Appendix F. Daily Simulations of Delta Wetlands Project Operations

Appendix F. Daily Simulations of Delta Wetlands Project Operations

This appendix presents the results of simulations of daily operations of the Delta Wetlands Project (Alternative 2) for the 1985-1994 simulated period using the Daily Standards and Operations Simulations model (DailySOS). The following text provides a narrative explanation and graphic representation of the results. It describes Delta Wetlands diversions and discharges and the relationship between Delta Wetlands operations and Central Valley Project (CVP) and State Water Project (SWP) operations for each year.

Pursuant to the diversion rules (see Table 3-19), Delta Wetlands cannot divert water to storage unless there is available surplus water (as defined in the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary [WQCP]) and the X2 location criteria have been met. The timing and magnitude of diversions are also limited by the amount of available surplus water, the amount of Delta outflow, Delta Cross Channel (DCC) gate operations, and the amount of Delta inflow.

According to the discharge rules (see Table 3-19), Delta Wetlands discharges for export are limited to permitted export capacity and a maximum calendar-year total of 250 thousand acre-feet (TAF). Delta Wetlands discharges from Bacon Island are also restricted by the amount of San Joaquin River inflow, and discharges from Webb Tract are prohibited from January through July.

For project simulations, Bacon Island diversions are assumed to be made first. Webb Tract diversions would then be made using any remaining diversion capacity under the final operations criteria (FOC). Several of the criteria are more restrictive if the fall midwater trawl (FMWT) delta smelt index is less than 239; however, because the FMWT index value cannot be calculated, the model assumes a FMWT index greater than 239 for the daily simulations. Likewise, the FOC terms include criteria that limit diversions if delta smelt are located near the Delta Wetlands islands during monitoring; the criteria also give the California Department of Fish and Game (DFG) the discretion to limit diversions for 15 days based on San Joaquin River flows. Because these conditions are not predictable, they also were not modeled in the daily simulation.

The 1985-1994 period was chosen because it includes some characteristically dry years (e.g., 1989 through 1992) and some moderately wet years (e.g., 1985, 1986, 1993). For each year, four figures are shown. The first shows Delta Wetlands daily operations (diversion, discharge to export, and storage) as a function of excess inflow (i.e., available surplus water) and unused permitted export capacity, and the second shows the correlating X2 position. The excess inflow is greater than the minimum outflow and within the allowable amount of exports as a percentage of

C-063284

C-063284

inflow (i.e., E/I ratio). The "Baseline X2" position in the second figure is the modeled position without the Delta Wetlands Project; the "Adjusted X2" position shows the modeled X2 position with daily Delta Wetlands operations. The third figure for each year shows simulated daily Delta Wetlands operations with simulated daily CVP and SWP operations. This figure demonstrates how the Delta Wetlands Project would operate in relation to SWP and CVP exports, as controlled by outflow limits, the E/I ratio limits, and San Luis Reservoir operations. The fourth figure shows the simulated Delta Wetlands discharges to export in addition to the combined SWP and CVP deliveries from exports and San Luis Reservoir operations modeled by DWRSIM. The Delta Wetlands Project is always modeled as an independent project, and not as an integrated element of assumed SWP and CVP operations (see Chapter 2). To show the maximum possible daily operations of Delta Wetlands as an independent project, Delta Wetlands exports are assumed not to be limited by delivery deficits.

Note that the vertical lines in the graphs divide the years into equal increments representing 31 days. This results in the spring and summer months appearing to begin later than they should (i.e., the lines are shifted to the right of the beginnings of the months). Refer to Table 3-20 in Chapter 3 for more precise information on timing of simulated diversions and discharges.

DELTA WETLANDS 1985 OPERATIONS

Figure F-1a illustrates the simulated daily Delta Wetlands operations for 1985. The available surplus water for diversion is shown by the open triangles ("Excess Inflow"). The unused permitted export capacity is shown by the open diamonds ("Unused Export Capacity"). There is excess inflow (i.e., available surplus water) in November, and Delta Wetlands diversions begin after the X2 position moves downstream of Chipps Island (kilometer [km] 74) in late November (Figure F-1b). Figure F-1a shows that the initial Bacon Island and Webb Tract diversions start in late November and continue into December. The Delta Wetlands diversion is limited to 5,500 cubic feet per second (cfs) for 5 days pursuant to the DCC rule, but because Delta inflows are less than 50,000 cfs and the DCC gates are closed, the maximum diversion is limited to 4,000 cfs. The Delta Wetlands diversion rate is increased above 4,000 cfs for a few days in November when Delta inflows are greater than 50,000 cfs. The diversion rate is assumed to decrease as the storage reservoir fills.

As shown in Figure F-1a, there was a short period for Delta Wetlands discharges to export from Bacon Island in late December and late January, but the island refilled quickly. Both Delta Wetlands islands are simulated to be full from February through May (with some evaporative losses). Bacon Island discharges are simulated in June and are limited to 50% of San Joaquin River inflows (i.e., less than 1,000 cfs). The Bacon Island and Webb Tract discharges simulated in July are limited to 75% of the unused permitted export capacity. The discharge rate is assumed to be reduced as the reservoir islands are emptied. Bacon Island and Webb Tract are simulated to be empty at the end of July. Total Delta Wetlands discharges to export were 17 TAF from October through December and 220 TAF from January through September of 1985. This result is approximately 21% greater than the monthly model's estimate of 195 TAF of Delta Wetlands discharges to export in 1985 (Table 3-20), and the models show different monthly patterns for

diversions and discharges. The monthly model allowed exports in March, but San Luis Reservoir was full and this is not a likely period for additional exports. The monthly model overestimated June exports because San Joaquin River flows limited discharges on a daily basis during that time.

Figure F-2 shows the allowable combined SWP and CVP exports for 1985 constrained by the permitted export capacity, the minimum required Delta outflow, and the maximum allowed E/I ratio, which is computed with a 15-day moving average inflow. Delta Wetlands operations are shown as additional diversions above the permitted SWP and CVP exports in November through February, and as additional exports in June and July (with a small increment in December and January) (Figure F-2a). These 1985 daily simulated operations illustrate Delta Wetlands' ability to capture water that is in excess of the permitted export capacity, but within the allowable E/I ratio (during major storm events), and to provide water for export during the summer period of reduced inflows. Figure F-2b shows the additional potential delivery of water from Delta Wetlands discharges to export. The historical 1985 delivery is 5,506 TAF (as shown by the thin line) and the DWRSIM 771 estimated monthly delivery pattern is 6,350 TAF (as shown by the light shaded values). The additional Delta Wetlands exports are shown by the dark shaded area. Total Delta Wetlands discharges to export of 237 TAF were simulated for 1985. Most of the additional Delta Wetlands exports are simulated to occur near the peak demand period (June and July), and available water for delivery south of the Delta would increase by about 4% with the Delta Wetlands exports.

DELTA WETLANDS 1986 OPERATIONS

Figure F-3 illustrates the simulated Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1986. Initial Delta Wetlands diversions occur in February, after the X2 location has been downstream of Chipps Island (km 74) for 10 days (Figure F-3b). The diversions are limited to 5,500 cfs for 5 days pursuant to the DCC rule, and the Delta Wetlands storage reservoirs are both filled in February. Bacon Island discharge begins in June; discharge is limited to 50% of the available unused permitted export capacity. Webb Tract discharge begins in July.

Figure F-4 shows Delta Wetlands operations with the combined SWP and CVP exports and a south-of-Delta delivery pattern. The monthly simulated DWRSIM CVP and SWP delivery is 5,155 TAF for 1986, and the daily historical delivery for 1986 is 4,570 TAF (Figure F-4b). The daily simulated Delta Wetlands discharges to export of 206 TAF would increase south-of-Delta delivery by 4%. The monthly model estimated Delta Wetlands discharges for export during 1986 as 212 TAF. The months of Delta Wetlands exports simulated in the monthly model were also June and July, but more June exports were simulated by the monthly model than the daily model because the percentage of unused export capacity limited June exports.

DELTA WETLANDS 1987 OPERATIONS

Figure F-5 illustrates simulated Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1987. There are two major storm inflows, with available surplus flows in February and March. The initial Delta Wetlands diversions do not occur until late February because the X2 location does not reach Chipps Island (km 74) until the middle of February and the 10-day delay period extends to about the end of the first storm. The Delta Wetlands diversions in March are limited by the allowable E/I ratio of 35% and the FOC measure that limits diversions to 50% of available surplus water. Bacon Island is simulated to fill in March and begins to discharge in June; discharge is limited to 50% of the San Joaquin River inflow. There was not enough Delta Wetlands diversion capacity to fill Webb Tract during March.

Figure F-6 shows Delta Wetlands operations with the combined SWP and CVP exports and a south-of-Delta delivery pattern. Results of the daily model indicate that San Luis Reservoir is full in February, so the full CVP and SWP export capacity cannot be used. CVP and SWP pumping is limited to the monthly deliveries. This allows Delta Wetlands to divert water once the X2 position is downstream of Chipps Island for 10 days. Therefore, Delta Wetlands may divert water in March within the allowable E/I limits. The monthly simulated DWRSIM delivery of 5,775 TAF in 1987 is similar to the daily historical delivery of 5,837 TAF (Figure F-6b). The daily simulated Delta Wetlands discharges to export of 115 TAF, including 16 TAF in October from diversions at the end of September (see Figure F-3a), would have increased total south-of-Delta delivery in 1987 by 2%. The monthly model estimated Delta Wetlands discharges for export during 1987 as only 26 TAF, with June as the month of Delta Wetlands exports. The daily estimated diversions in March were sufficient to fill Bacon Island and provide approximately 70 TAF more exports in June, July, and August than simulated in the monthly model.

DELTA WETLANDS 1988 OPERATIONS

Figure F-7 illustrates simulated Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1988. There is only one major storm inflow, with available surplus flow in January. The X2 location does not reach Chipps Island (km 74) until the middle of the storm event and Delta Wetlands diversions do not begin until after the required 10-day waiting period, which extends to almost the end of the storm. Total Delta Wetlands diversions are 16 TAF in January and are simulated to be discharged in early February.

