GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

October 1999 – December 1999

April 7, 2000

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

Report prepared by the San Francisco Estuary Institute

I. INTRODUCTION

The Grassland Bypass Project (GBP) intercepts agricultural subsurface drainage flows south of the Grassland Water District and conveys them through the northernmost 28 miles of the San Luis Drain to a discharge point in Mud Slough (North), a tributary of the San Joaquin River. The location of the Project and the Grassland Drainage Service Area are shown in Figure 1. A schematic of the GBP showing the hydrology of the Project and sampling locations is provided in Figure 2. The GBP has removed much of the agricultural subsurface drainage from wetland water supply channels in the Grassland Water District and from Salt Slough, but has increased quantities of agricultural subsurface drainage in the six miles of Mud Slough (North) that receive the re-routed water. The Grassland Bypass Project Compliance Monitoring Program (GBPCMP) has been in place since October 1996 and is designed to evaluate whether the terms and conditions of the Project are being met. Specific conditions for the Project include monthly and annual selenium load values from the San Luis Drain into Mud Slough (North), selenium load reductions over the long term, removal of subsurface agricultural drainage from the wetland water supply channels, the prevention of significant adverse environmental impacts, and the prevention of significant adverse effects on human health. Detailed background information on the GBP is documented in the "Finding of No Significant Impact and Supplemental Environmental Assessment (FONSI)" and the Interim Use Permit (USBR 1995). The comprehensive monitoring plan (USBR 1996) and the Quality Assurance Project Plan (Entrix 1997) contain detailed descriptions of the sampling and analytical methods employed in the GBPCMP.

The purpose of the Quarterly Narrative and Graphical Data Summary series is to provide an overview of the data collected in the most recent quarter of the GBP. Complete listings of the data are provided in Monthly Data Reports and Quarterly Data Reports (SFEI 1999). The data and detailed background information on the GBP are also available on the Internet at the following address:

http://www.mp.usbr.gov/mp150/grassland/HomePage/Homepage.html.

This report provides information on the project for the fourth year of the project in the quarter including October through December 1999.

II. FLOW MONITORING

Flow data in the GBP are measured to allow computation of selenium load discharge, to establish seasonal flow patterns, and to determine the influence of the discharge from the San Luis Drain on the hydrology of Mud Slough (North). According to the Interim Use Permit, discharge into Mud Slough (north) from the San Luis Drain may not exceed 150 cfs (USBR 1995).

Daily mean flow data for Sites A, B, D, F, and N are shown in Figure 3. Flows near the inlet to the San Luis Drain (Site A) averaged 19 cfs for the quarter. At the point of discharge of the San Luis Drain into Mud Slough (North) (Site B), flows averaged 27 cfs (Figure 3). Maximum flows for this quarter were 29 cfs on October 3-5 at Site A and 38 cfs on October 4-6 at Site B.

Of the two monitoring sites at Mud Slough (north) above and below the GBP discharge (sites C and D, respectively), flow is measured only at Site D. The average flow at Site D for the quarter was 155 cfs. A maximum flow of 237 cfs occurred at Site D on October 20. Discharge from the SLD (Site B) accounted for 17% of the average total flow in Mud Slough (north) (Site D). Flows in Salt Slough (Site F) averaged 141 cfs for the quarter. The highest flow in Salt Slough (245 cfs) occurred on November 11.

At Site N in the San Joaquin River, flows averaged 776 cfs this quarter. The maximum flow measured was 1180 cfs on October 21.

III. WATER QUALITY MONITORING

Water quality data in the GBP are collected to evaluate compliance with selenium load values given in the FONSI and the Interim Use Permit (USBR 1995), to evaluate compliance with the commitment to not discharge agricultural subsurface drainage to the wetland channels, and to evaluate potential adverse effects of the GBP discharge and of waters in Mud Slough (North) below the discharge on test organisms. Electrical conductivity, pH, boron, and selenium concentrations provided by the CVRWQCB are considered draft at time of preparation for this report.

Selenium

Daily Selenium Measurements

Selenium concentrations are measured daily at sites B and N using autosamplers (USBR 1996). Daily selenium load discharge is computed at Site B, and monthly totals are shown in Figure 4a. Monthly total selenium load discharges were below the selenium load values in each month of this quarter.

Selenium load from the GBP (discharge from the terminus of the Drain as measured at Site B) averaged 6.6 lbs/day for the quarter (Figure 4e). The maximum daily selenium load discharge (10.8 lbs/day) occurred on October 30. Flow at Site B averaged 27 cfs for the quarter with a minimum of 19 cfs on December 26 and a maximum of 38 cfs on October 4-6 (Figure 4c). Selenium concentrations at Site B varied between a minimum of 22.7 µg/L on October 15-16 and a maximum of 82.3 µg/L on December 24 (Figure 4d). The cumulative selenium load discharge for the quarter was 610 lbs. (Figure 4b). As this was the first quarter, 610 was also cumulative selenium load discharge for the sampling year to date.

Selenium concentrations at Site N (San Joaquin River at Crow's Landing) averaged 1.8 µg/L for the quarter (Figure 5a). The highest concentration for the quarter, 3.9 µg/L, was measured on December 28 (Figure 5b). The minimum concentration for the quarter, 0.6 µg/L, was measured on October 18 and 21. In months with complete sets of daily flow and selenium concentration data for both stations B and N (October and

December), calculated monthly loads at Site B (181 and 236 lbs, respectively) account for most of the calculated loads at Site N (196 and 246 lbs, respectively).

Weekly Selenium Measurements

Selenium concentrations are measured in weekly grab or composite samples collected at 12 sites. Concentrations in samples for the period beginning October 1999 are shown in Figures 6-8.

Average selenium concentrations near the inlet to the San Luis Drain (Site A) were higher than those near the point of discharge into Mud Slough (North) (Site B) (Figure 6). Site A averaged 67.6 µg/L as compared to 41.5 µg/L for Site B in this quarter.

Selenium concentrations in Mud Slough (North) upstream of the GBP discharge (Site C) averaged less than the detection limit of 0.4 µg/L, with a maximum measured concentration for the quarter of 0.6 µg/L on November 18 (Figure 6). Most of the samples were below the detection limit. Concentrations were much higher in Mud Slough (North) downstream of the GBP discharge (Site D) than upstream at Site C (note differences of scales in graphs). Concentrations at Site D averaged 7.4 µg/L, with a maximum of 13.5 µg/L on December 28.

Selenium concentrations in Salt Slough (Site F) and the wetland water supply channels (Sites J, K, L2, M2) frequently have reached or exceeded 2 µg/L in the past. An objective of the GBP is monthly mean selenium concentrations below 2 µg/L at these locations. In this period, measurements exceeded 2.2 µg/L only once at Site J (Figure 7). Consequently, no monthly mean concentrations exceeded the objective this quarter (Table 1).

In the San Joaquin River, weekly selenium samples were collected at sites upstream of the GBP discharge (Site G), downstream of the discharge but above the Merced River (Site H), and downstream of the Merced River (Site N) (Figure 8). Selenium concentrations at Site G were low, averaging 0.7 µg/L and ranging between 0.4-1.0 µg/L. Concentrations were somewhat higher at Site H, averaging 2.7 µg/L during October and ranging from 1.9-3.9 µg/L. Site H was previously believed to be upstream of influence from the Merced River, but seasonal inflows from the Merced have been found upstream of Site H, precluding meaningful interpretation of weekly data collected at this site. Sampling at this site has therefore been discontinued.

