GRASSLAND BYPASS PROJECT

QUARTERLY NARRATIVE AND GRAPHICAL SUMMARY

October 1998 - December 1998

June 1, 1999

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 irrigation return 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, 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 agricultural drainage from wetland water supply channels in the Grassland Water District and from Salt Slough, but has increased quantities of agricultural drainage in the six miles of Mud Slough that receives the re-routed drainage water. A detailed monitoring program, the Grassland Bypass Project Compliance Monitoring Program (GBPCMP) has been in place since October 1996 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, 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 1998). 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.

II. FLOW MONITORING

Flow data in the GBPCMP 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. According to the Interim Use Permit, discharge flow into Mud Slough from the San Luis Drain may not exceed 150 cfs (USBR 1995).

Flows near the inlet of agricultural drainage into the San Luis Drain (Site A), which averaged 22 cfs for the quarter, were lower than flows at the point of discharge of the San Luis Drain into Mud Slough (Site B), which averaged 27.5 cfs (Figure 3). Maximum flow for the quarter was 34 cfs on October 30 at Site A and 42 cfs on October 1 at Site B.

Of the two monitoring sites in Mud Slough 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 168 cfs. The discharge from the SLD (Site B) accounted for an average of 16% of the total flow in Mud Slough (Site D). Flows in Salt Slough (Site F) were of a similar magnitude as those in Mud Slough, averaging 163 cfs for the quarter. The highest flow in Salt Slough (224 cfs) occurred on October 25 and October 26.

Site N flows during the quarter averaged 1624 cfs. The maximum flow measured was 2620 cfs on October 15.

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 drainage to the wetland channels, and to evaluate potential adverse effects on test organisms of the GBP discharge and of waters in Mud Slough below the discharge.

Selenium

Daily Selenium Measurements

Daily selenium concentrations are measured at sites B and N using autosamplers (USBR 1996). Monthly total selenium load discharge is computed at Site B. Monthly totals are shown in Table 1 and illustrated in Figure 4a. Monthly total selenium load discharge was below the selenium load value in all three months of the quarter.

Selenium load discharge from the GBP (discharge from the terminus of the Drain as measured at Site B) averaged 8.1 lbs/day for the quarter. The maximum daily selenium load discharge (17.8 lbs/day) occurred on October 26. Flow at Site B was relatively constant, averaging 27.5 cfs for the quarter with a minimum of 17.8 cfs on December 10 and a maximum of 42 cfs on October 1. Selenium concentrations at Site B were more variable, fluctuating between a minimum of 21.1 µg/L on October 1 and 95.0 µg/L on December 25. The cumulative selenium load discharge for the quarter was 742 lbs.

Selenium concentrations at Site N (San Joaquin River at Crow's Landing) averaged 1.5 µg/L for the quarter. The highest concentration was measured on November 29 (2.6 µg/L). The minimum concentration for the quarter, 0.5 µg/L, was measured on December 15.

Weekly Selenium Measurements

Selenium concentrations are measured in weekly grab samples collected at 12 sites (Figures 6-8). It should be noted that data from weekly grab samples provide a relatively imprecise basis for comparison of differences between sites.

Average selenium concentrations were higher near the inlet to the San Luis Drain (Site A) than near the point of discharge into Mud Slough (Site B) (Figure 6). The average concentration at Site A was 68 µg/L compared to 62 µg/L at Site B.

Selenium concentrations in Mud Slough upstream of the GBP discharge (Site C) averaged 0.6 µg/L, with a maximum concentration of 0.7 µg/L (Figure 6). Concentrations were higher in Mud Slough downstream of the GBP discharge (Site D) than upstream at Site C (note differences in scales). Concentrations at Site D averaged 10 µg/L, with a maximum of 12.3 µg/L on October 22.

Selenium concentrations in Salt Slough (Site F) and the wetland water supply channels (sites J, K, L, and M) were frequently above 2 µg/L at sites J (five samples), K (five samples), and L (six samples). One sample at Site M2 was above 2 µg/L. The highest concentrations of selenium measured in the wetland water supply channels were at sites J (6.8 µg/L) and K (6.4 µg/L) in late December.

In the San Joaquin River, weekly selenium samples were collected at sites upstream of the GBP discharge (Site G), downstream of the discharge and above the Merced River (Site H), and downstream of the Merced River (Site N) (Figure 8). Selenium concentrations at Site G were low, averaging 0.5 µg/L, with five samples below the detection limit of 0.4 µg/L. Concentrations were higher at Site H, averaging 2.3 µg/L.

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.

IV. SEDIMENT MONITORING

Sediment quality is measured in the San Luis Drain and in Mud and Salt Sloughs. The purpose of monitoring sediment in the San Luis Drain is 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.

Selenium concentrations in sediments have varied considerably over time and within cores at a given site. For example, at Site A in November the sample collected at a depth of 3-8 cm had a concentration of 140 µg/g dry, while the sample from the 0-3 cm depth had 27 µg/g dry and the whole core sample had 31 µg/g dry. This variation does not appear to be attributable to the analytical methods. Interpretation of these data will be

provided in the GBP Annual Report for the year October 1998 - September 1999.

V. BIOLOGICAL MONITORING

Biological monitoring is conducted throughout the GBP area on a quarterly basis (USBR 1996). Tissue sampling in the GBPCMP is being 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 being analyzed for selenium residues to assess impacts to fish and wildlife. Muscle fillets from gamefish are being analyzed for selenium to assess human health risks. These data will be presented and discussed in the GBP Annual Report for the year October 1998 - September 1999.

VI. TOXICITY TESTING

The purpose of the GBP toxicity testing program is to evaluate the potential adverse effects to test organisms of the GBP discharge and of waters in Mud Slough below the discharge. 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. Toxicity test results for the year are summarized below; complete datasets are presented in the GBP Monthly Data Reports and GBP Quarterly Data Reports (SFEI 1998).

In the fathead minnow tests, several samples exhibited significantly reduced survival or growth. There were statistically significant reductions in survival at Site C in all three months. Significant reductions in survival were also observed at sites D and F in November. Only one of these reductions in survival occurred at a site under the influence of the GBP discharge. Statistically significant reductions in fathead minnow growth were also observed in several of the samples collected during the quarter. Samples collected from Site C exhibited significantly reduced growth in October and November. Significantly reduced growth was also observed at sites D and F in November. Again, the observed growth inhibition occurred primarily at sites not under the influence of the GBP discharge.

In the *Daphnia* tests, no significant reductions in survival were observed. Significantly reduced reproduction was observed in two samples: one from Site B in October and one from Site D in October. These two sites are both under the influence of the GBP discharge.

In the *Selenastrum* tests, inhibition of growth was observed in three samples from Site B, one sample from Site D (in November), and one sample from Site F (in December). Inhibition of *Selenastrum* growth has been consistently observed in samples

from Site B, and infrequently observed in samples from the other sites.

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. 1998. 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. 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 (USBR 1995).

	Selenium load discharge (lbs)	Load value (lbs)	Amount over load value (%)
Oct 1998	277	348	NA
Nov 1998	226	348	NA
Dec 1998	239	389	NA