Figure F-8 shows simulated Delta Wetlands operations with the combined SWP and CVP exports and a south-of-Delta delivery pattern. The monthly simulated DWRSIM delivery of 4,165 TAF in 1988 is less than the historical delivery of 5,780 TAF (Figure F-8b). The monthly model estimated Delta Wetlands discharges for export during 1988 as 184 TAF, with the diversion simulated in January. In the monthly simulation, the months of Delta Wetlands exports were February and March, because the SWP and CVP exports are constrained by the 35% E/I limit. The

monthly model overestimated Delta Wetlands diversions because the 10-day waiting period for the X2 criteria cannot be simulated in the monthly model.

DELTA WETLANDS 1989 OPERATIONS

Figure F-9 illustrates simulated Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1989. There is one major storm inflow, with available surplus flow in March, and a smaller storm in early August. Delta Wetlands diversions are not allowed until the middle of March because the X2 location does not reach Chipps Island (km 74) until the middle of the storm event, and the 10-day waiting period extends to almost the end of March. Delta Wetlands diversions simulated in March are 59 TAF. Additional Delta Wetlands diversions of 45 TAF were simulated in August. Bacon Island discharges of 50 TAF were simulated in June, with additional discharges of 37 TAF at the end of August.

Figure F-10 shows Delta Wetlands operations with the combined SWP and CVP exports and a south-of-Delta delivery pattern. The monthly simulated DWRSIM delivery of 4,858 TAF in 1989 is less than the historical delivery of 6,085 TAF (Figure F-10b). The monthly model estimated that the Delta Wetlands discharges for export during 1989 would be 0 TAF. The daily model provides a more accurate estimate of how Delta Wetlands diversions can capture water during the storm inflow periods.

DELTA WETLANDS 1990 OPERATIONS

Figure F-11 illustrates simulated Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1990. There is only one major storm, with available surplus flow in January. Delta Wetlands diversions do not occur because the X2 location never moves downstream of Chipps Island (km 74).

Figure F-12 shows the combined SWP and CVP Delta exports and south-of-Delta delivery pattern. The monthly simulated DWRSIM delivery of 4,216 TAF in 1990 is less than the historical delivery of 5,674 TAF. The monthly model estimated Delta Wetlands discharges for export during 1990 as 0 TAF; the daily model also simulated no Delta Wetlands diversions or discharges in this water year.

DELTA WETLANDS 1991 OPERATIONS

Figure F-13 illustrates simulated Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1991. There is only one major storm, with available surplus flow in March. Delta Wetlands diversions of 12 TAF occur after the X2 location reaches Chipps Island

(km 74) a few days before the end of March. Delta Wetlands diversions are prohibited in April and May. Delta Wetlands would discharge 6 TAF for export in June.

Figure F-14 shows the combined SWP and CVP Delta exports and south-of-Delta delivery pattern. The monthly simulated DWRSIM delivery of 2,502 TAF in 1991 is less than the historical delivery of 3,015 TAF. The monthly model estimated Delta Wetlands discharges for export during 1991 as 0 TAF, whereas the daily simulation estimated 6 TAF.

DELTA WETLANDS 1992 OPERATIONS

Figure F-15 illustrates potential Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1992. There is only one major storm, with available surplus flow in February. Delta Wetlands diversions of 5 TAF occur after the X2 location reaches Chipps Island (km 74) a few days before the end of the storm. This water is discharged for export in March.

Figure F-16 shows the combined SWP and CVP Delta exports and south-of-Delta delivery pattern. The monthly simulated DWRSIM delivery of 3,205 TAF in 1992 is similar to the historical delivery of 3,090 TAF. The monthly model estimated Delta Wetlands discharges for export during 1992 as 0 TAF, whereas the daily simulation estimated 5 TAF.

DELTA WETLANDS 1993 OPERATIONS

Figure F-17 illustrates potential Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1993. It finally rained again. There was a series of major inflows beginning in January. Simulated Delta Wetlands diversions begin at the end of January, when X2 is downstream of Chipps Island, and continue through February. Both Delta Wetlands reservoir islands are filled by the end of February. Some discharge from Bacon Island is simulated in early March, with refill of 25 TAF at the end of March and another 40 TAF of diversions in early June. Delta Wetlands discharges from Bacon Island and Webb Tract were simulated in late June and July. Delta Wetlands reached its calendar-year total export limit of 250 TAF during July. Bacon Island diverted an additional 26 TAF in August and September, and the Delta Wetlands carryover storage is 65 TAF.

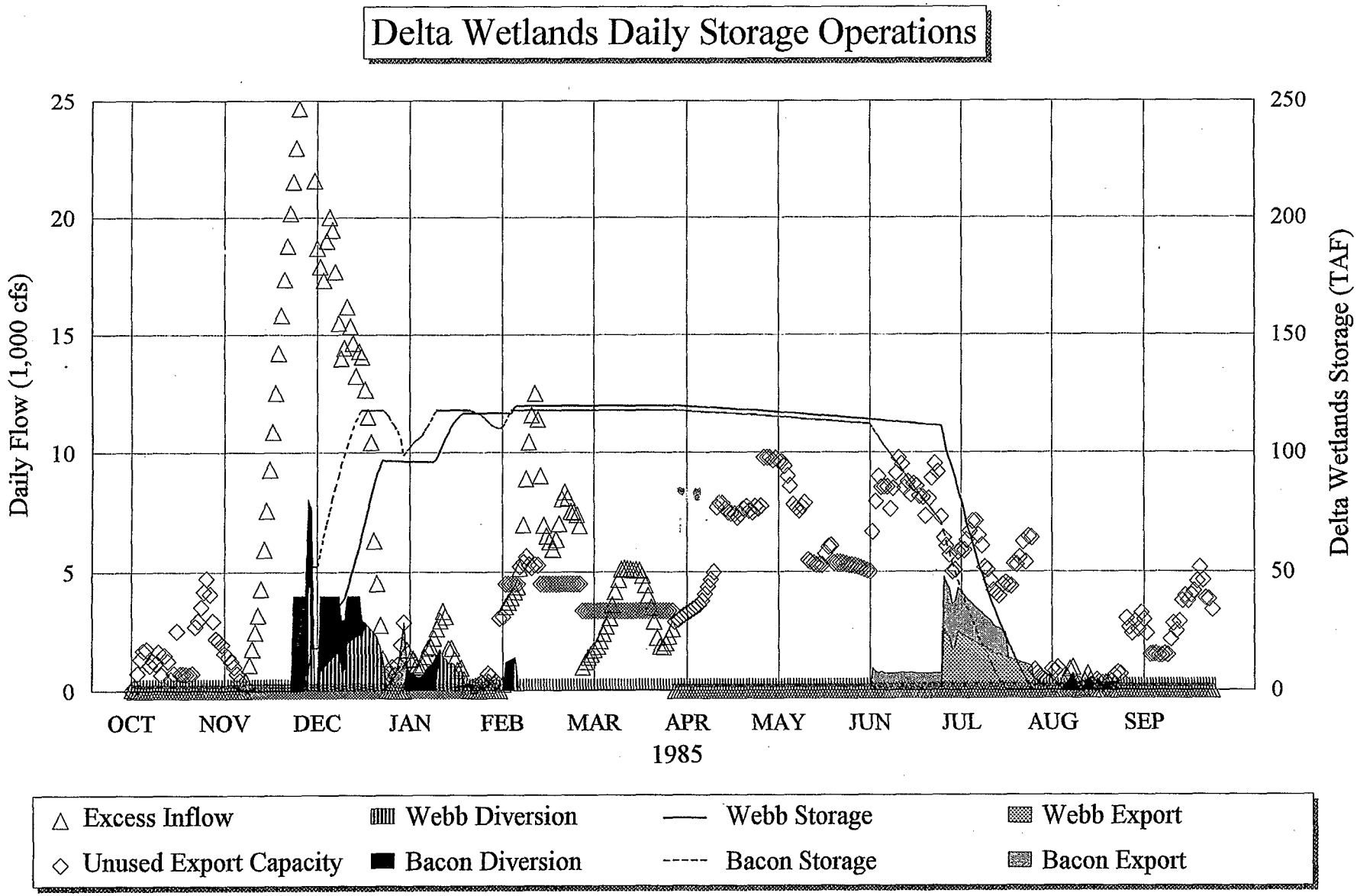
Figure F-18 shows daily simulated Delta Wetlands operations with the combined SWP and CVP Delta exports and a south-of-Delta delivery pattern. The monthly simulated DWRSIM delivery of 5,690 TAF in 1993 is considerably higher than the historical delivery of 3,832 TAF. The 250 TAF of Delta Wetlands exports simulated in March, June, and July would increase south-of-Delta water supply by about 4%. The monthly model estimated Delta Wetlands discharges for export during 1993 as 225 TAF, with all Delta Wetlands diversions in March and all Delta Wetlands discharges for export in July. The daily simulation provides a more accurate picture of the way in

which Delta Wetlands could respond to opportunities for diversions and discharges as Delta inflow conditions change during and after major storm events.

DELTA WETLANDS 1994 OPERATIONS

Figure F-19 illustrates potential Delta Wetlands operations under the FOC diversion and discharge measures for water-year 1994. There was only one major inflow event in February and March. Delta Wetlands reservoirs had carryover storage of 65 TAF (Figure F-17). Delta Wetlands exports of 62 TAF were simulated in late October and November. Simulated Delta Wetlands diversions at the end of February and into March were 100 TAF. Discharge from Bacon Island is simulated in June and July, with a minor increment in September, with a total of 90 TAF exported in these months.

Figure F-20 shows daily simulated Delta Wetlands operations with the combined SWP and CVP Delta exports and a south-of-Delta delivery pattern. The monthly simulated DWRSIM delivery of 5,701 TAF in 1994 is higher than the historical delivery of 4,807 TAF. The 153 TAF of Delta Wetlands exports simulated in November and then in May, June, July, and August would increase south-of-Delta water supply by about 3%. The monthly model estimated that Delta Wetlands discharges for export during 1994 would be 76 TAF, with all Delta Wetlands diversions in February and all Delta Wetlands discharges for export in March. The daily simulation modeled available discharge in November from carryover storage and indicated that Delta Wetlands diversions would not occur until March, when San Luis Reservoir was filled. The daily simulation provides a more accurate picture of the way in which Delta Wetlands operations could respond to opportunities for diversions and discharges as Delta inflow and export conditions change during the year.



