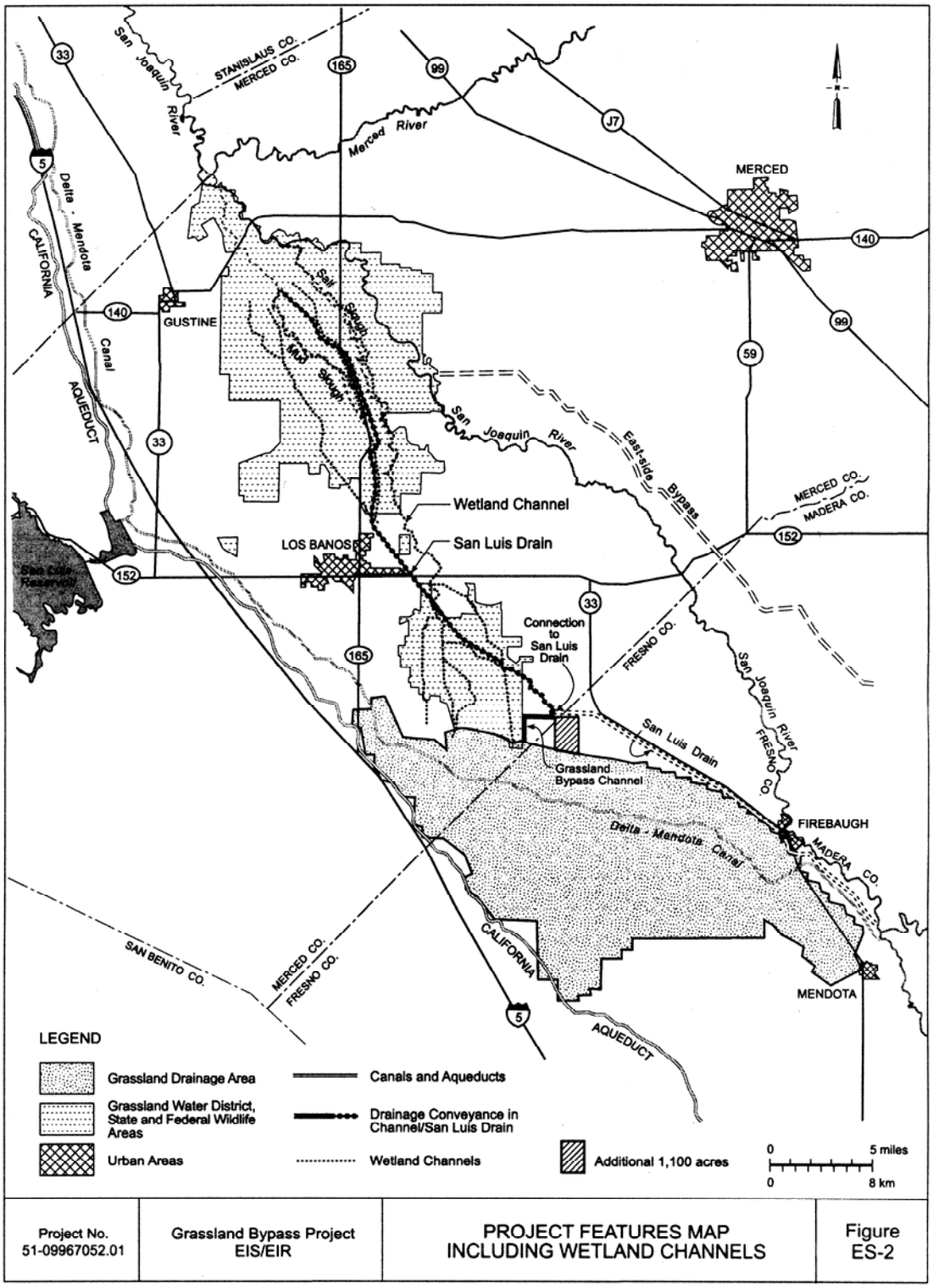
Table 7: San Luis Drain Sediment Monitoring Specifications (Quality)

Station	Station Description	WDR	Sampling Frequencies and Parameters
B	San Luis Drain between Check 1 and terminus		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	50' south of Check 1		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	Midpoint of Checks 1 & 2		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	50' north of Check 2		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	50' south of Check 10		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	Midpoint of Checks 10 & 11		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	50' north of Check 11		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	50' south of Check 14		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	Midpoint of Checks 14 & 15		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	50' north of Check 15		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
A	San Luis Drain @ Check 17		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	Midpoint of Checks 17 & 18		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR
	50' north of Check 18		Annual, Selenium, Total Organic Carbon, Per Cent Moisture, whole core, USBR

Table 8: San Luis Drain Sediment Monitoring Specifications (Quantity)

Pool	Checks	WDR	Sampling Frequencies and Parameters
1	1 to 2		Annual, Sediment in Drain, SLDMWA
10	10 to 11		Annual, Sediment in Drain, SLDMWA
14	14 to 15		Annual, Sediment in Drain, SLDMWA
17	17 to 18		Annual, Sediment in Drain, SLDMWA

Figure 1. Map of the Grassland Bypass Project (from the Grassland Bypass Project EIS/EIR)



Project No. 51-09967052.01	Grassland Bypass Project EIS/EIR	PROJECT FEATURES MAP INCLUDING WETLAND CHANNELS	Figure ES-2

Figure 2. Schematic Diagram Showing Locations of GBP Monitoring Sites

Appendix A. Waste Discharge Requirements for Grassland Bypass Project (Phase II)