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

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

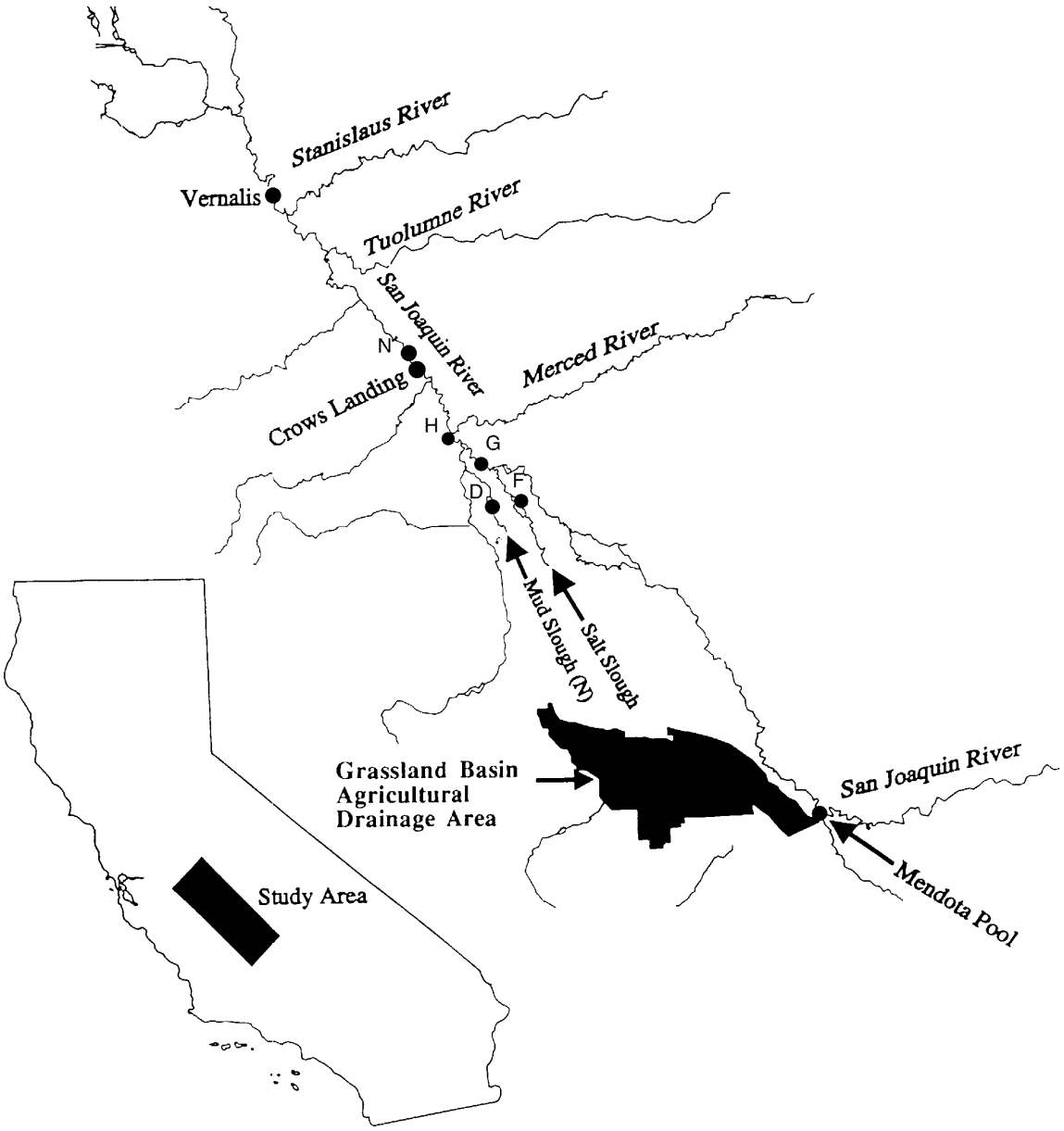


Figure 2. Schematic diagram showing locations of GBP monitoring sites relative to major hydrologic features of the study area.

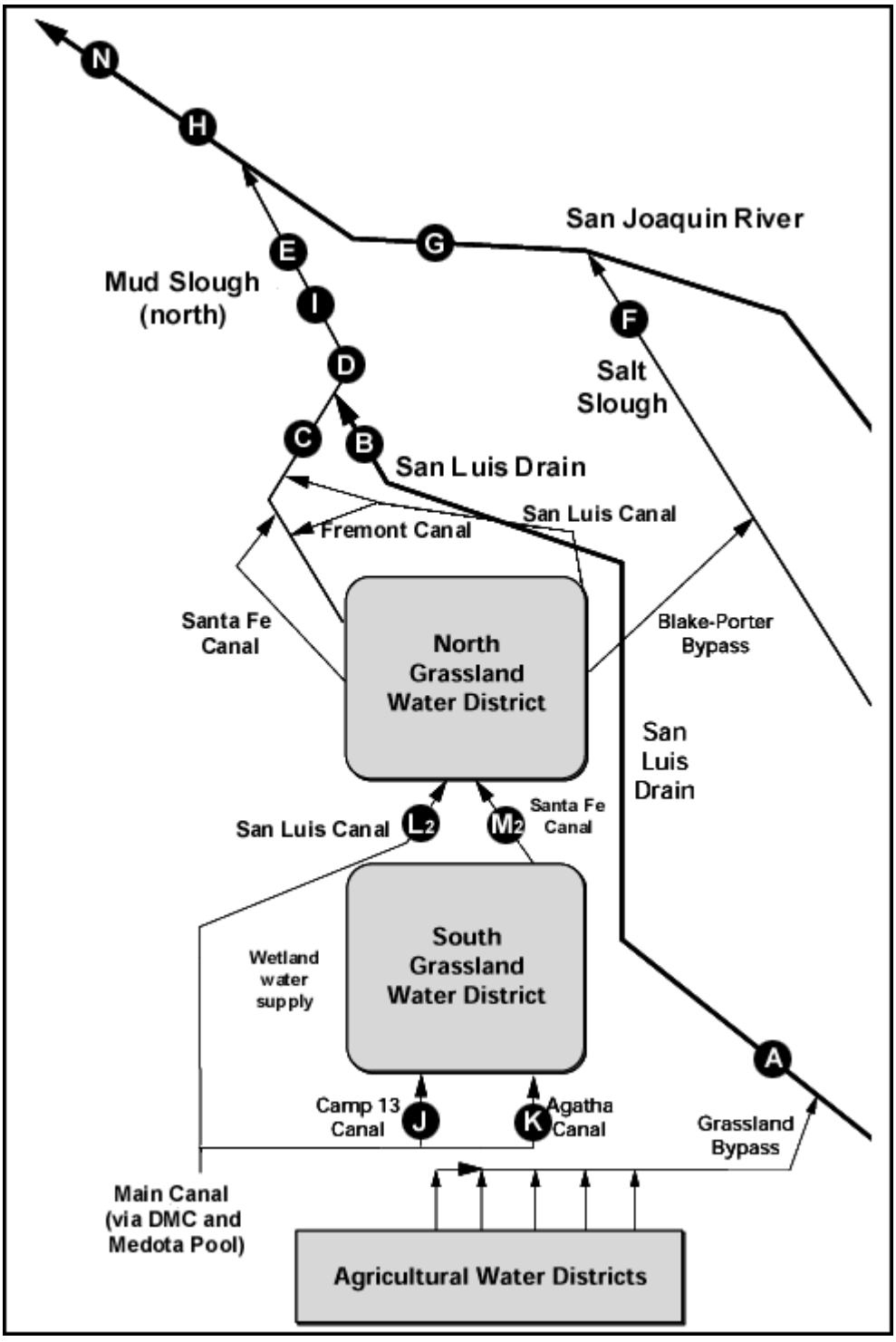


Figure 3. Daily mean flows (cfs) at GBPCMP sites. Flow at Site A is recorded as a daily mean. Flows at sites B, D, F, and N are recorded at 15 min intervals. Note different scales of vertical axes and break in vertical axis for Site N.