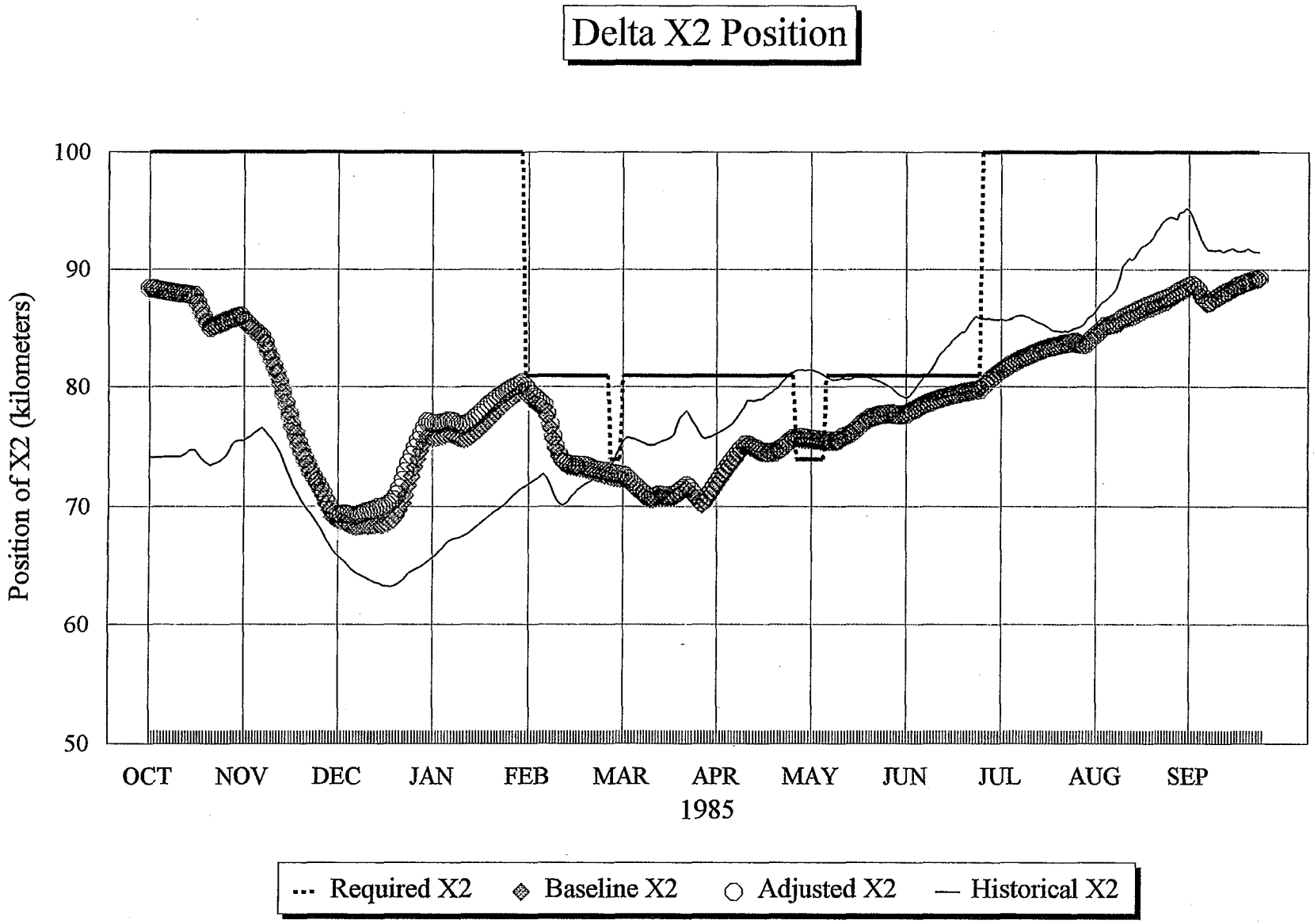
Jones & Stokes

Figure F-1a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1985

C-063291

C-063291

C-063292

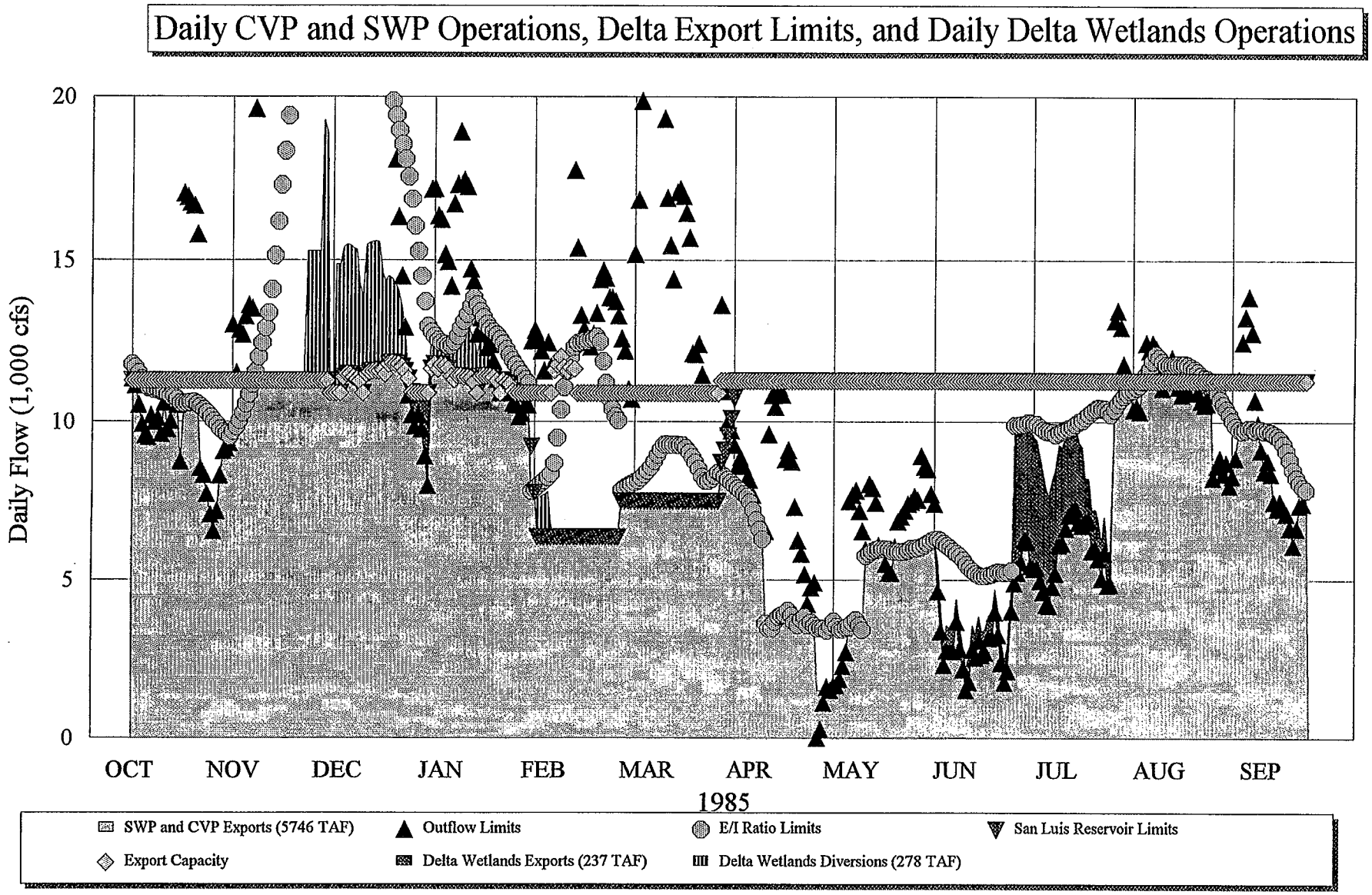


C—063292

Jones & Stokes

Figure F-1b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1985

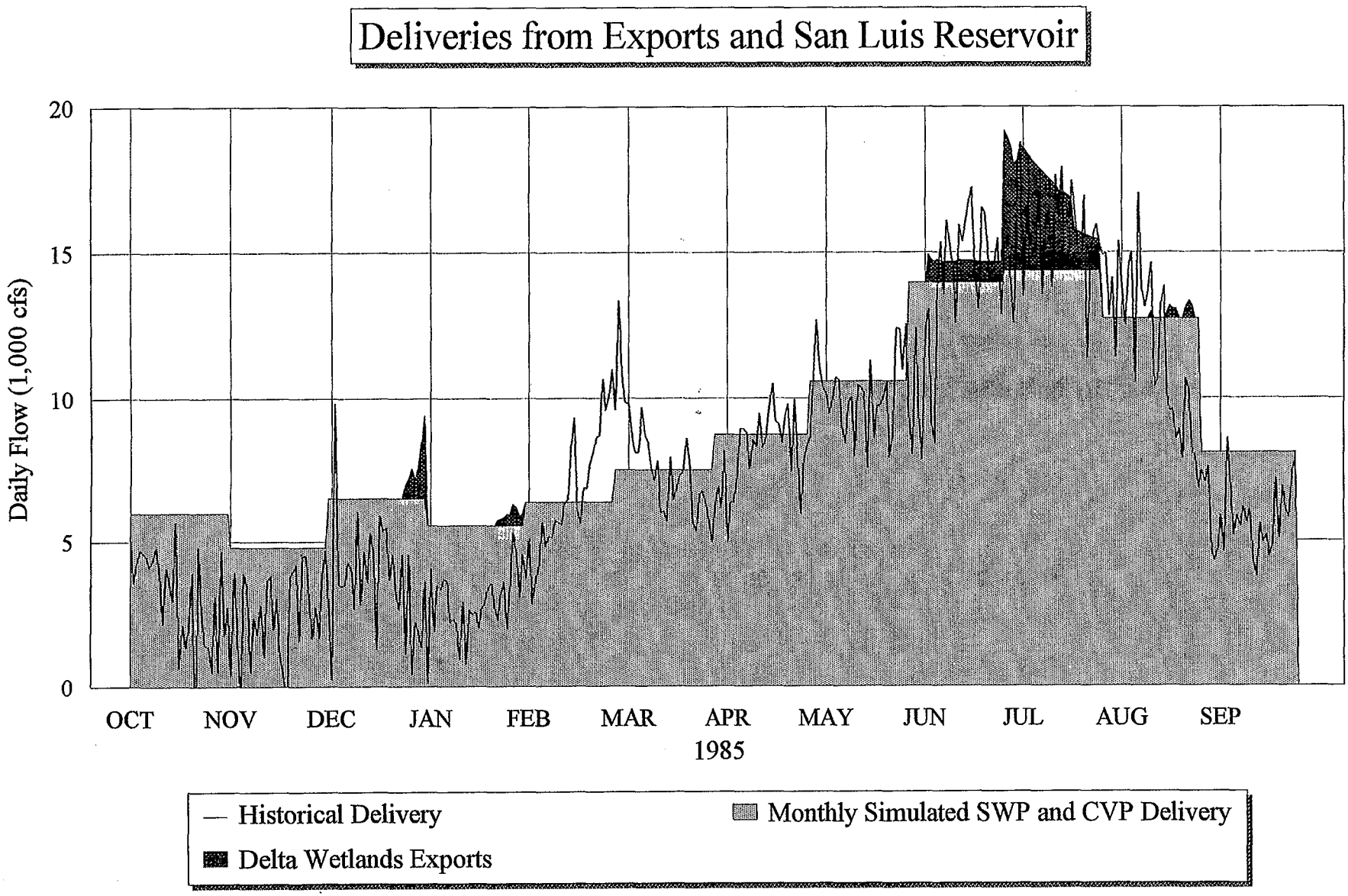
C-063293



Jones & Stokes