Specific conductance

Specific conductance is measured at 15 min intervals at sites B, D, F, and N, and in weekly grab samples at sites A, B, C, D, F, G, H, J, K, L, M, and N. These data are presented in Figures 9 and 10. Data for some sampling dates at various sites were not available at the time of preparation of this report.

IV. SEDIMENT MONITORING

Sediment quality is measured in the San Luis Drain and in Mud and Salt Sloughs to assess whether selenium concentrations in drain sediments are approaching the California Department of Health Services hazardous waste criterion (100 µg/g wet weight) and to provide information on the fate and transport of selenium within the Drain. Sites in Mud and Salt Sloughs are monitored to determine whether changes in sediment chemistry in these locations occur as a result of the GBP and to provide data that can be used in conjunction with biological data to assess accumulation or depletion of selenium in the aquatic food web.

Sediment selenium data were not yet available when this report was prepared.

V. BIOLOGICAL MONITORING

Biological monitoring is conducted throughout the GBP area on a quarterly basis (USBR 1996). Tissue sampling in the GBPCMP is performed to assess the potential for adverse impacts to fish and wildlife and to assess public health risks. Food web organisms (aquatic plants, invertebrates, and fish) are analyzed for selenium residues to assess impacts to fish and wildlife. Muscle fillets from gamefish are analyzed for selenium to assess human health risks. These data will be presented and discussed in the GBP Annual Report for this water year (October 1999 - September 2000).

VI. TOXICITY TESTING

The purpose of the GBP toxicity testing program is to evaluate the potential adverse effects of the GBP discharge and of waters in Mud Slough (North) below the discharge on test organisms. Monthly toxicity tests are conducted in the laboratory using water collected from sites B, C, D, and F. Test results from these sites are compared to results obtained using water from the Delta-Mendota Canal. Monthly toxicity tests include: the 7-day chronic fathead minnow (*Pimephales promelas*) larvae survival and growth test; the 7-day chronic water flea (*Daphnia magna*) survival and reproduction test; and the 4-day chronic algal (*Selenastrum capricornutum*) growth test. A 7-day *in situ* survival test using 4-day-old fathead minnow larvae is conducted at sites B, D, F, and a reference Site (Windmill) on a quarterly basis.

Some toxicity for water from Site B was observed for the algal growth test in November and December 1999 (Figure 11). Table 2 shows results from definitive tests on *S. capricornutum* for water from those months.

Water from Site C produced both chronic and acute toxic effects on fathead minnow in November and December (Figure 12). Acute toxicity was also seen in fathead minnow for water from Site D in both November and December, but chronic effects were found only in November (Figure 13). Site F showed acute effects in all three months, but chronic effects only occurred in November and December samples (Figure 14).

REFERENCES

Entrix, Inc. 1997. Final Draft Quality Assurance Plan for the Compliance Monitoring Program for the Use and Operation of the Grassland Bypass Project. Prepared for the U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

SFEI. 1999. Monthly and Quarterly Data Reports for the Grassland Bypass Project. Available from SFEI or on the Internet at http://www.sfei.org/grassland/reports/gbppdfs.htm.

USBR. 1995. Finding of No Significant Impact and Supplemental Environmental Assessment, Grassland Bypass Channel Project, Interim Use of a Portion of the San Luis Drain for Conveyance of Drainage Water through the Grassland Water District and Adjacent Grassland Areas. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

USBR. 1996. Compliance Monitoring Program for Use and Operation of the Grassland Bypass Project. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

Table 1. Monthly mean selenium concentrations (in µg/L) from weekly samples collected at Salt Slough (Site F) and the wetland water supply channels (Sites J, K, L2, M2) for water year 2000.

	F	J	K	L2	M2
October 1999	0.7	1.0	0.9	0.9	1.0
November 1999	0.8	1.5	1.3	1.5	0.8
December 1999	0.8	0.9	0.7	1.0	0.9

Table 2. Results from definitive toxicity tests on algal (Selenastrum capricornutum) growth for water from Site B in November and December 1999.

Definitive Site B Response versus Ambient Water - November 1999

Growth

Sample ID	96 hour Growth	
(% Site B diluted w/Ambient)	Count (105 cells/ml)	Variance (%)
Ambient	14.3	6.1
6.25	13.4	19.8
12.5	13.7	11.8
25	12.9	10
50	13.4	5.6
100	9.9	6.1

Statistical Analysis

End Point	IC 50	IC 25	NOEC	LOEC	Toxic Units
Growth	>100	87.5	50	100	2

Definitive Site B Response versus Ambient Water - December 1999

Growth

Sample ID	96 hour Growth	
(% Site B diluted w/Ambient)	Count (105 cells/ml)	Variance (%)
Ambient	18.8	12.5
6.25	14.6	7.7
12.5	16.8	21.8
25	15.8	8.7
50	14.3	22.8
100	12.0	6.3

Statistical Analysis

End Point	IC 50	IC 25	NOEC	LOEC	Toxic Units
Growth	>100	54.4	<6.25	6.25	>16

Figure 1. Map of the Grassland Bypass Project. Locations of sites D, F, G, H, and N are indicated.