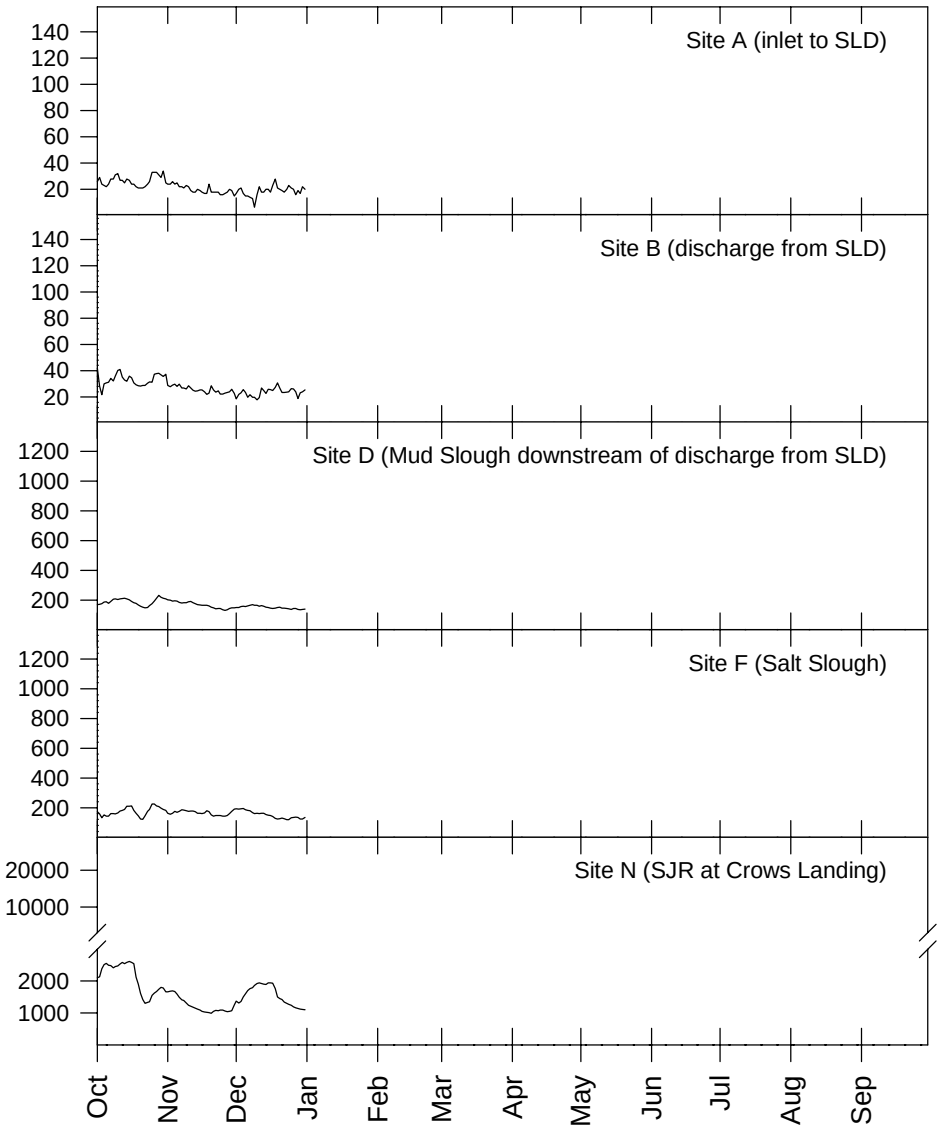


Figure 4. Selenium concentrations and selenium load discharge at Site B (discharge from SLD): a) comparison of monthly load discharge and load values; b) comparison of cumulative load discharge and load values; c) daily average flows; d) daily average selenium concentrations; and e) calculated daily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

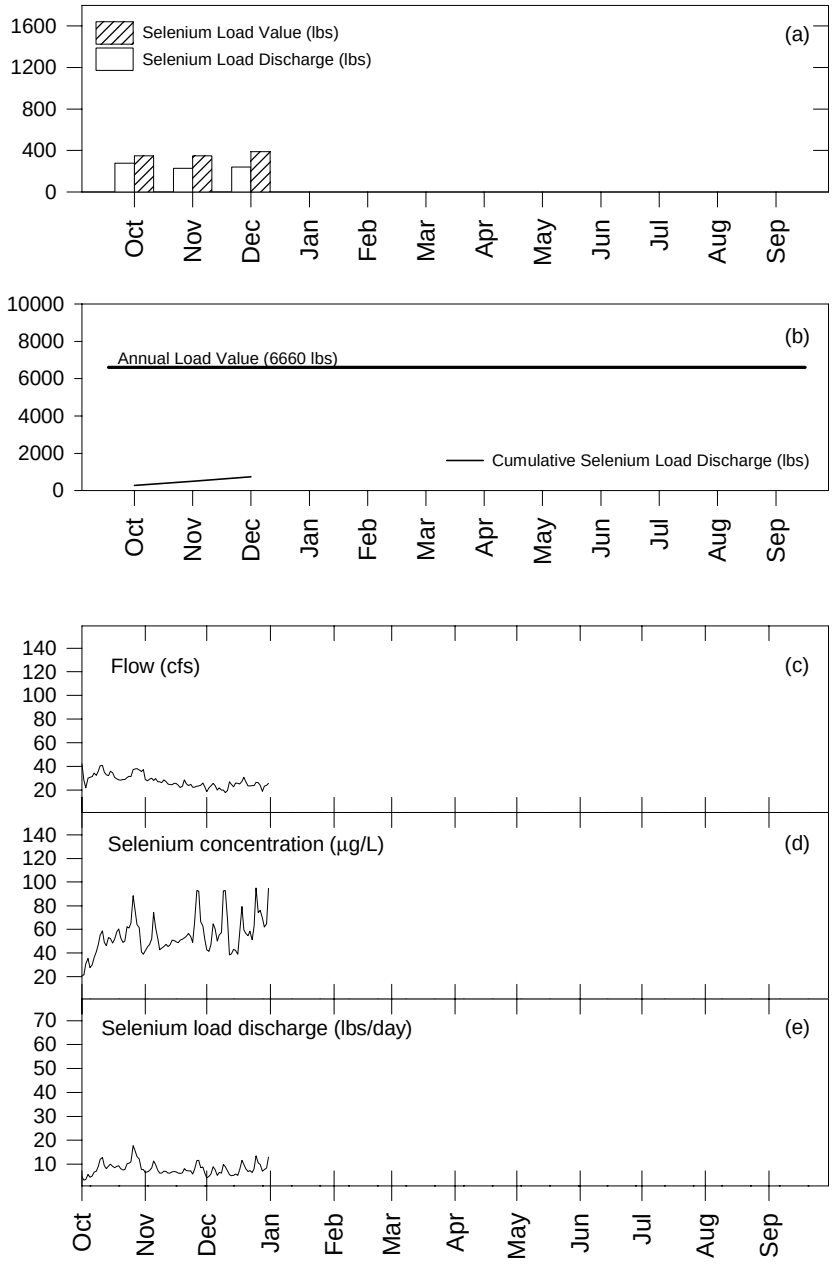


Figure 5. Daily average flows and selenium concentrations at Site N (San Joaquin River at Crow's Landing). Note break in vertical axis for flow plot.

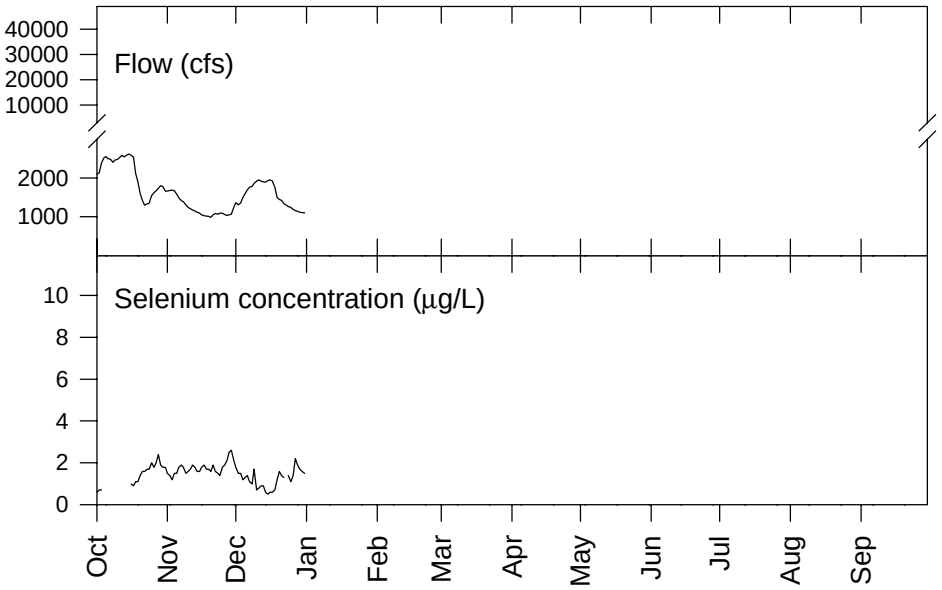


Figure 6. Selenium concentrations (µg/L) at Site A (near the inlet to the San Luis Drain), Site B (discharge from the San Luis Drain), Site C (Mud Slough upstream of the GBP discharge), and Site D (Mud Slough downstream of the GBP discharge). Data from weekly grab samples.