Figure F-2a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1985

C—063293

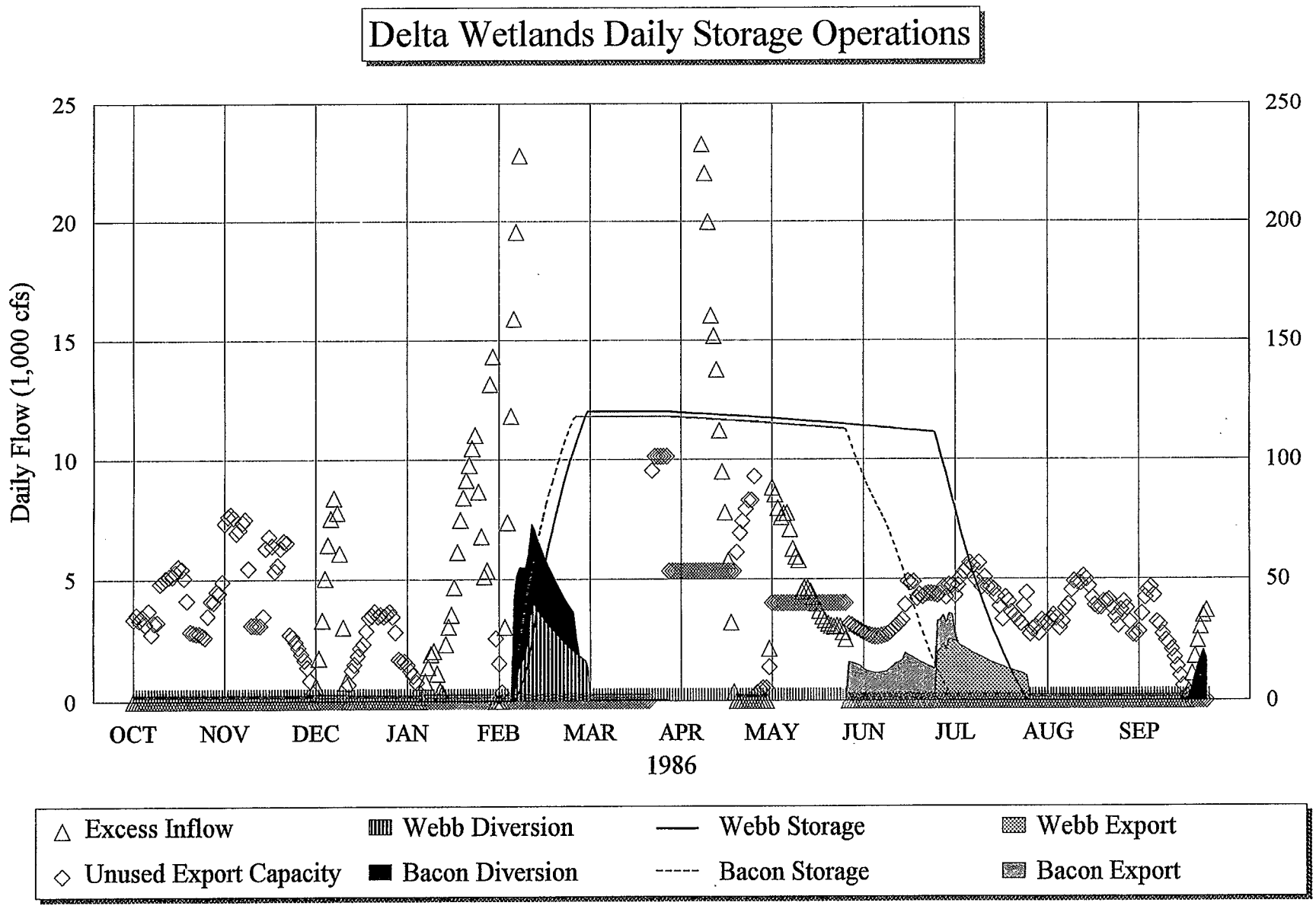


Jones & Stokes

Figure F-2b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1985

C-063294

C-063294

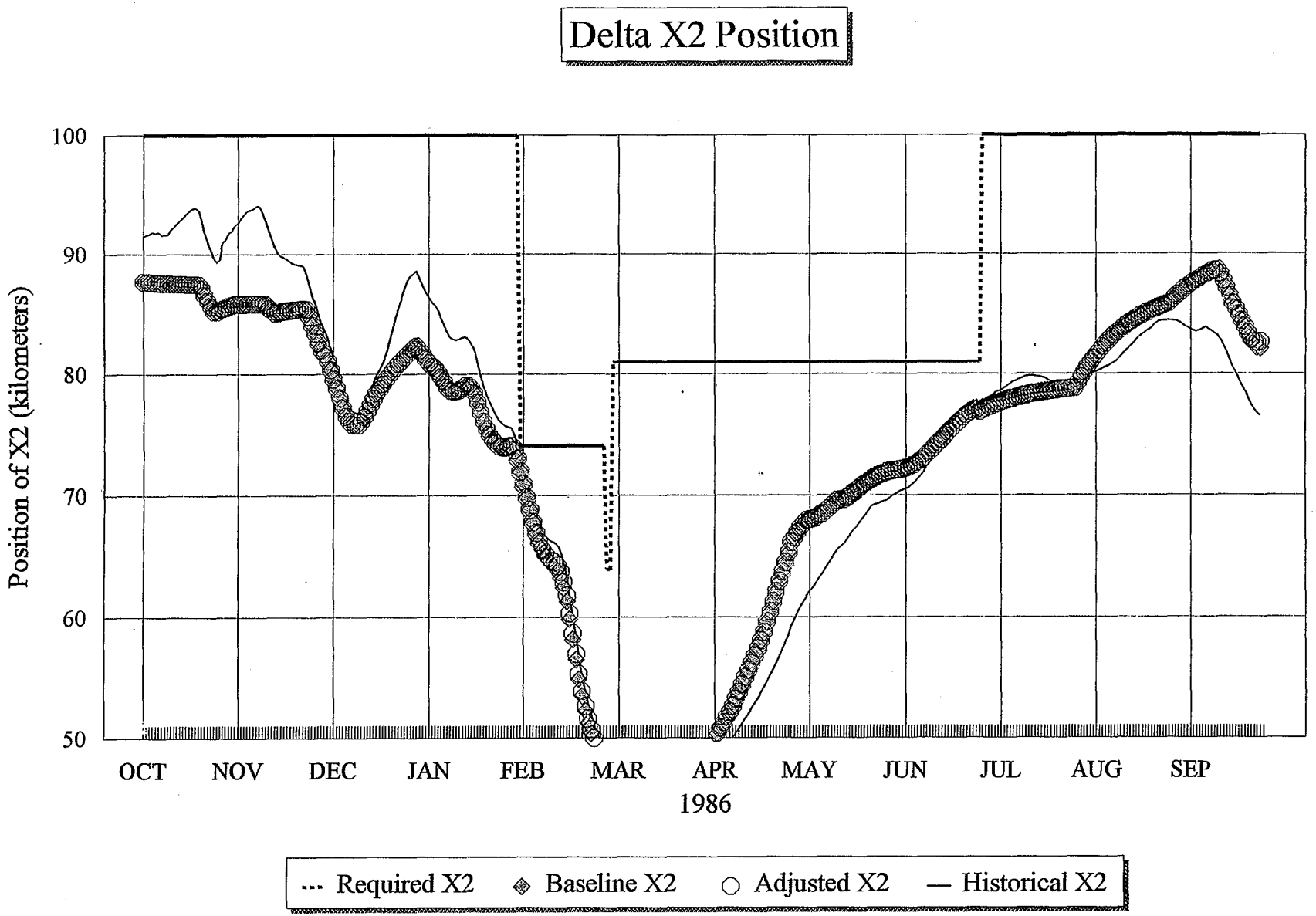


Jones & Stokes

Figure F-3a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1986

C-063295

C-063295

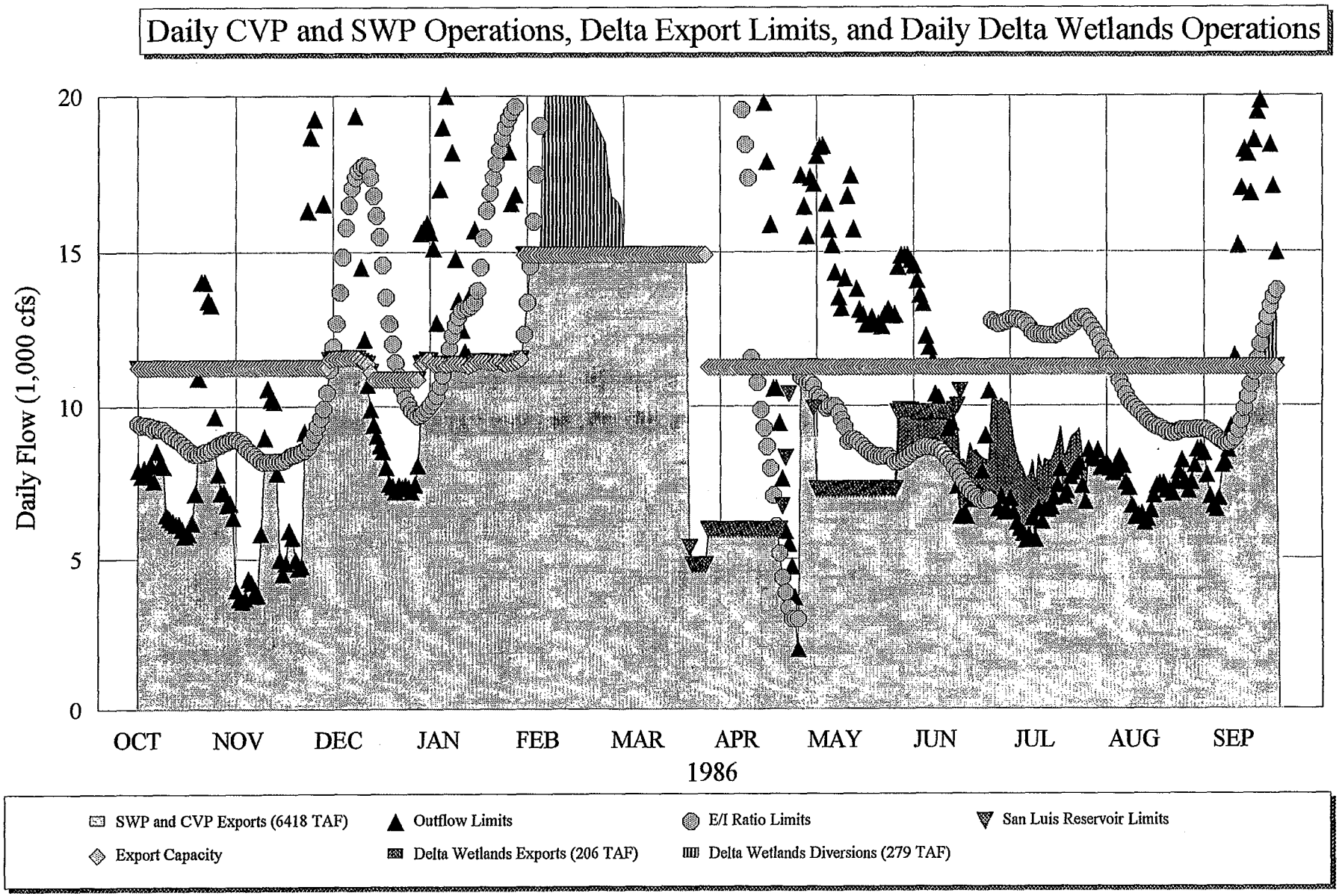


Jones & Stokes