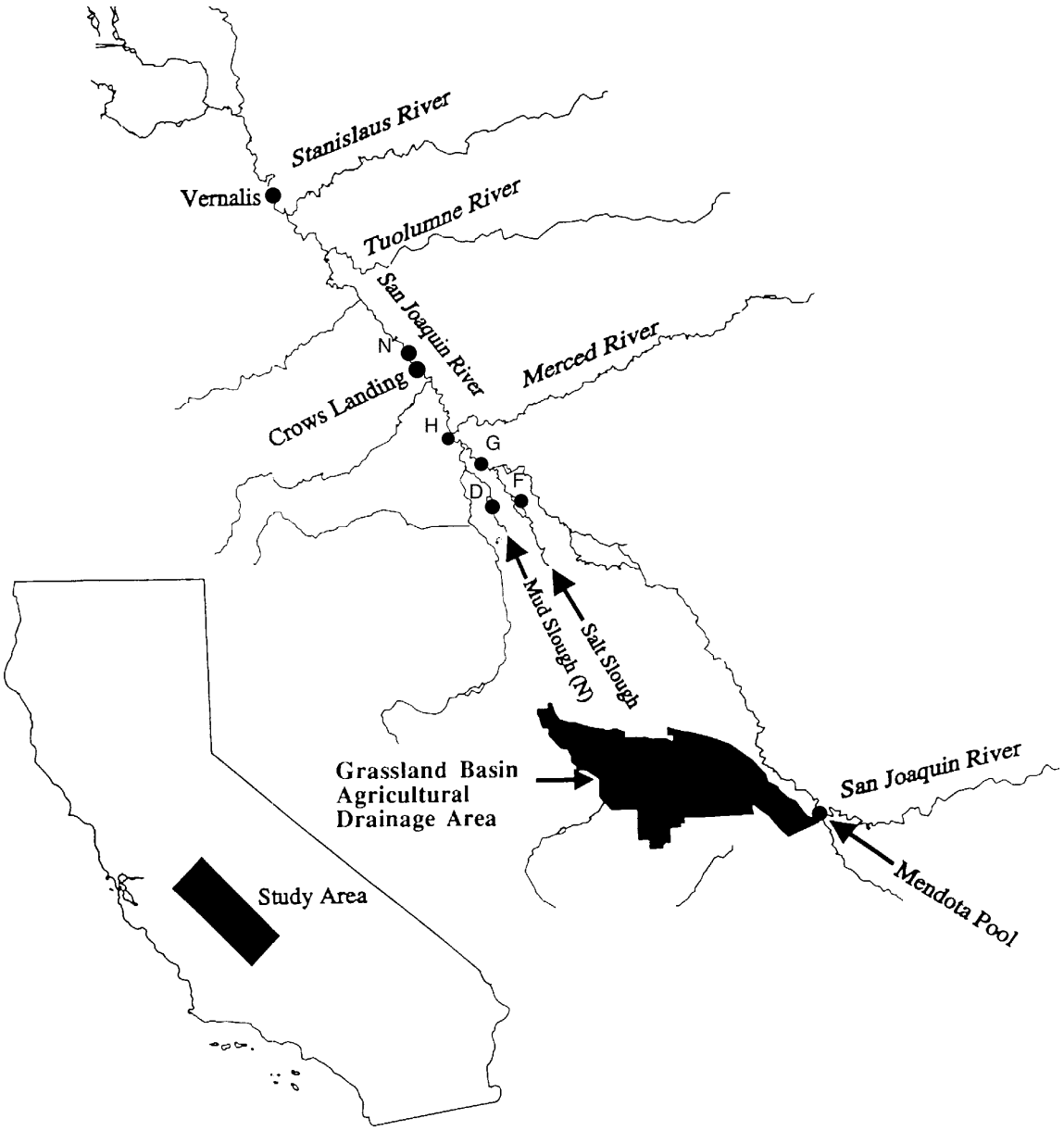


Figure 2. Schematic diagram showing locations of GBP monitoring sites relative to major hydrologic features of the study area.

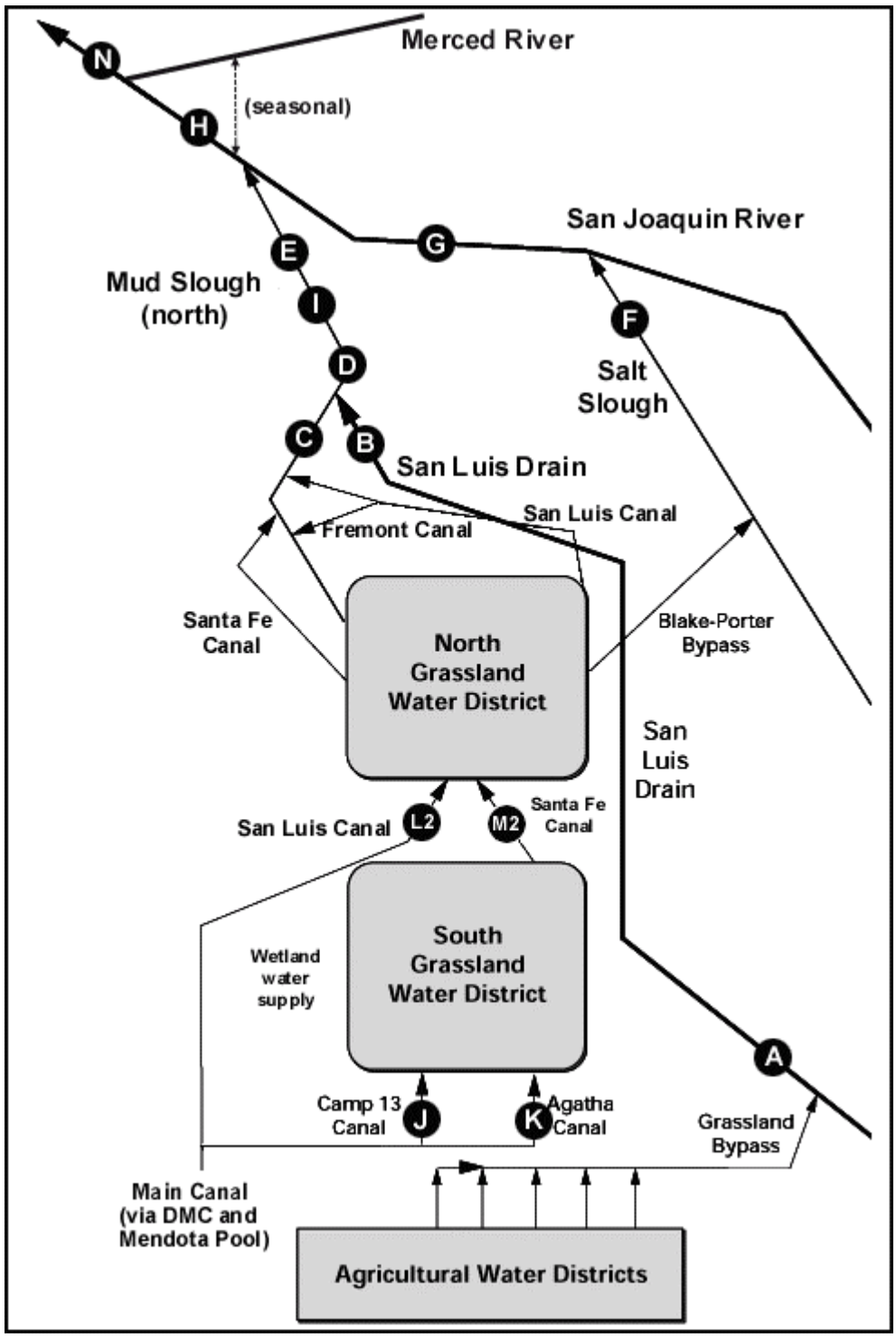


Figure 3. Daily mean flows (cfs) at GBPCMP sites. Flow at Site A is recorded as a daily mean. Flows at sites B, D, F, and N are recorded at 15 min intervals. Note different scales of vertical axis.