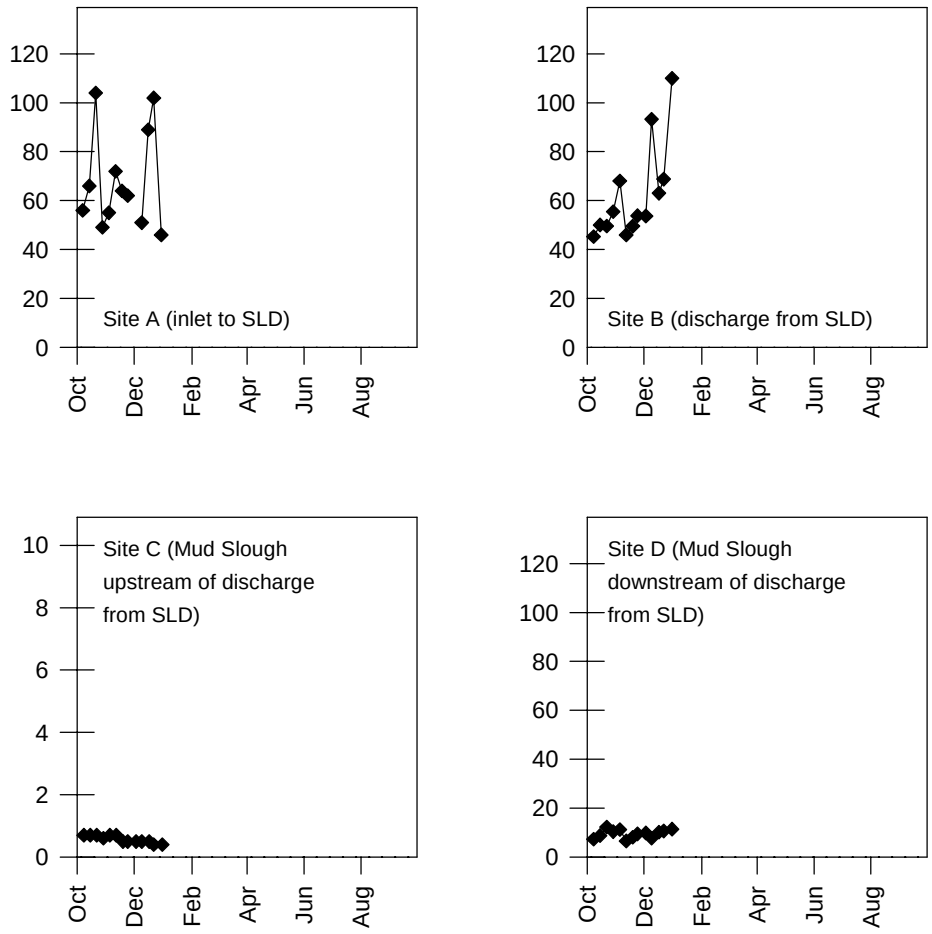


Figure 7. Selenium concentrations (µg/L) at Site F (Salt Slough) and in the wetland water supply channels at Site J, Site K, Site L2, and Site M2. Data from weekly grab samples.

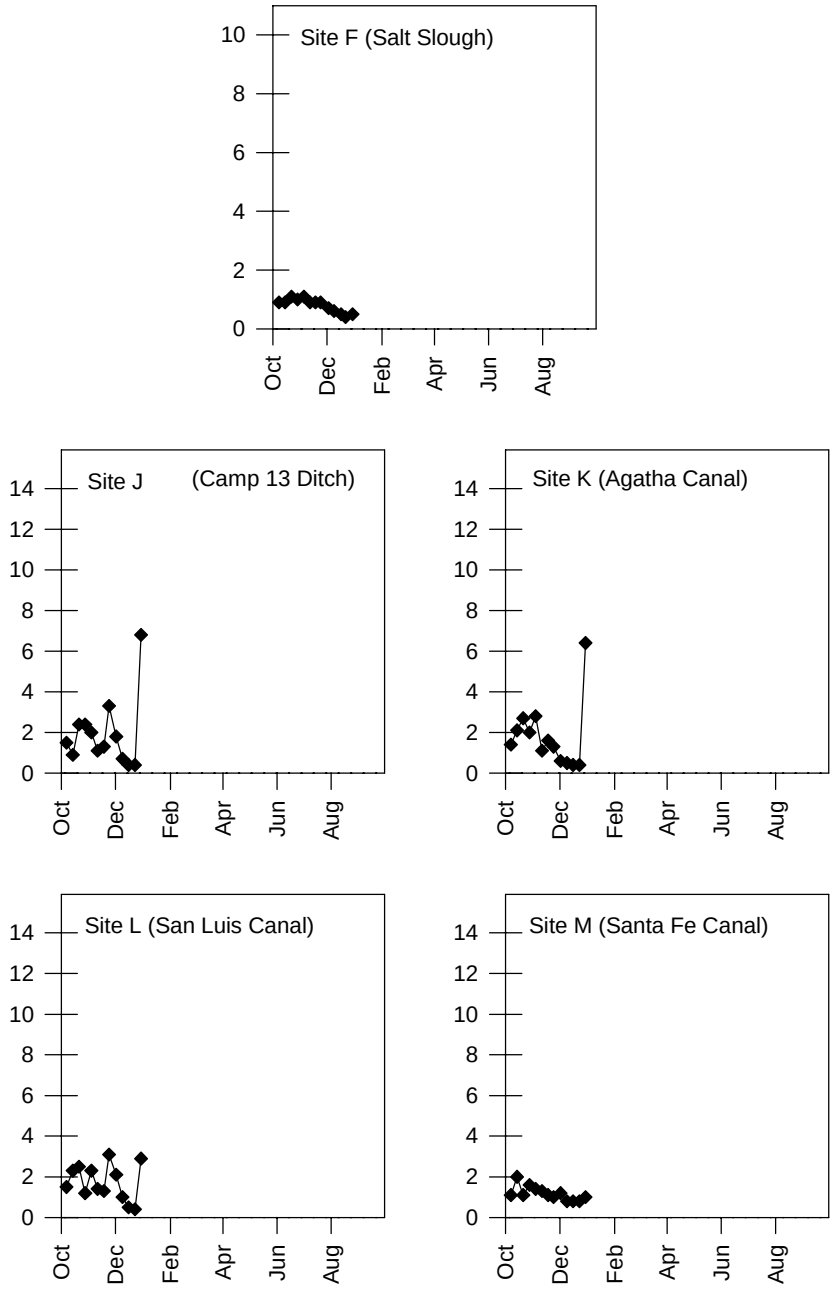


Figure 8. Selenium concentrations (µg/L) at San Joaquin River sites G (San Joaquin River upstream of Mud Slough confluence), H (San Joaquin River downstream of Mud Slough confluence), and N (at Crow's Landing, downstream of Merced River confluence). Data from weekly grab samples.

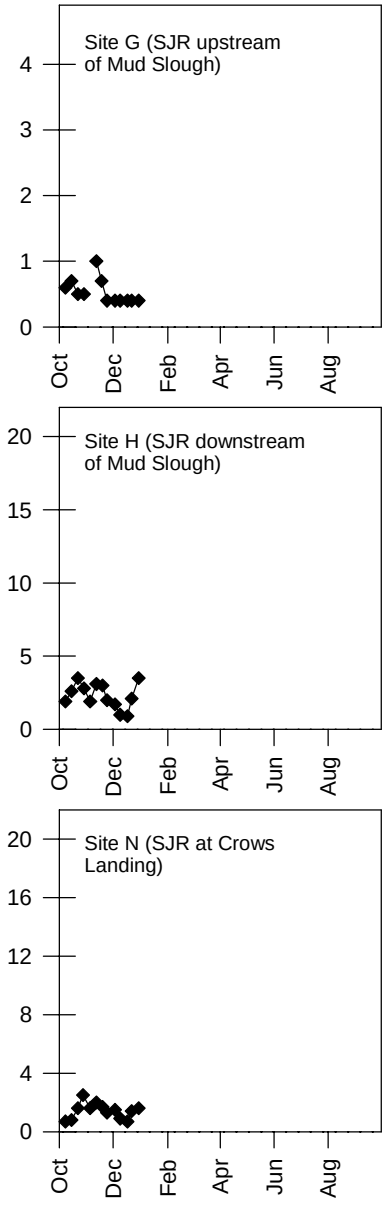


Figure 9. Daily average specific conductance (µS/cm) derived from measurements at 15 min intervals at sites B (discharge from the SLD), D (Mud Slough downstream of the GBP discharge), F (Salt Slough), and N (San Joaquin River at Crow's Landing).