Figure F-3b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1986

C-063296

C-063296

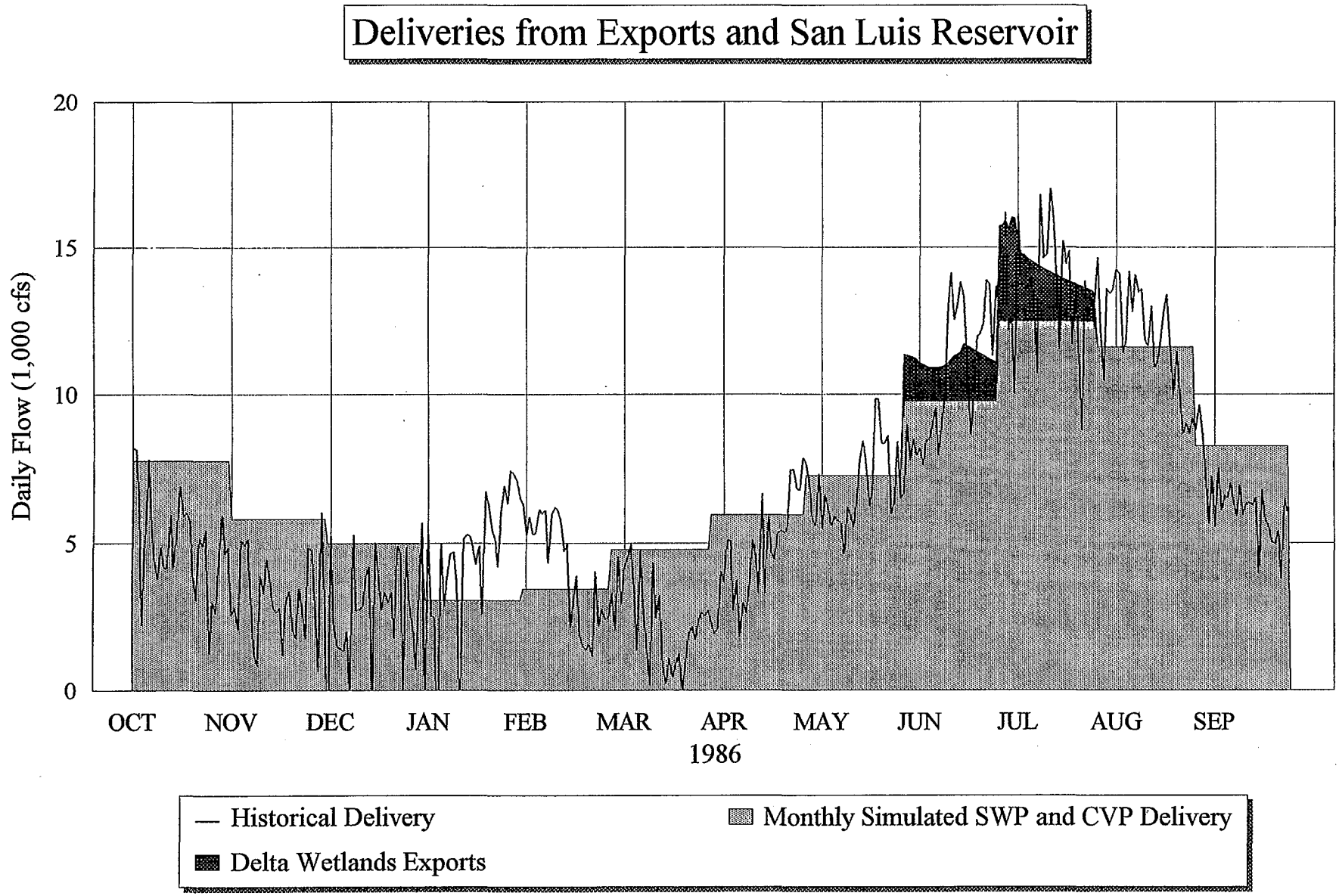


Jones & Stokes

Figure F-4a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1986

C-063297

C-063297

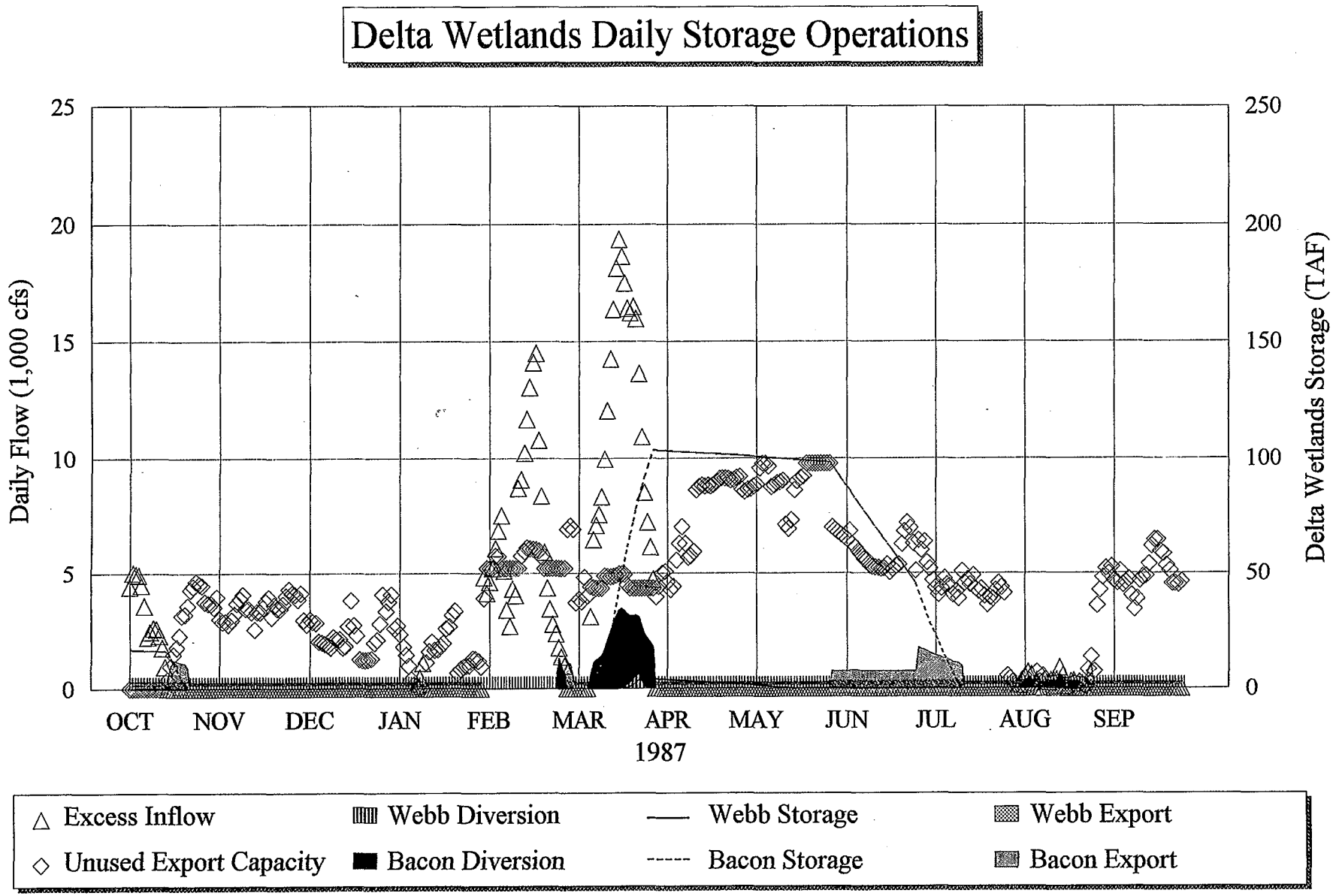


Jones & Stokes

Figure F-4b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1986

C-063298

C-063298