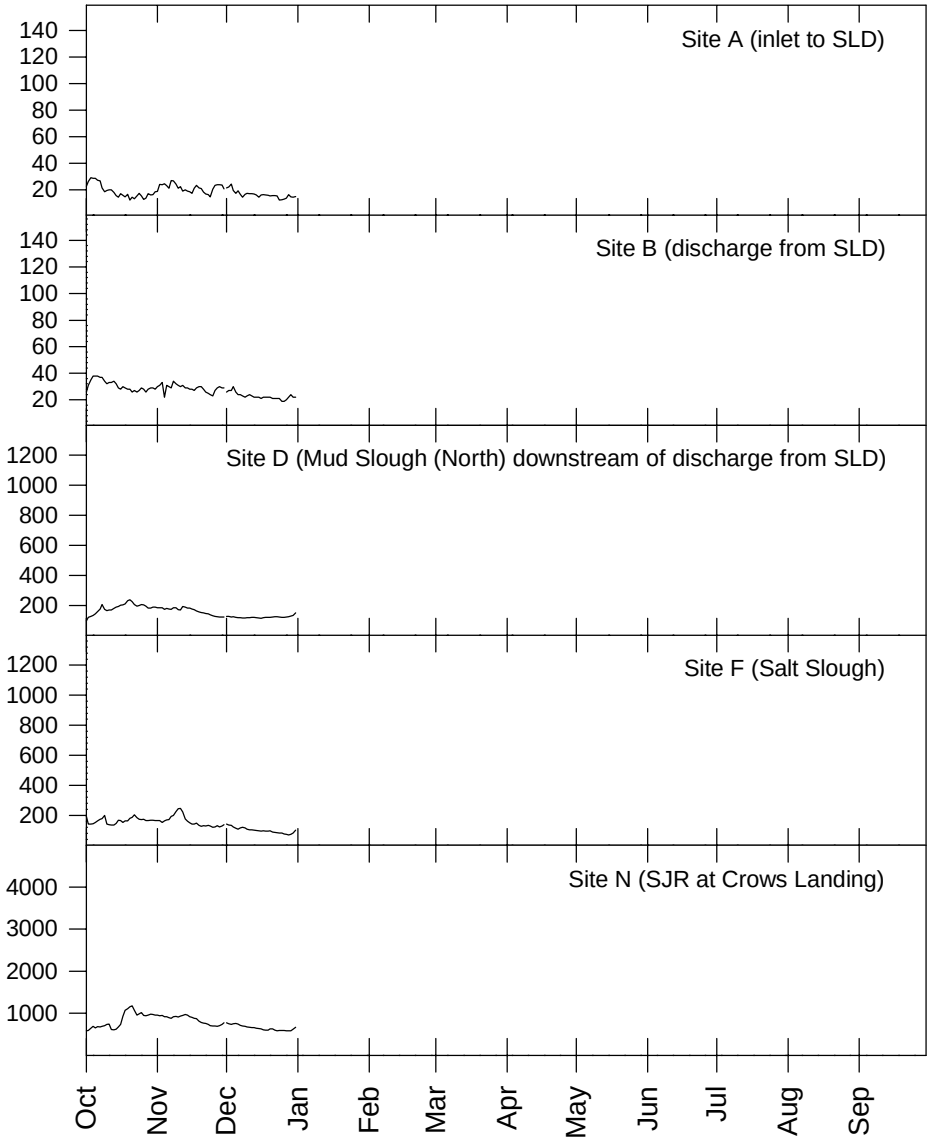
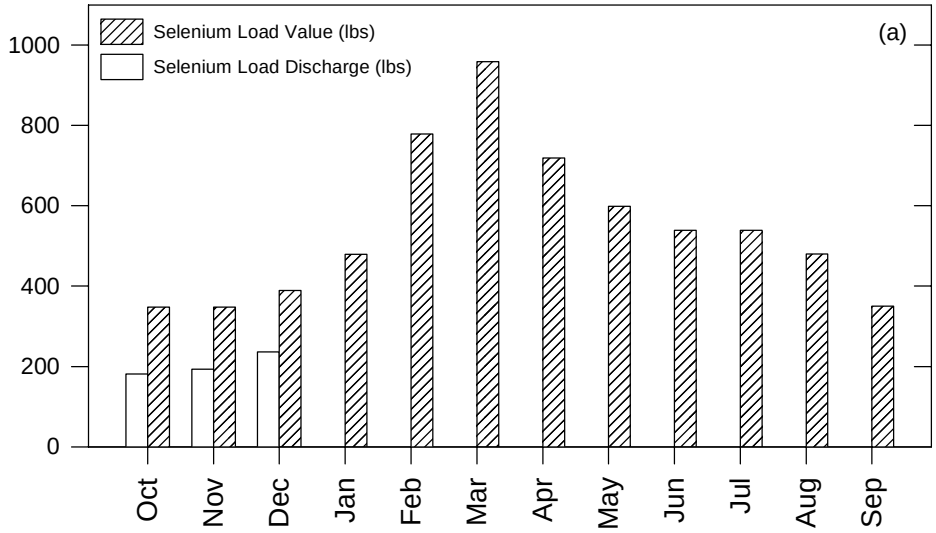


Figure 4a. Comparison of monthly selenium load discharge from the terminus of the San Luis Drain (Site B) with the monthly load values in the Interim Use Permit for the 4th year of the project (USBR 1995).



Water Year 2000	Load value (lbs)	Selenium load discharge (lbs)	Amount over load value (lbs)
Oct 1999	348	181	NA
Nov 1999	348	193	NA
Dec 1999	389	236	NA

NA: not applicable (load discharge was less than load value)

Figures 4b-e. Selenium concentrations and selenium load discharge at Site B (discharge from SLD): b) comparison of cumulative load discharge and load values; c) daily average flows; d) daily average selenium concentrations; and e) calculated daily average load discharge.

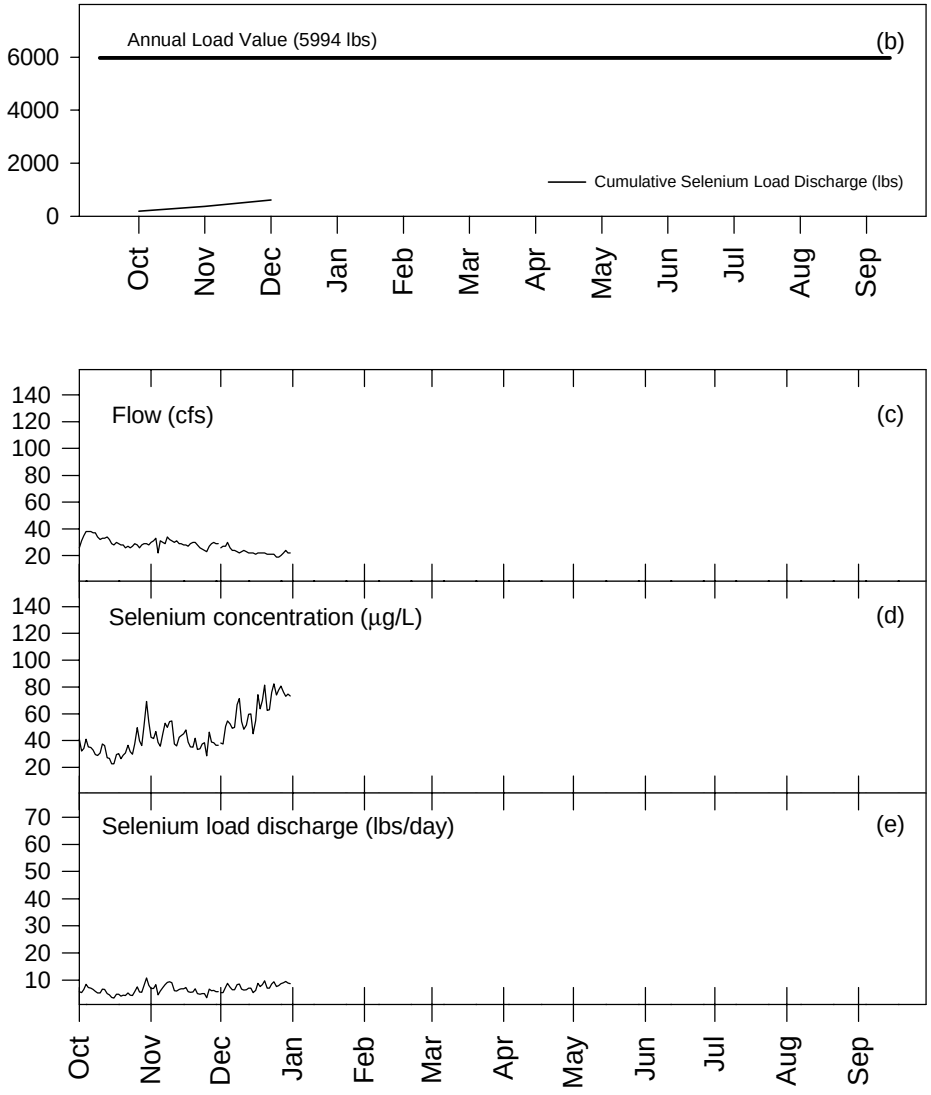


Figure 5. Daily average flows and selenium concentrations at Site N (San Joaquin River at Crow's Landing).