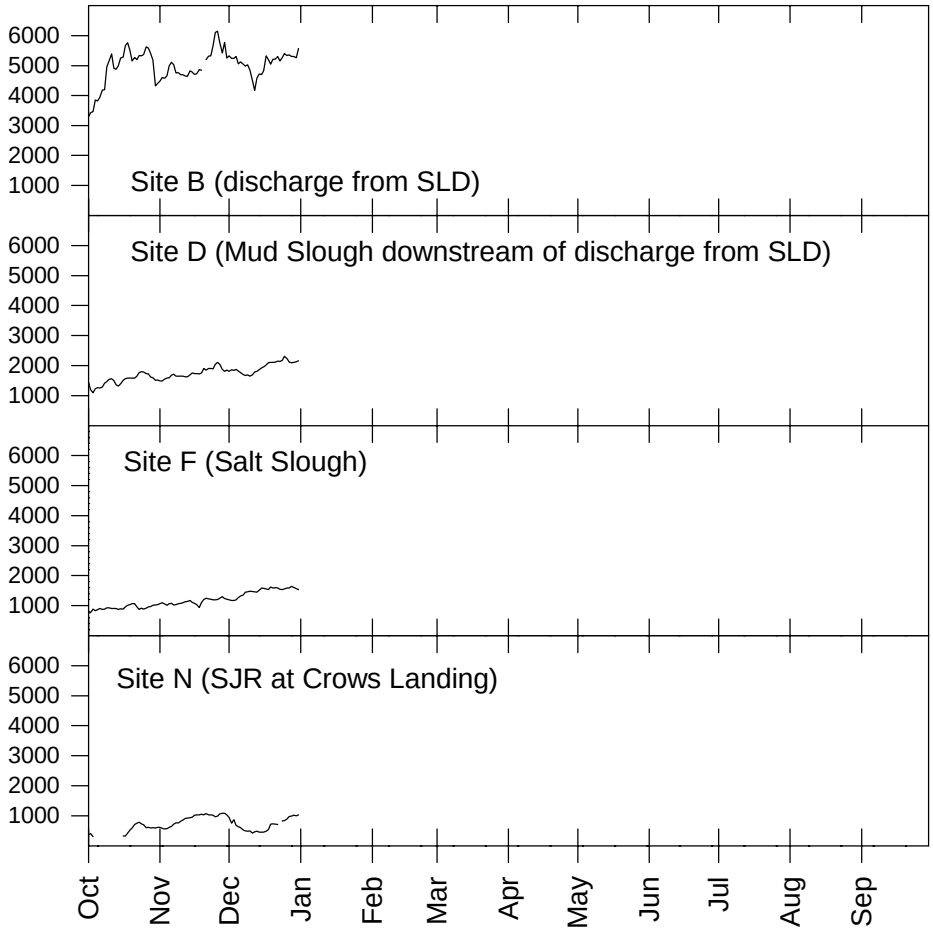


Figure 10. Specific conductance (µS/cm) in weekly grab samples. Letters indicate sites.

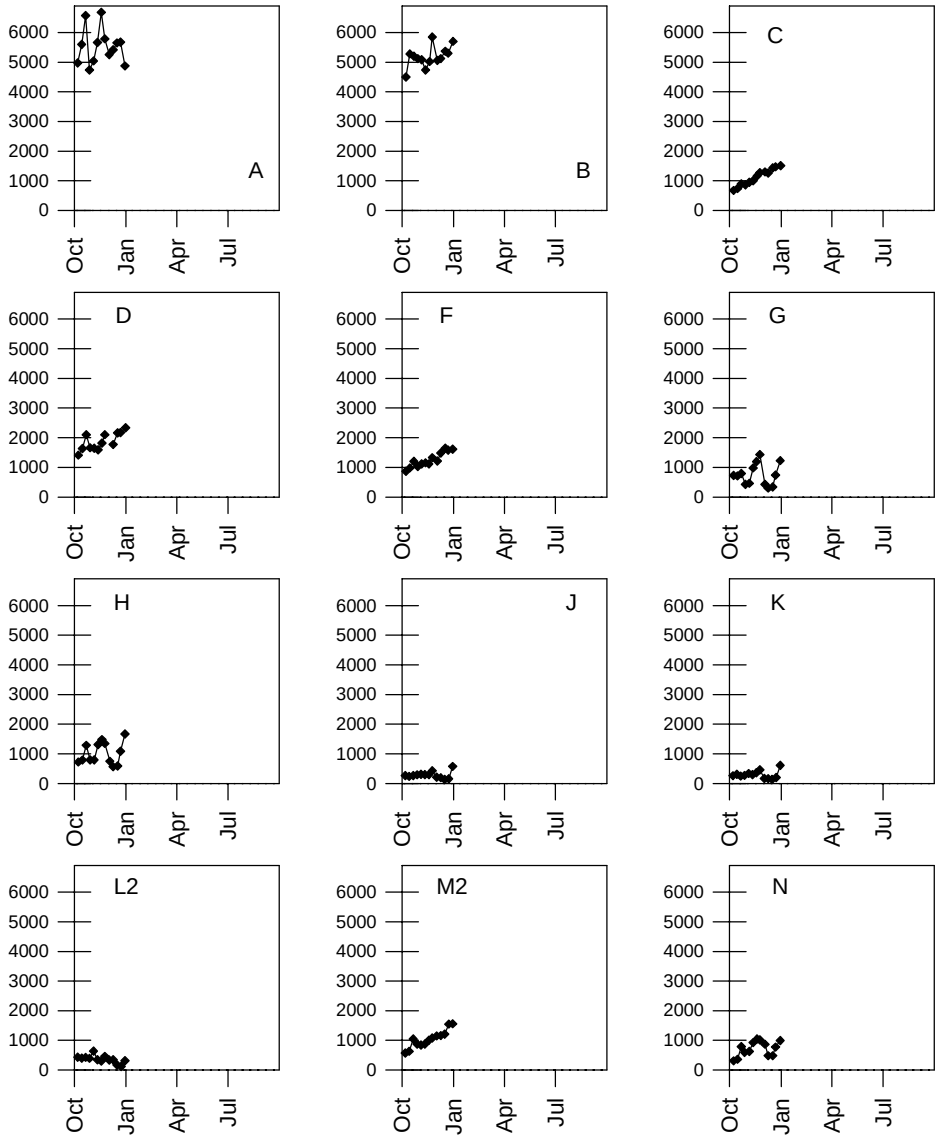


Figure 11. Comparison of toxicity test results from Site B with results from the Delta Mendota Canal reference location. The different tests are described in the text.