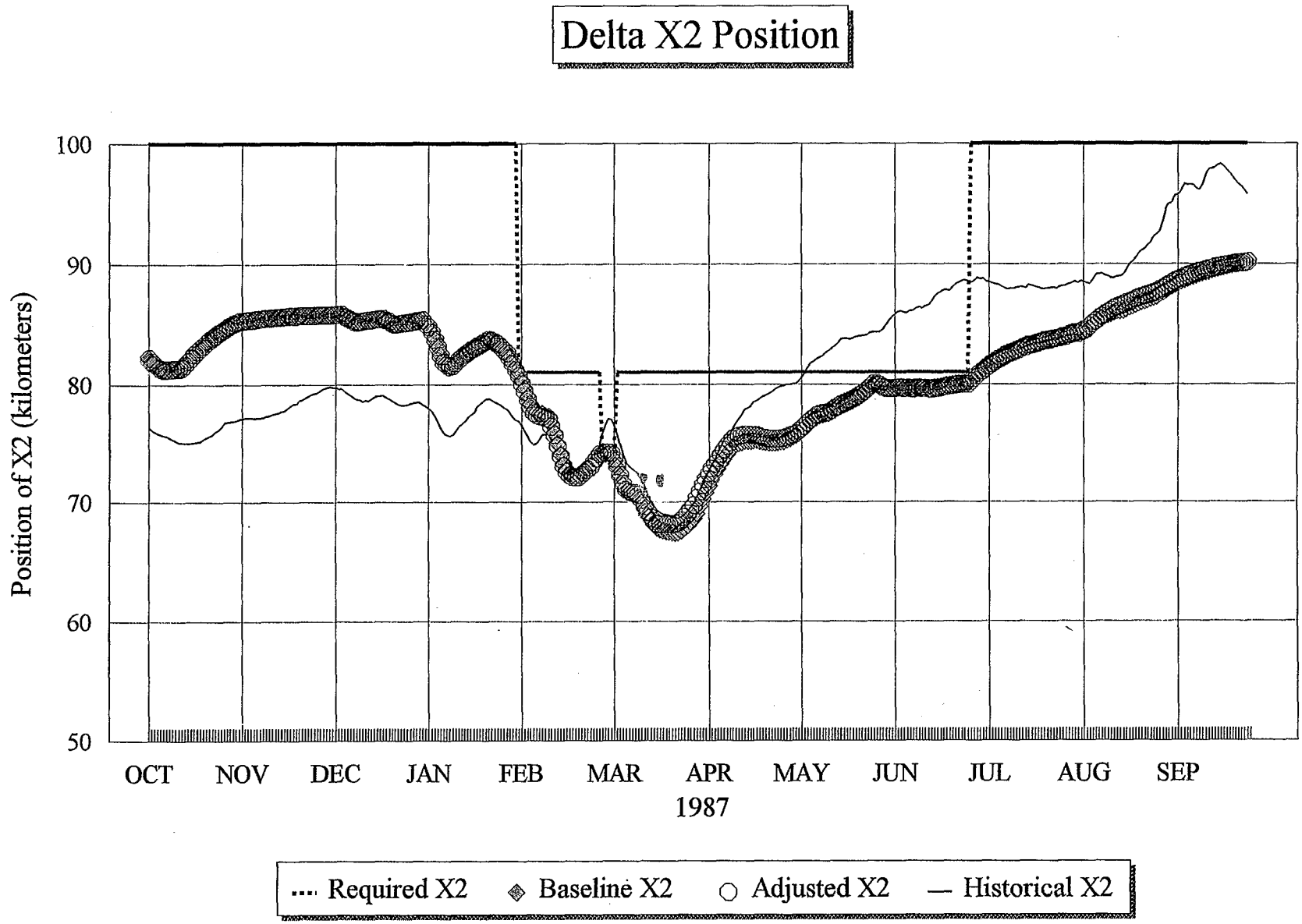
Jones & Stokes

Figure F-5a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1987

C-063299

C-063299

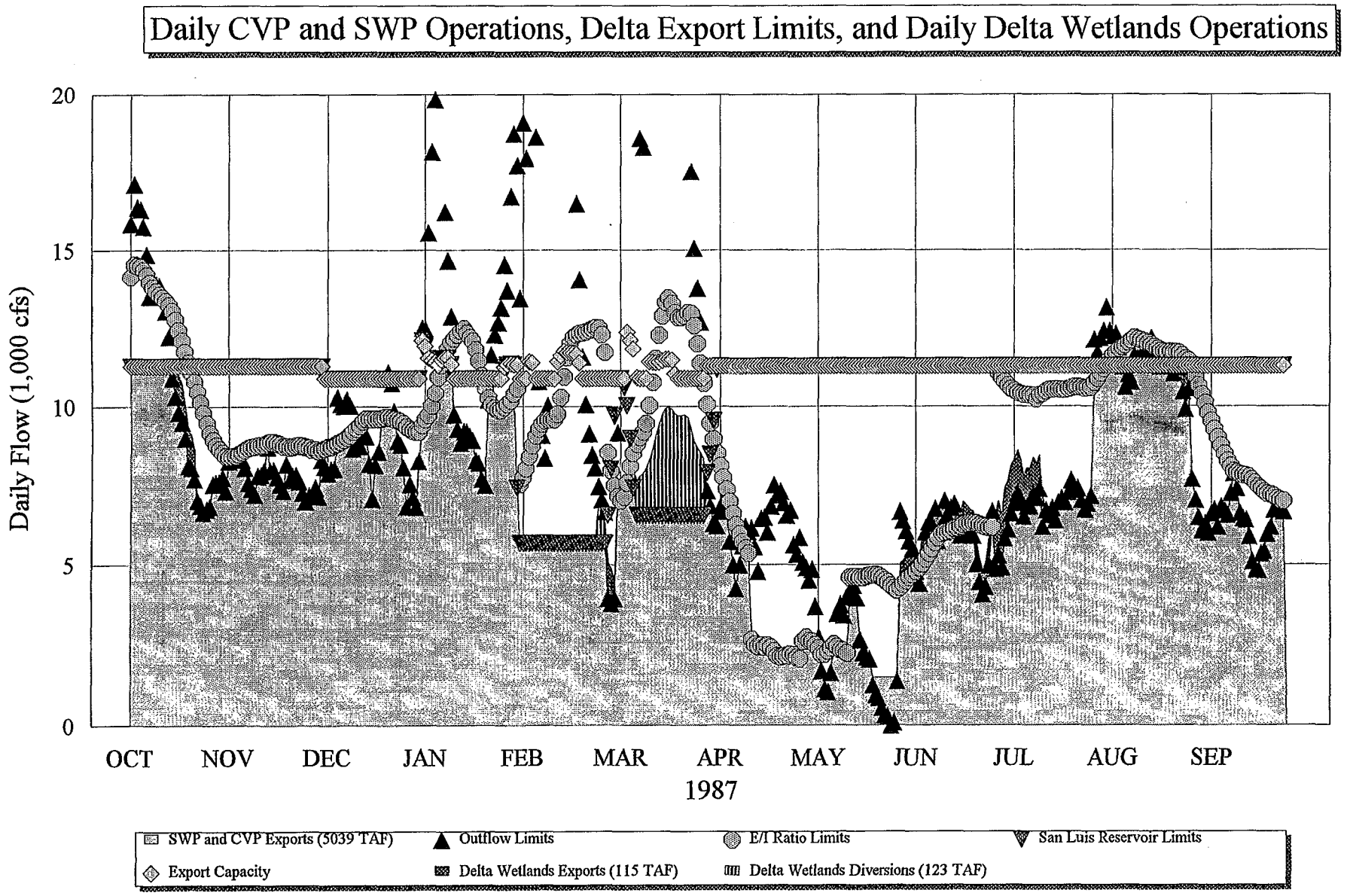
C-063300



C—063300

Jones & Stokes

Figure F-5b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1987

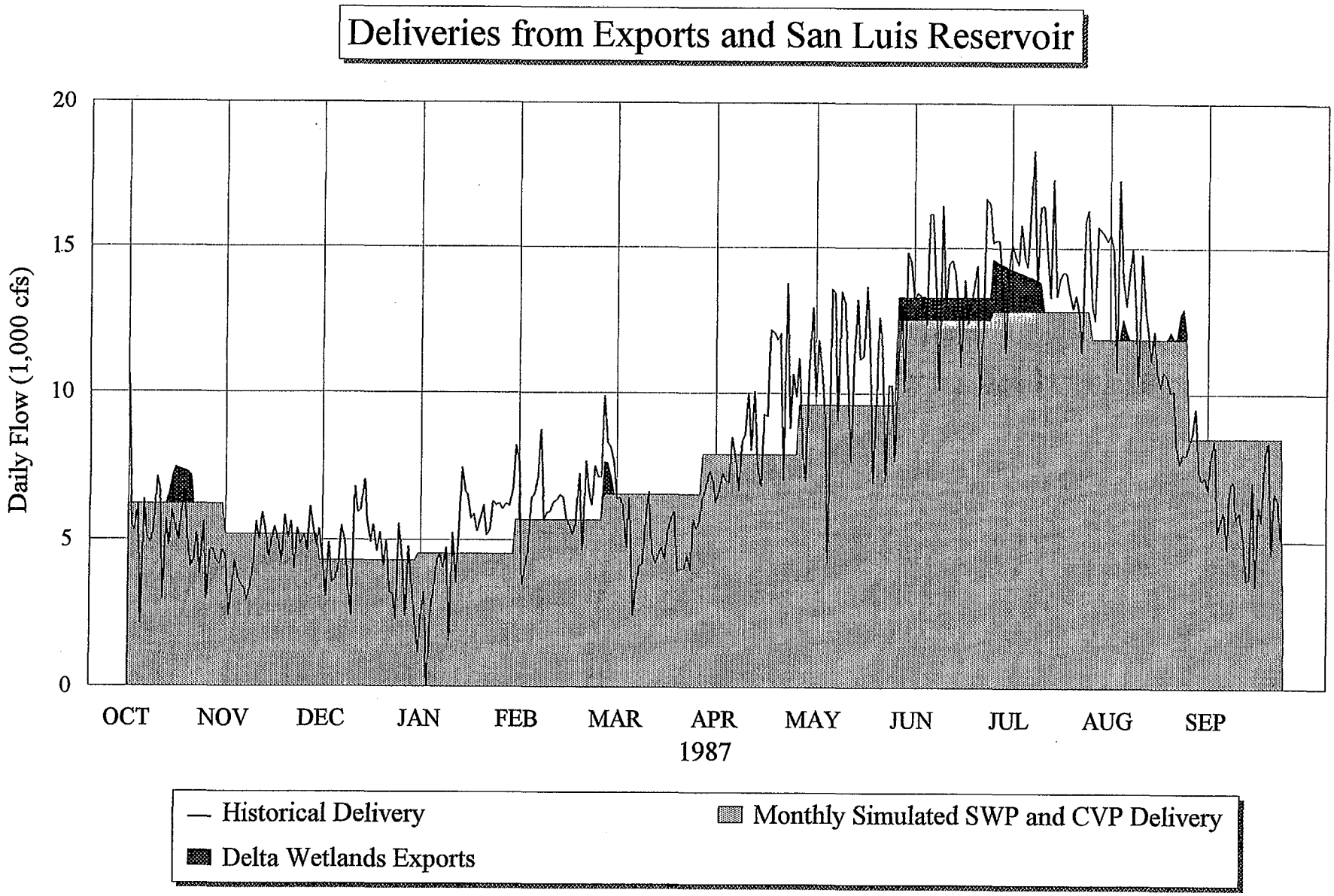


Jones & Stokes

Figure F-6a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1987