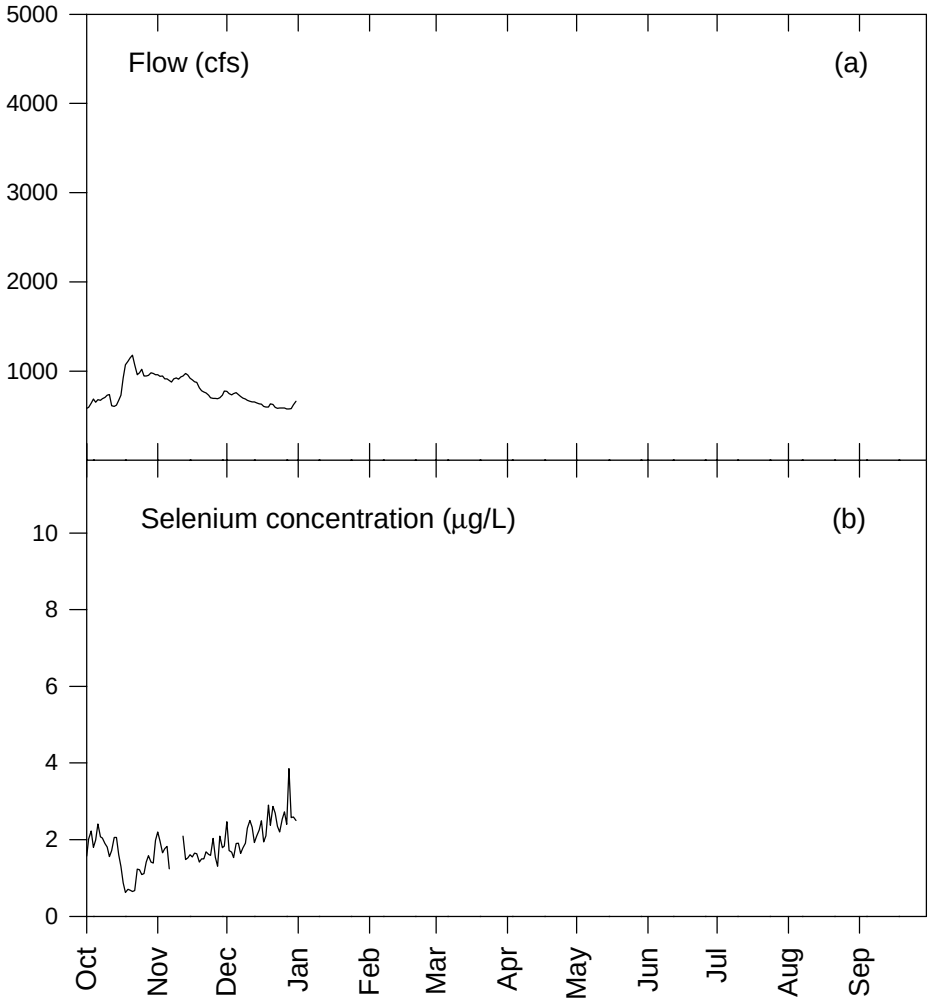


Figure 6. Selenium concentrations (µg/L) at Site A (near the inlet to the San Luis Drain), Site B (discharge from the San Luis Drain), Site C (Mud Slough (North) upstream of the GBP discharge), and Site D (Mud Slough (North) downstream of the GBP discharge). Data from weekly grab samples.

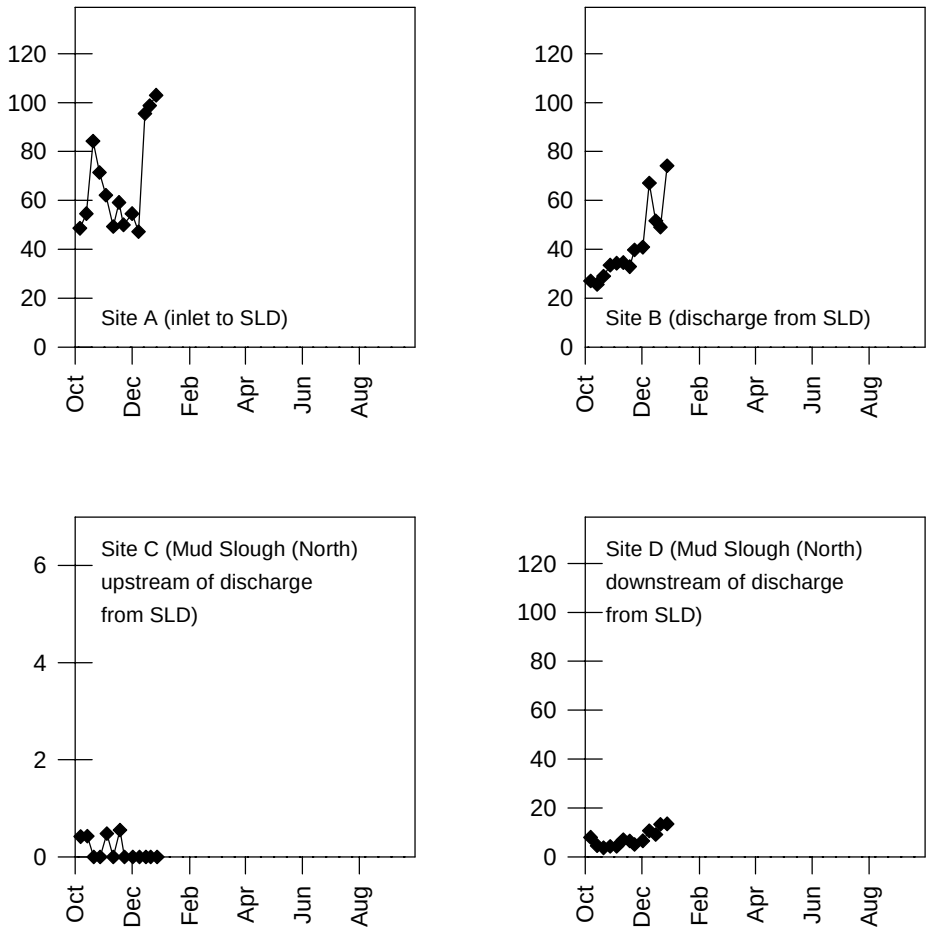


Figure 7. Selenium concentrations (µg/L) at Site F (Salt Slough) and in the wetland water supply channels at Site J, Site K, Site L2, and Site M2. Data from weekly grab samples.