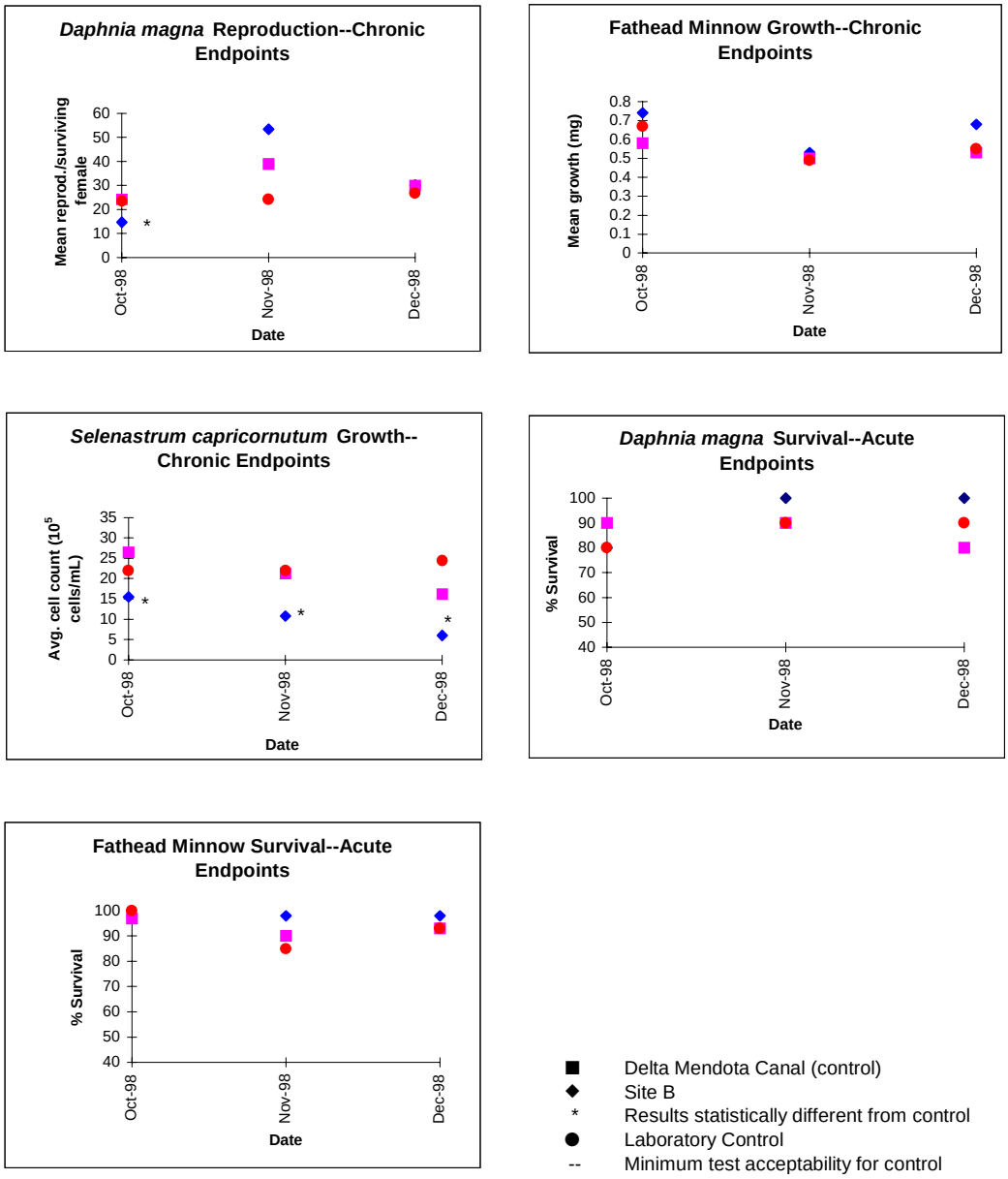


Figure 12. Comparison of toxicity test results from Site C with results from the Delta Mendota Canal reference location. The different tests are described in the text.

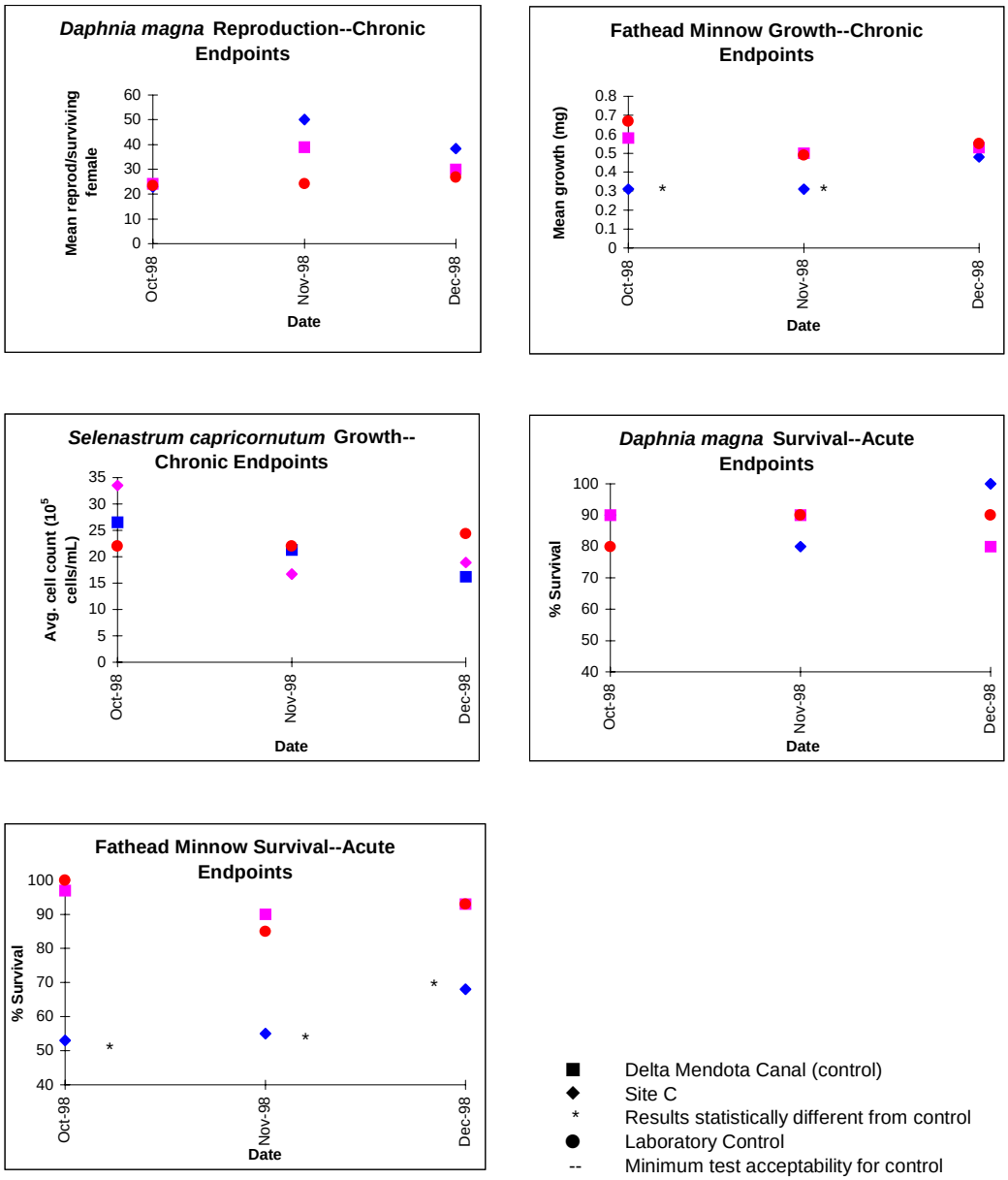


Figure 13. Comparison of toxicity test results from Site D with results from the Delta Mendota Canal reference location. The different tests are described in the text.