C-063301

C—063301

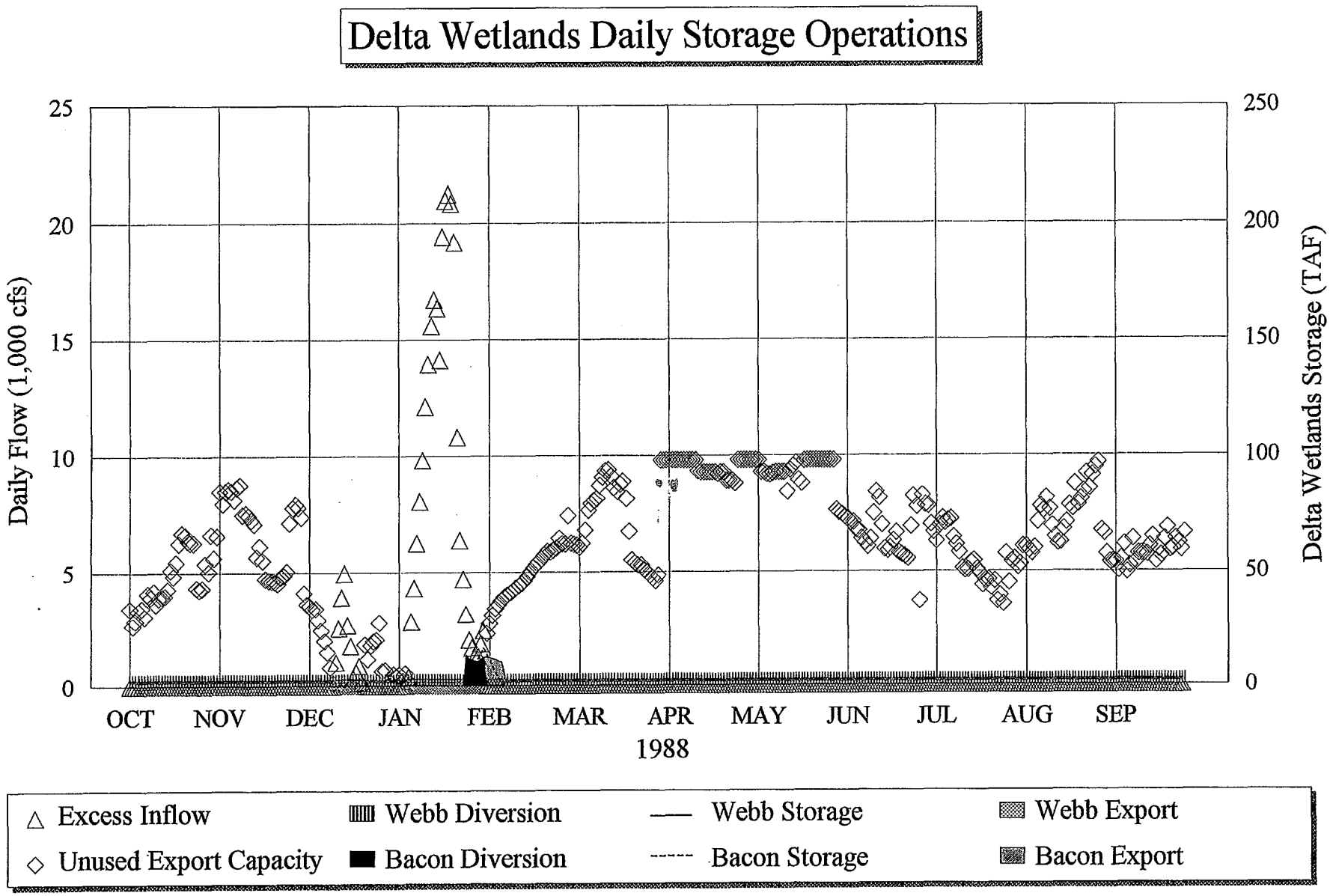


Jones & Stokes

Figure F-6b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1987

C-063302

C-063302

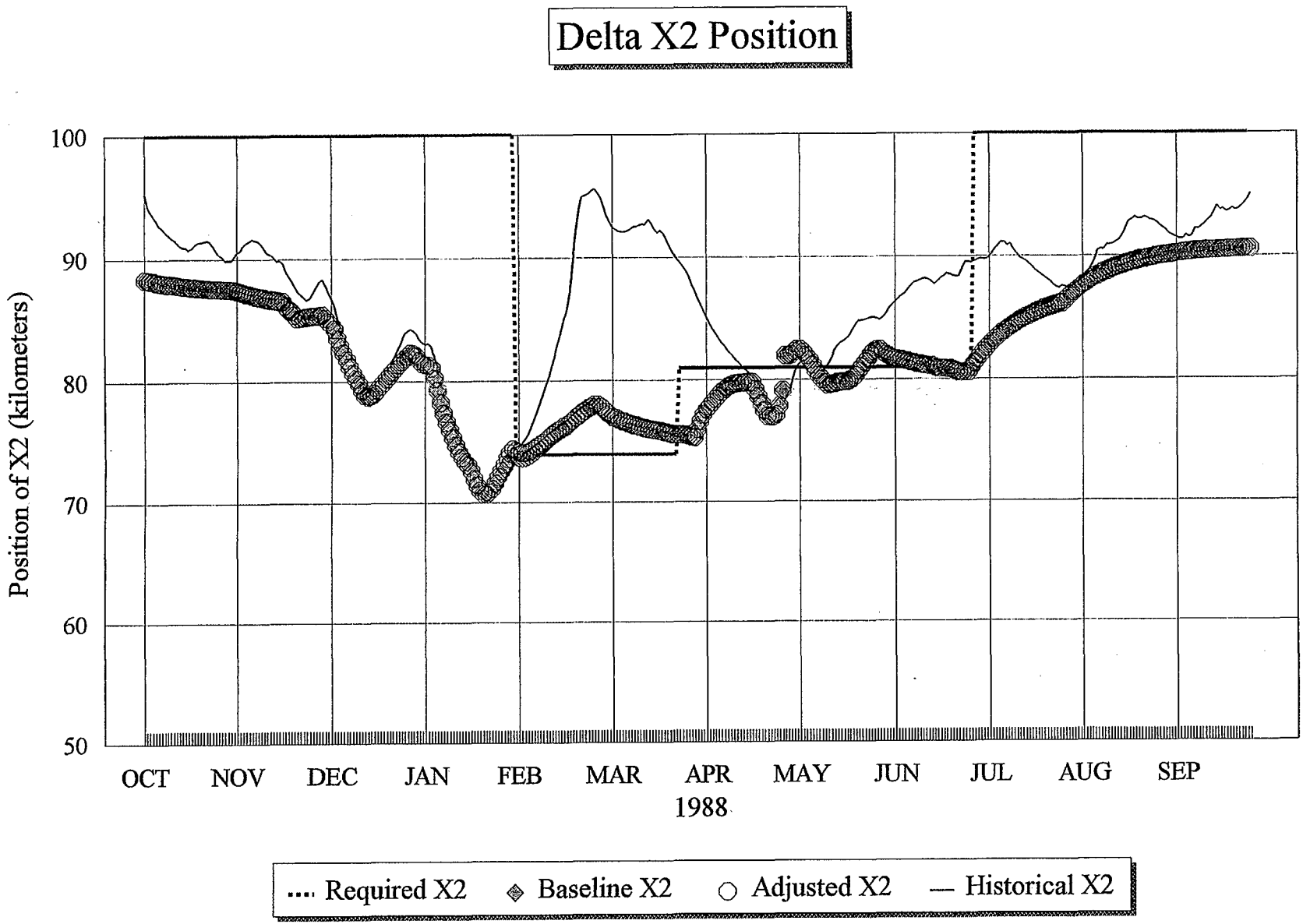


Jones & Stokes

Figure F-7a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1988

C-063303

C-063303

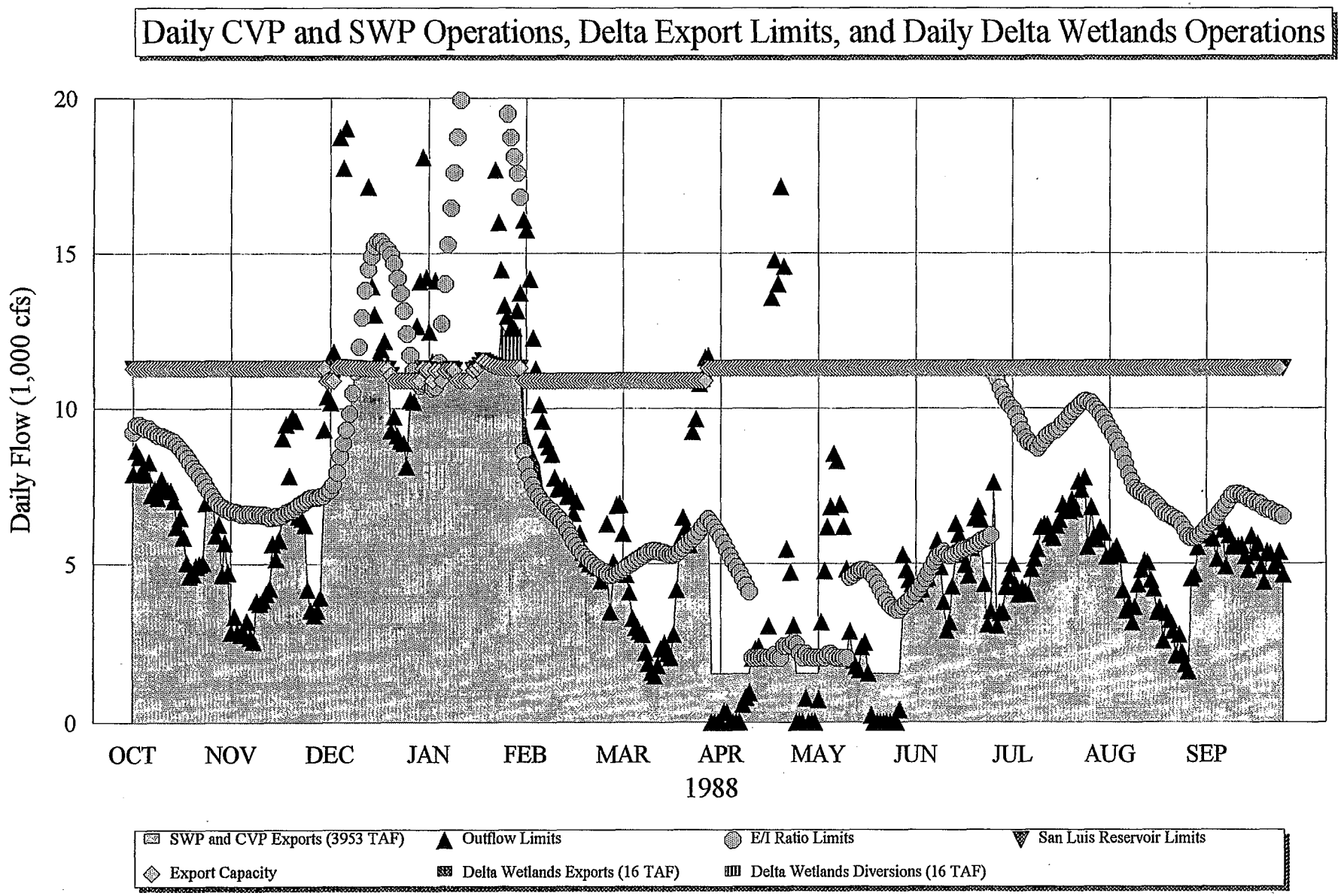


Jones & Stokes