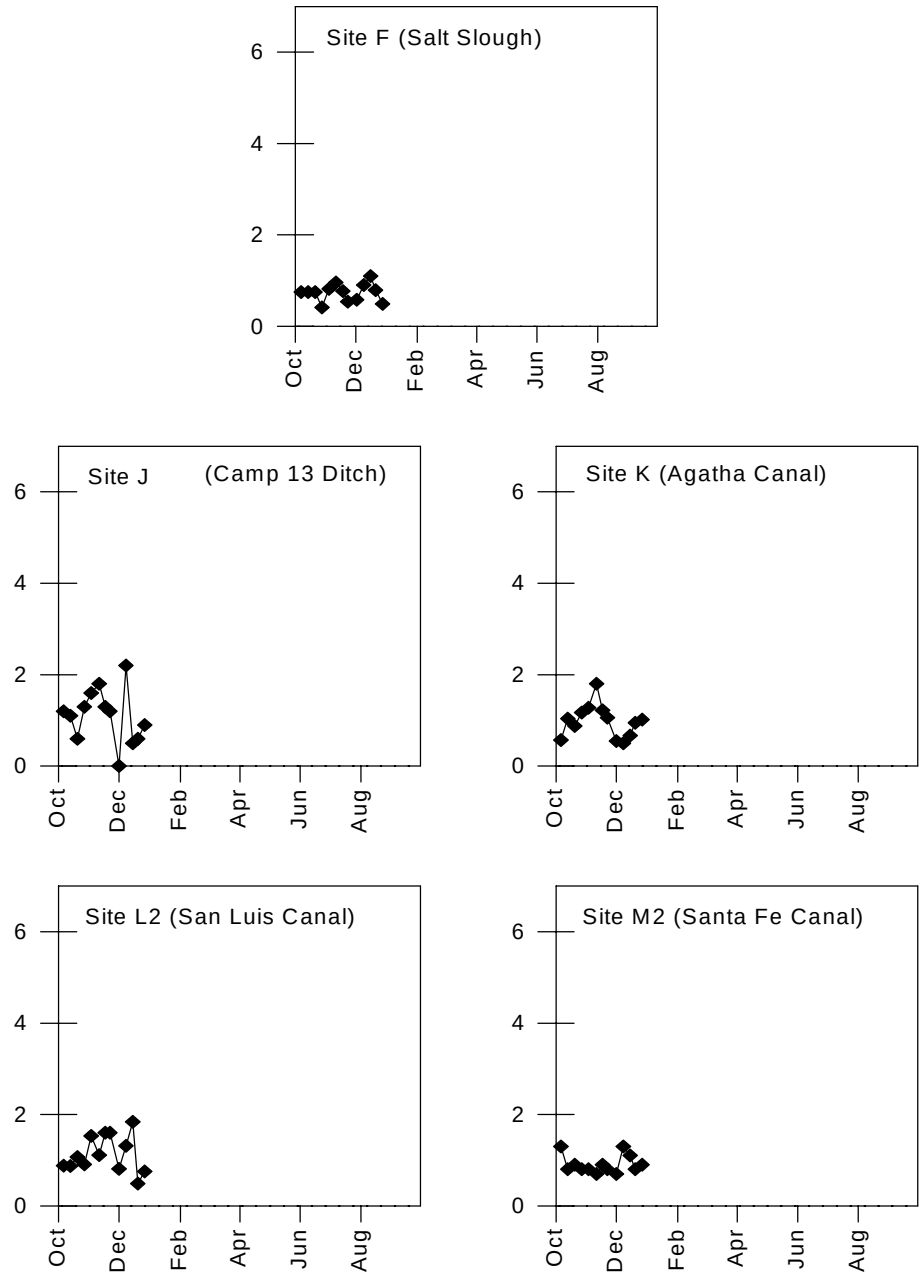


Figure 8. Selenium concentrations (µg/L) at San Joaquin River sites G (San Joaquin River upstream of Mud Slough (North) confluence), H (San Joaquin River downstream of Mud Slough (North) confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly grab samples.

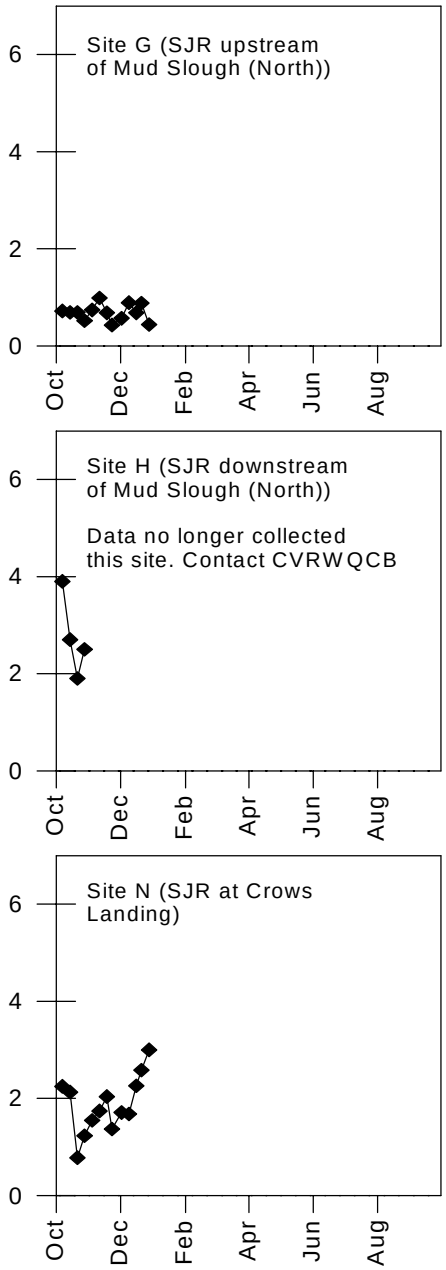


Figure 9. Daily average specific conductance (µS/cm) derived from measurements at 15 min intervals at sites B (discharge from the SLD), D (Mud Slough (North) downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

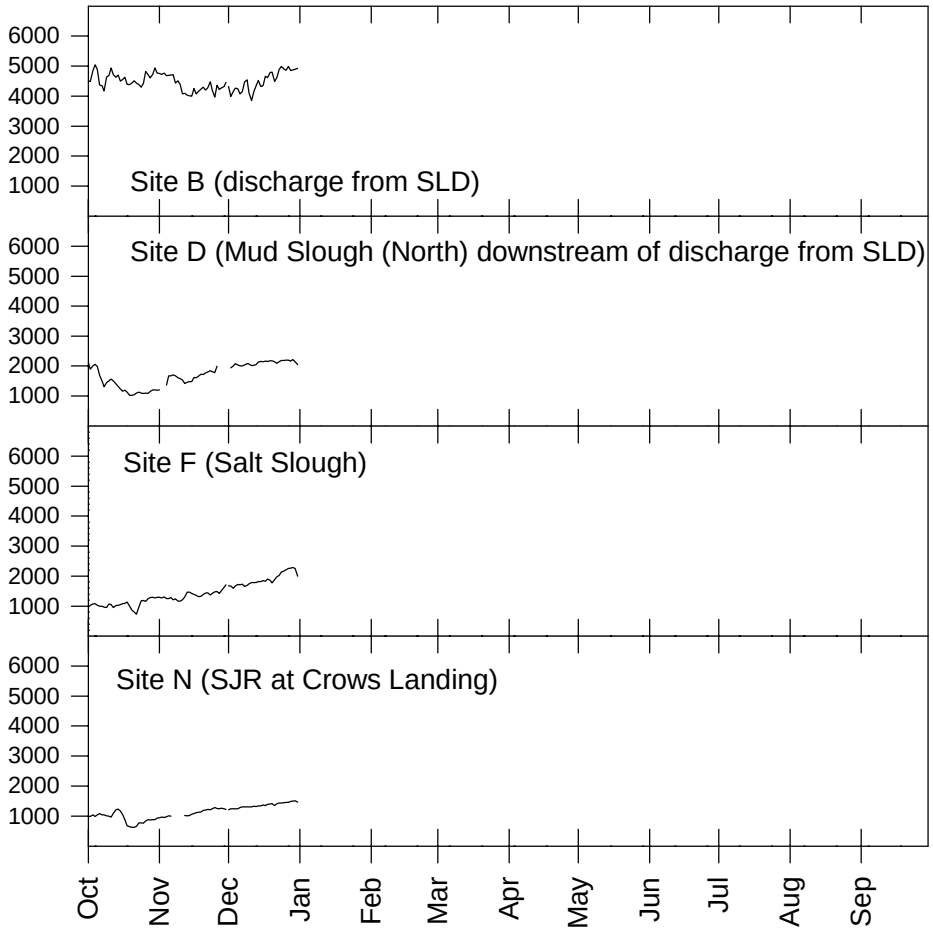


Figure 10. Specific conductance (µS/cm) in weekly grab samples. Letters indicate sites.