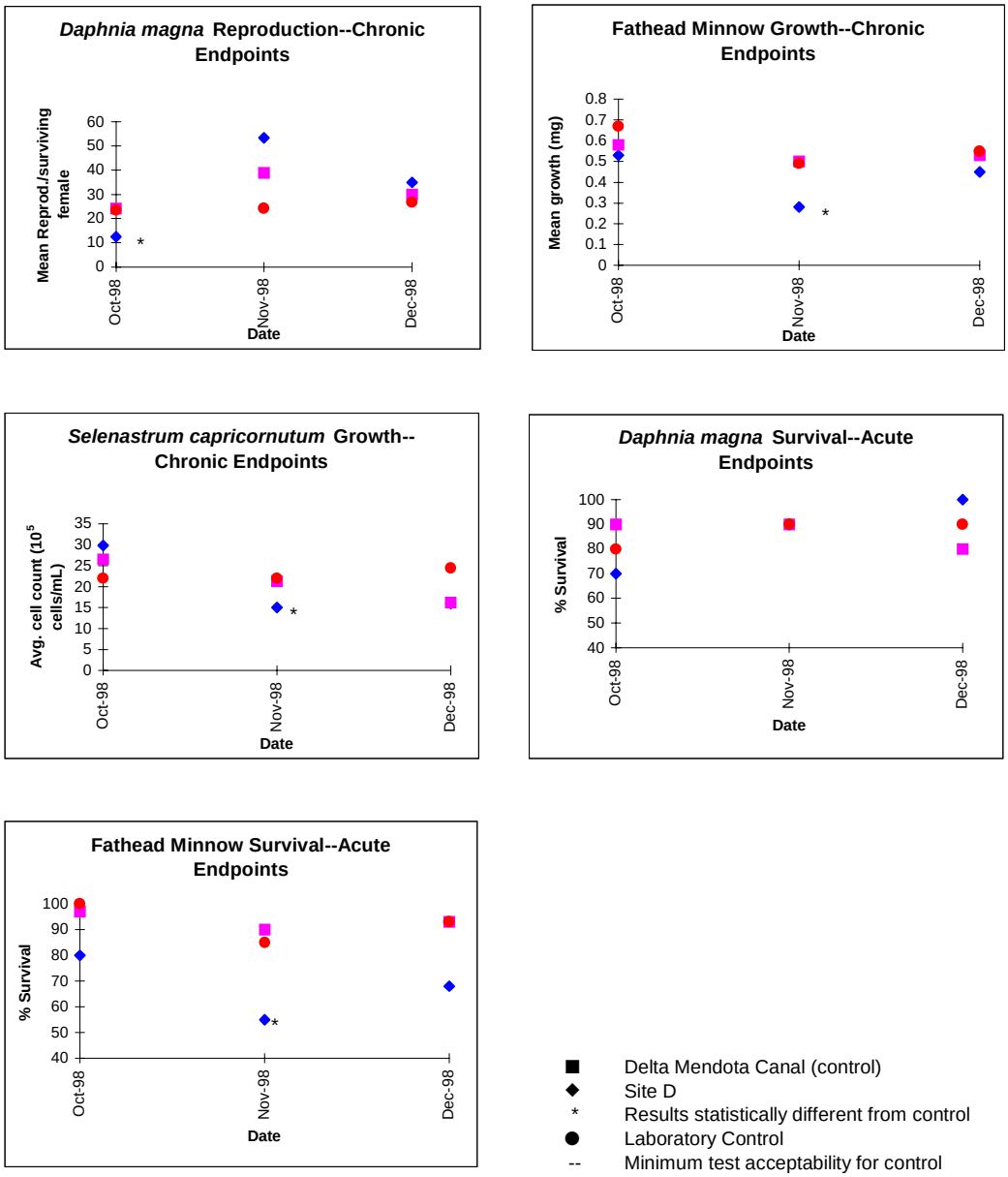


Figure 14. Comparison of toxicity test results from Site F with results from the Delta Mendota Canal reference location. The different tests are described in the text.

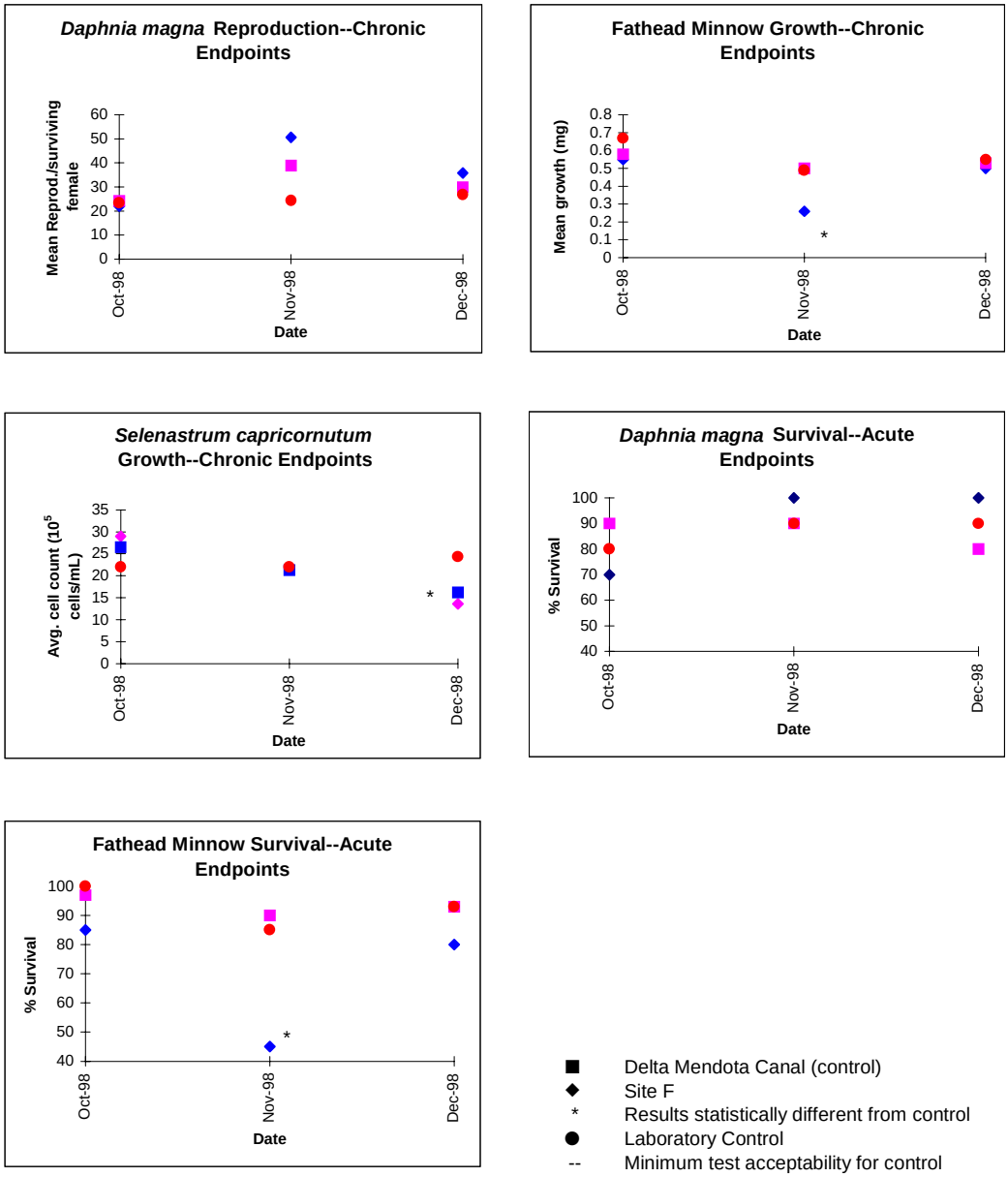
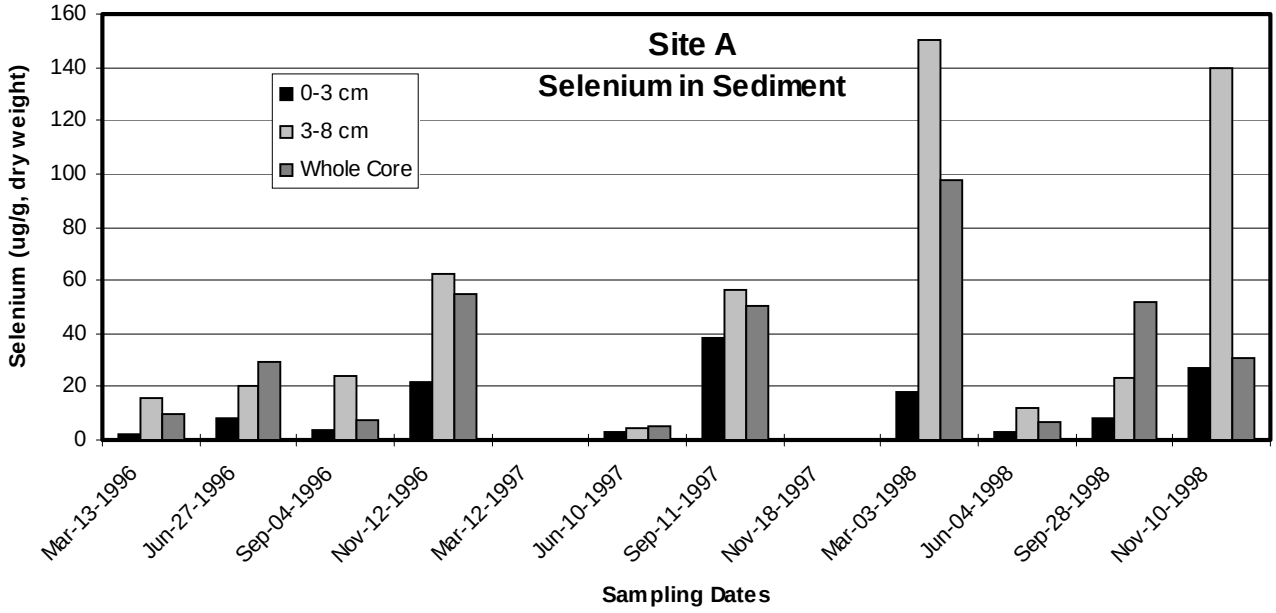


Figure 15. Selenium concentrations in sediment at sites A (inlet to San Luis Drain) and B (discharge from San Luis Drain). Samples not tested at Site A on March 12, 1997 and November 18, 1997 and at Site B on March 12, 1996. Concentration in whole core sample at Site B on June 10, 1997 was 0.11 µg/g dry weight.