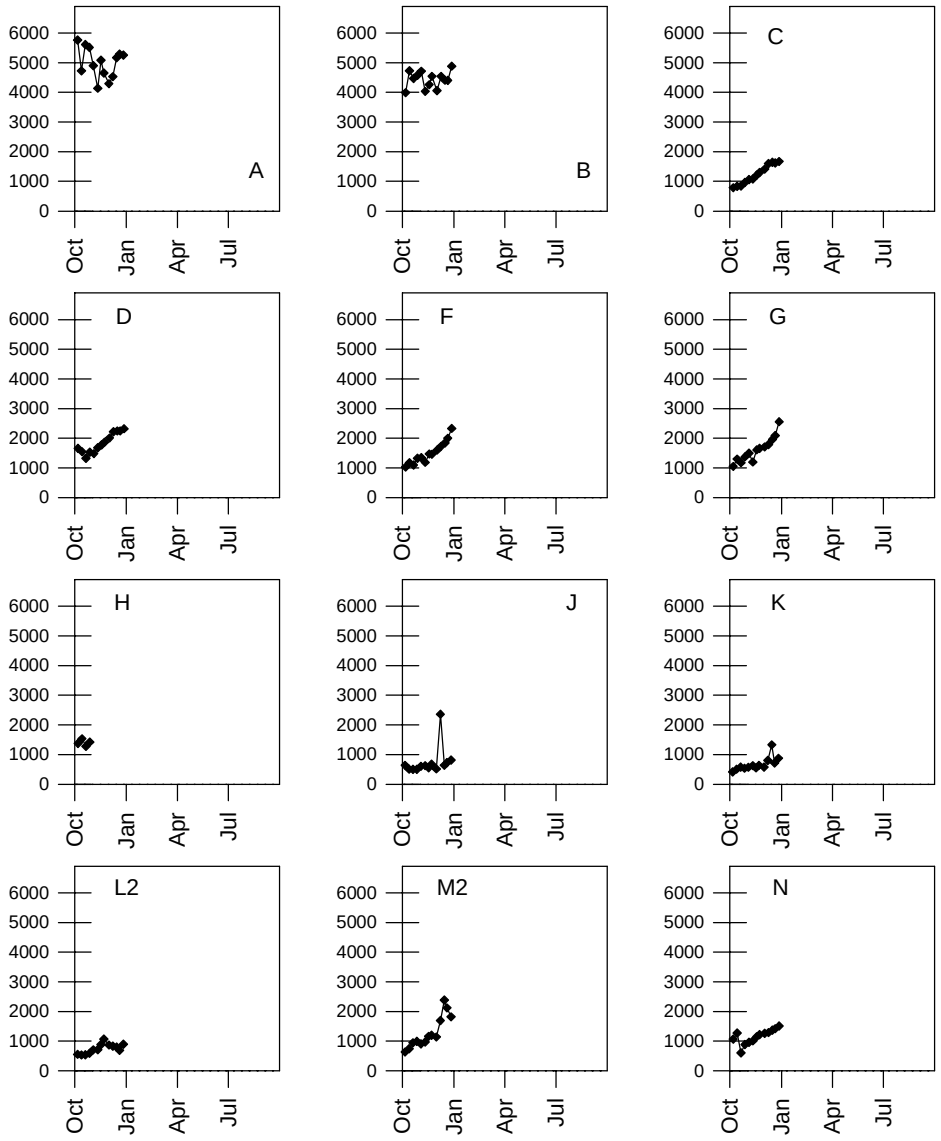


Figure 11. Comparison of toxicity test results from Site B with results from the Delta Mendota Canal reference location. The different tests are described in the text.

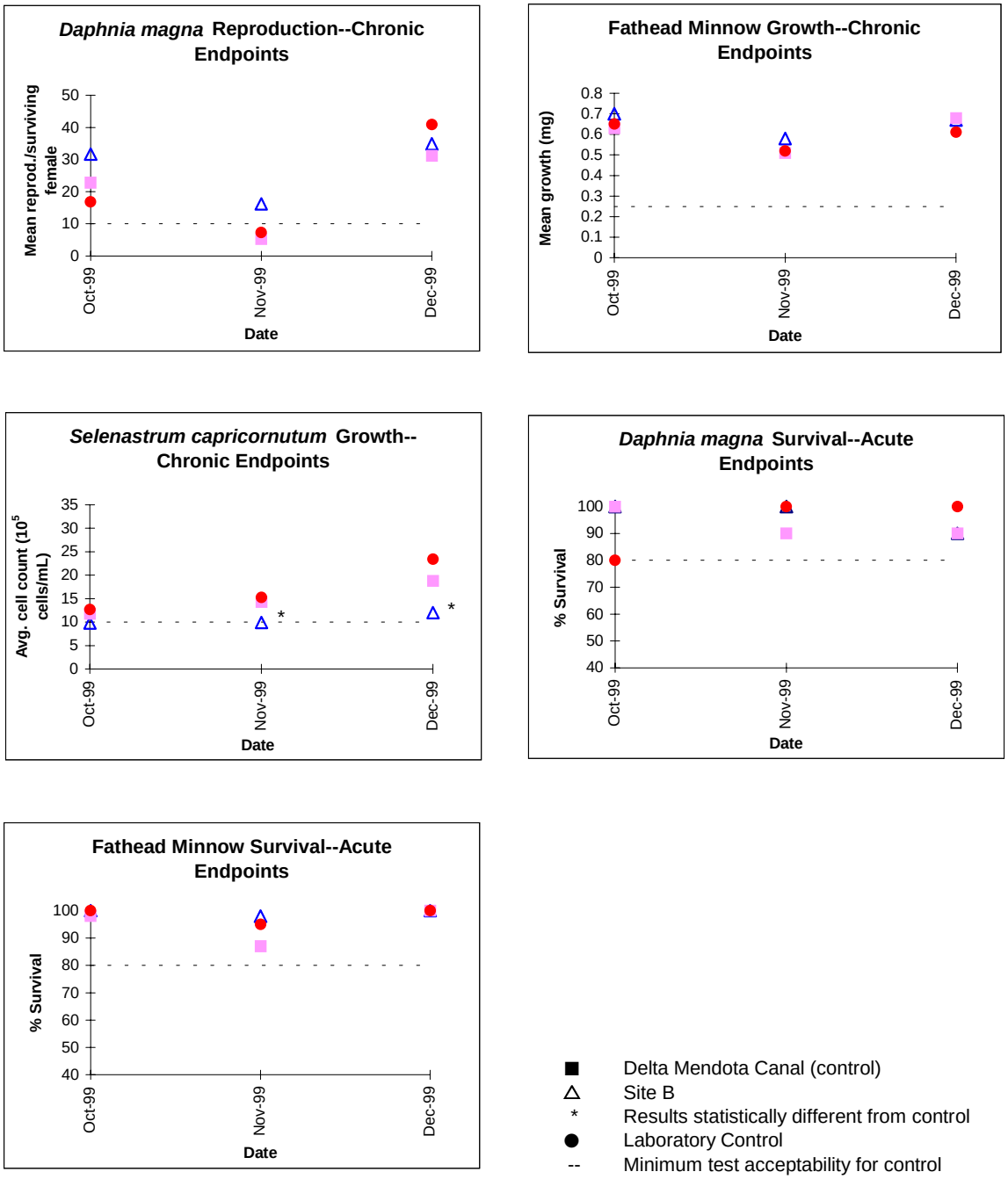


Figure 12. Comparison of toxicity test results from Site C with results from the Delta Mendota Canal reference location. The different tests are described in the text.