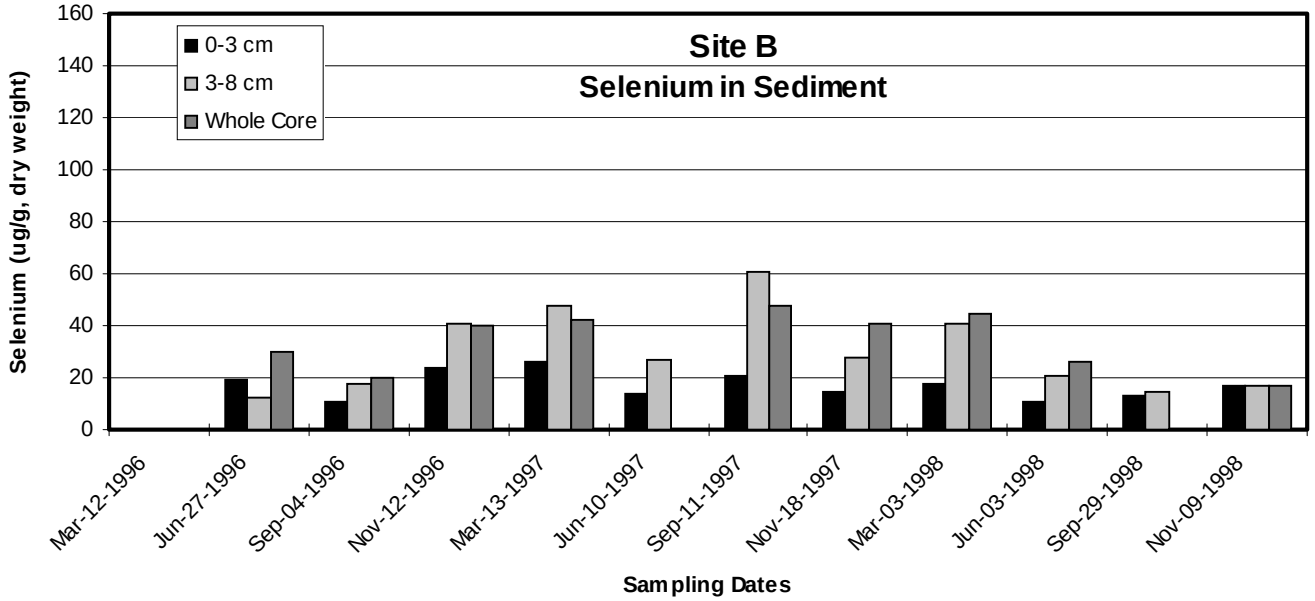
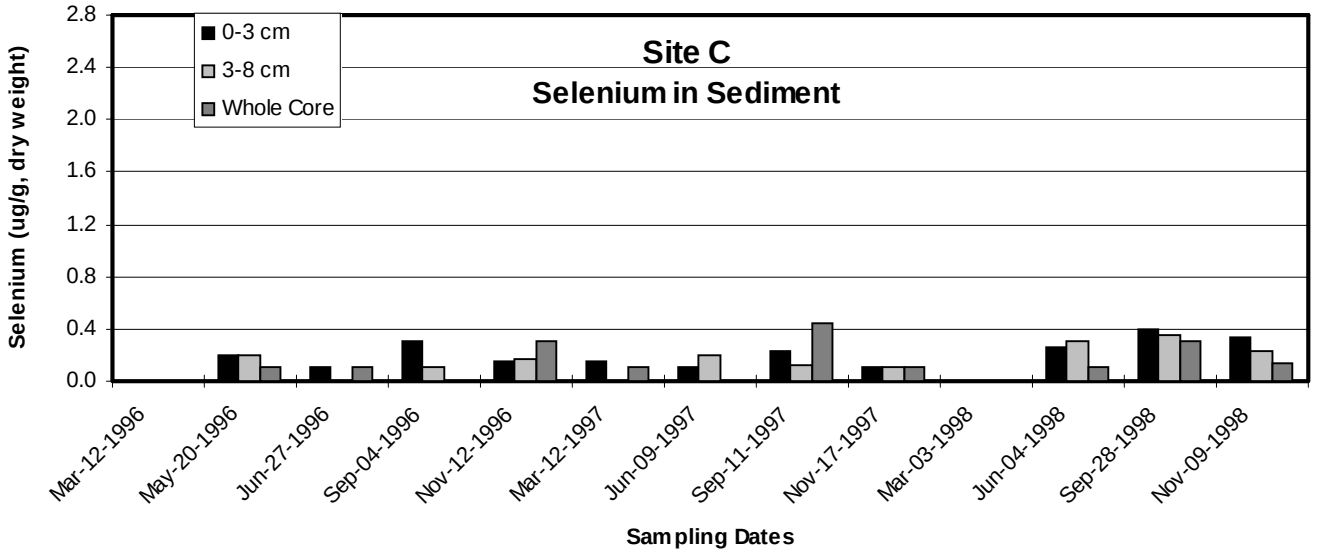


Figure 16. Selenium concentrations in sediment at sites C (Mud Slough upstream of the GBP discharge) and D (Mud Slough downstream of the GBP discharge). Samples not tested at sites C and D on March 12, 1996 and March 3, 1998. Other missing bars indicate concentrations were below limits of detection.



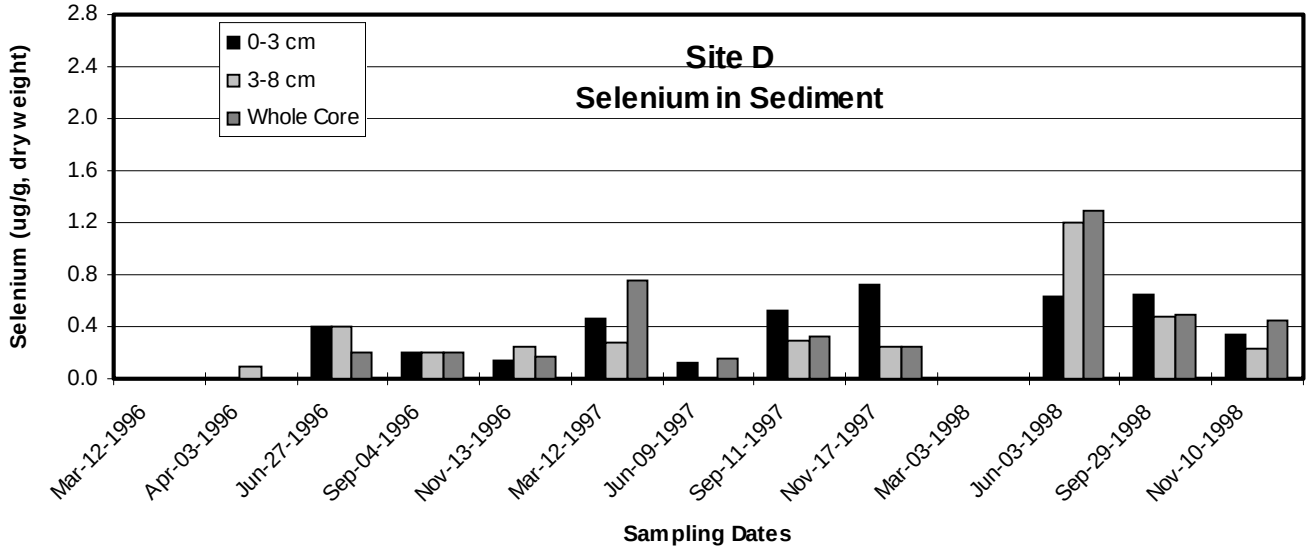


Figure 17. Selenium concentrations in sediment at sites E (Mud Slough at Highway 140) and F (Salt Slough). Samples not tested at Site E on March 12, 1996, September 4, 1996, March 3, 1998, and June 3, 1998 and at Site F on March 12, 1996. Other missing bars indicate concentrations were below limits of detection.