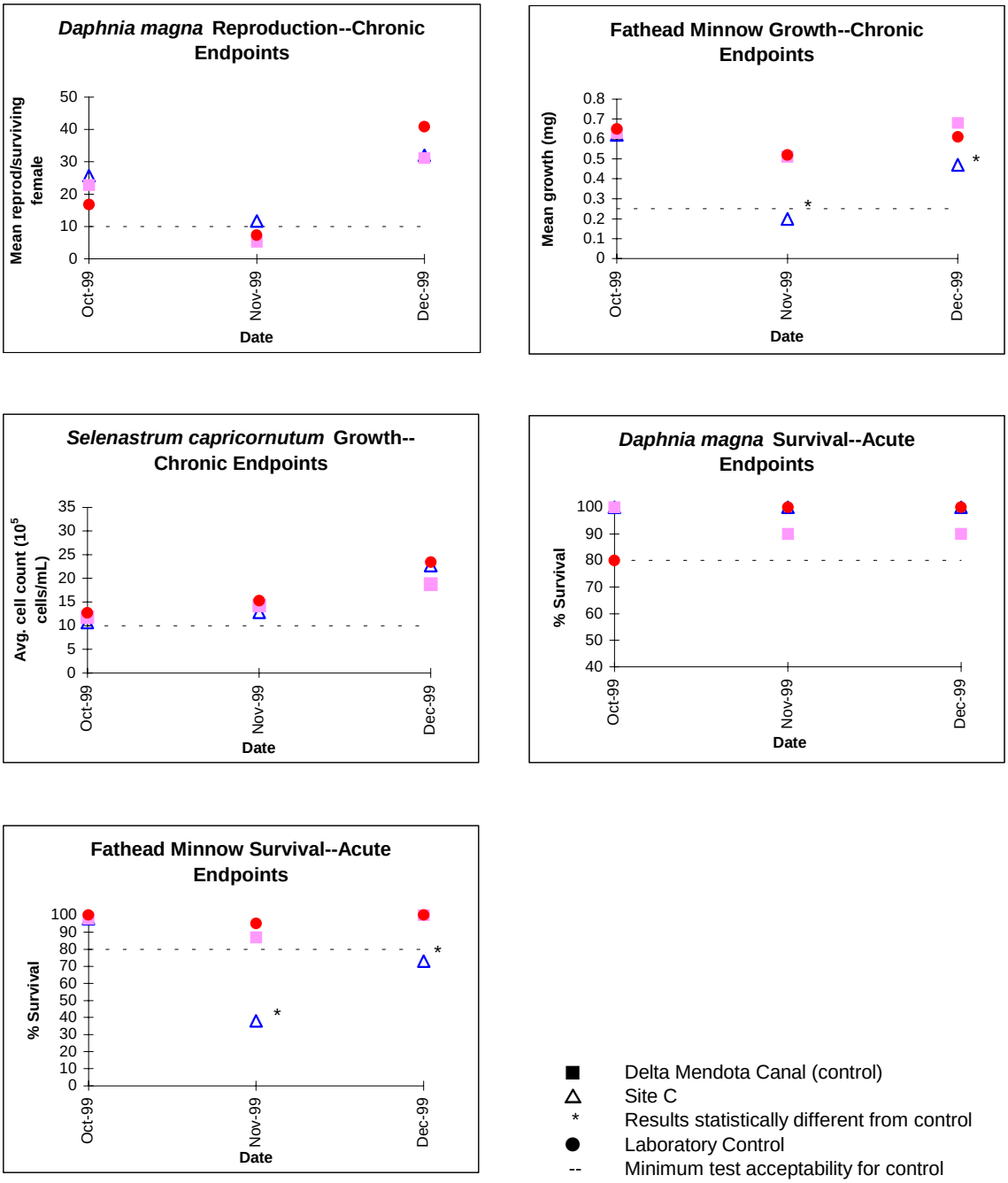


Figure 13. Comparison of toxicity test results from Site D with results from the Delta Mendota Canal reference location. The different tests are described in the text.

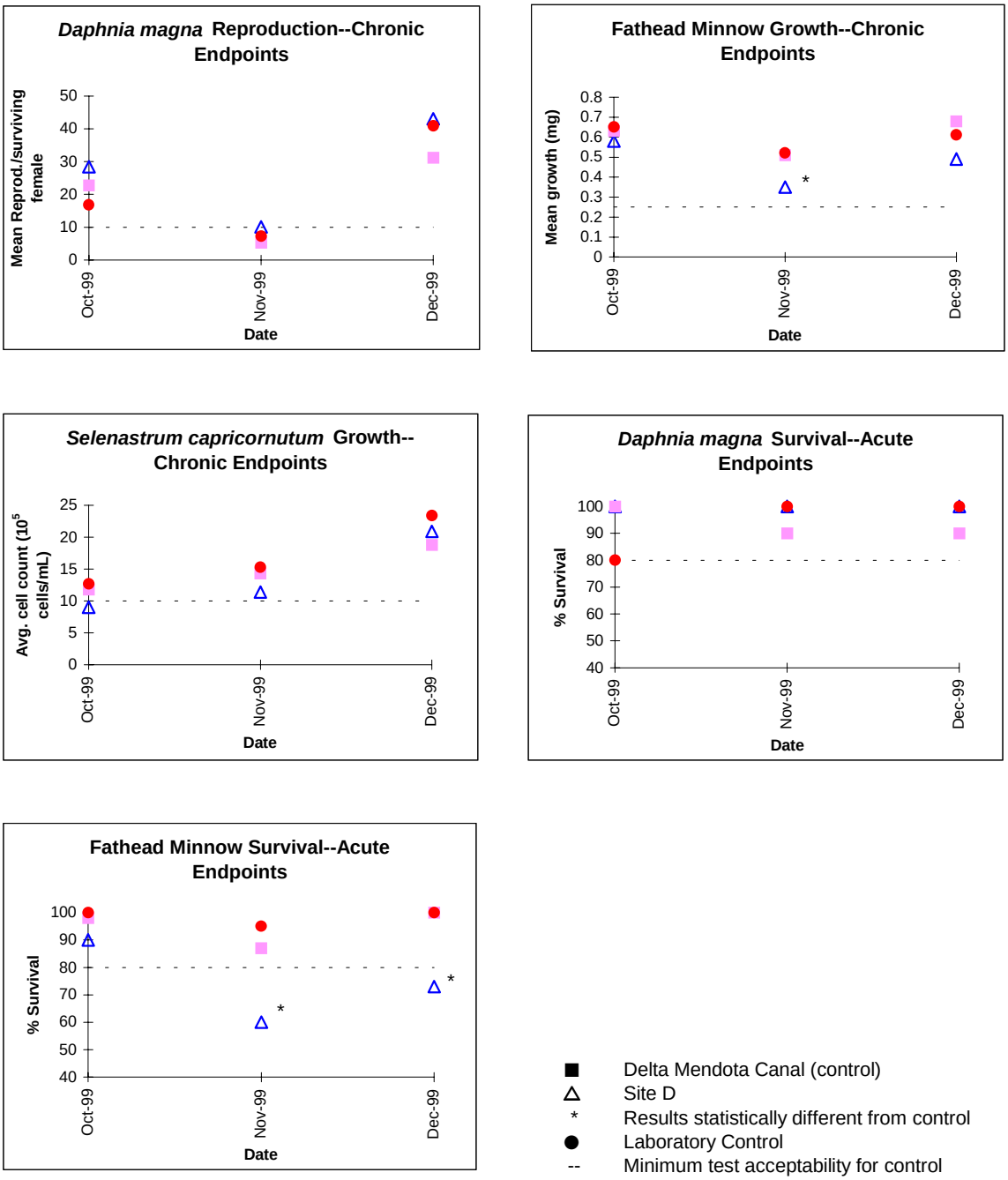


Figure 14. Comparison of toxicity test results from Site F with results from the Delta Mendota Canal reference location. The different tests are described in the text.