Figure F-7b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1988

C-063304

C-063304

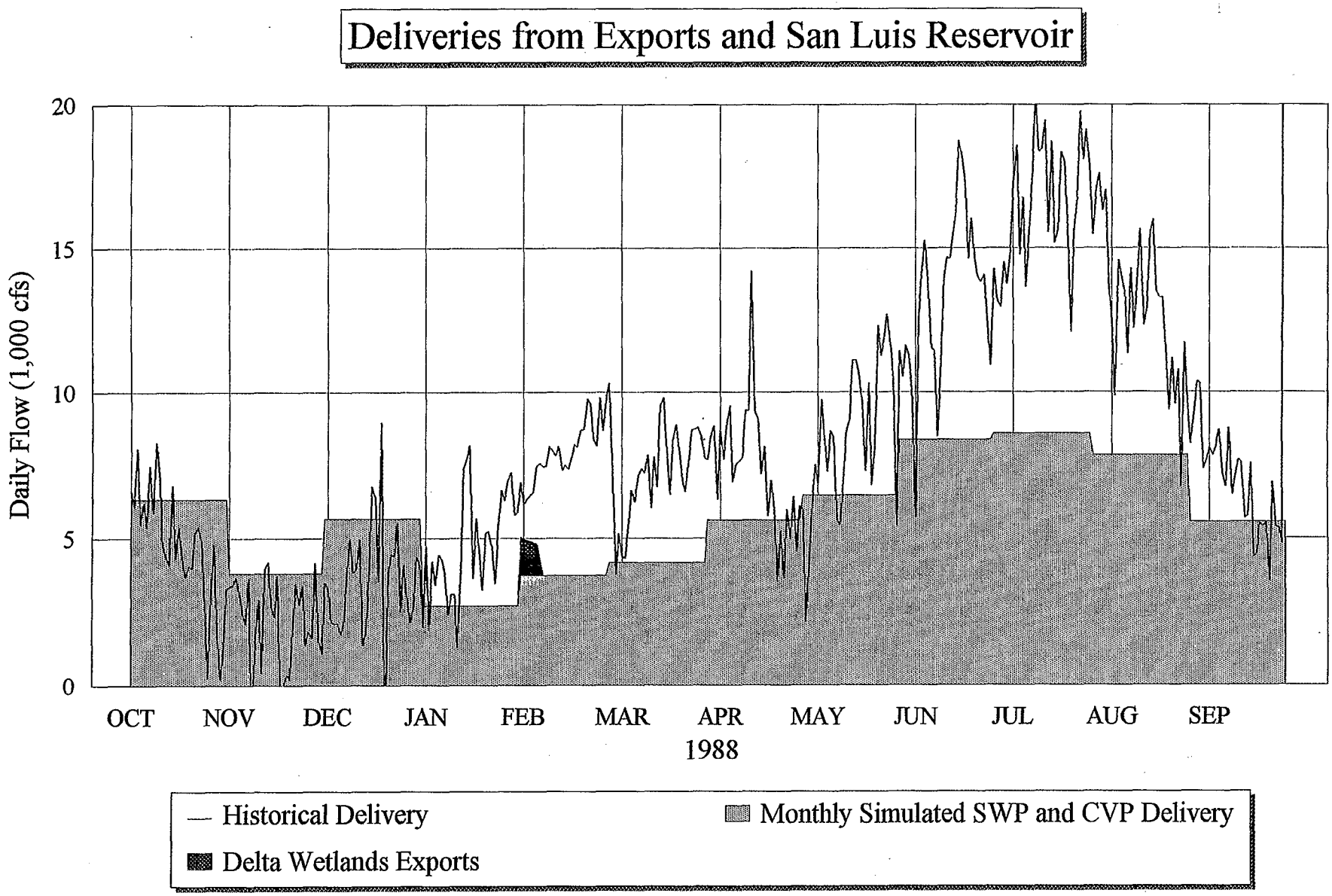


Jones & Stokes

Figure F-8a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1988

C-063305

C-063305

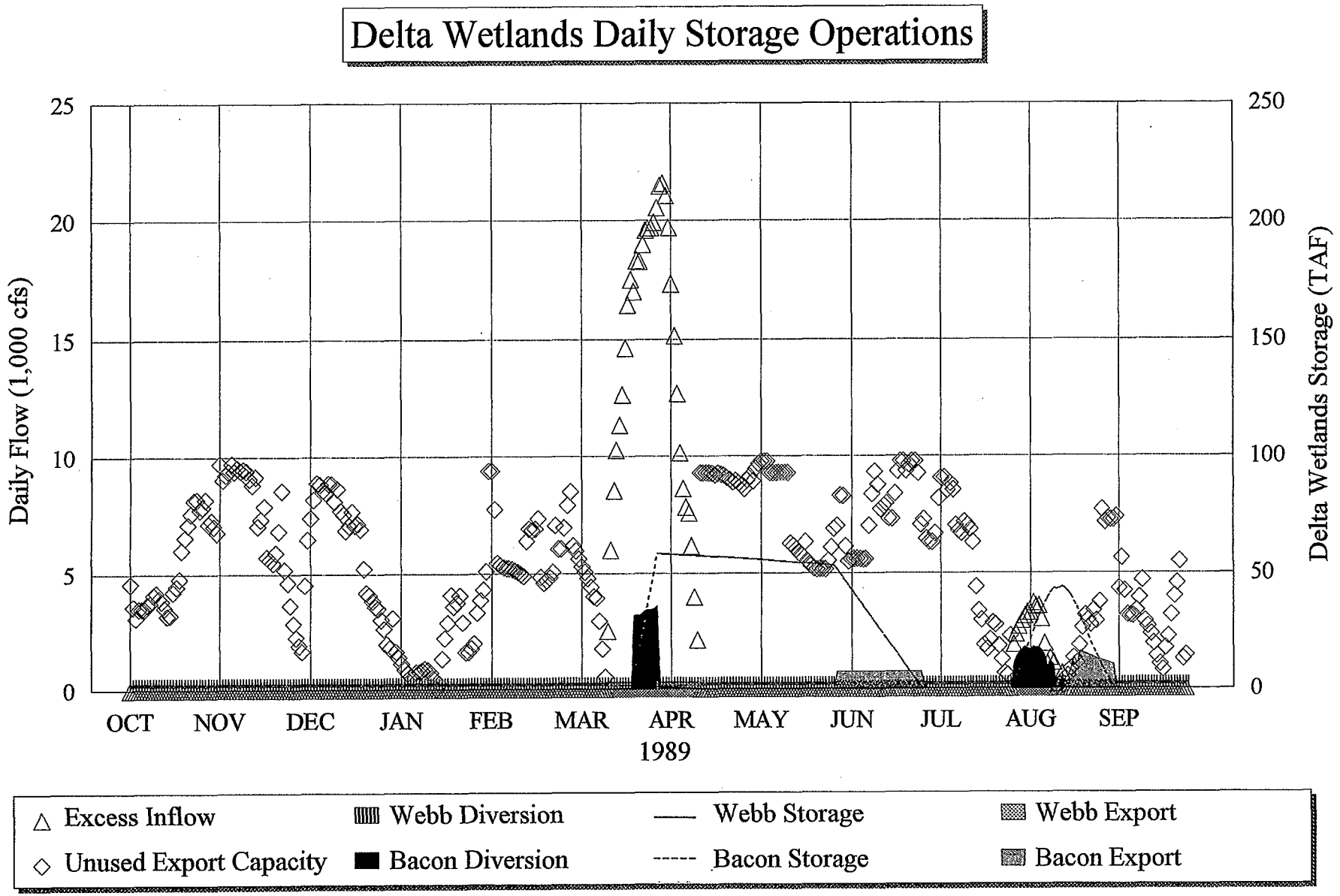


Jones & Stokes

Figure F-8b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1988

C-063306

C-063306



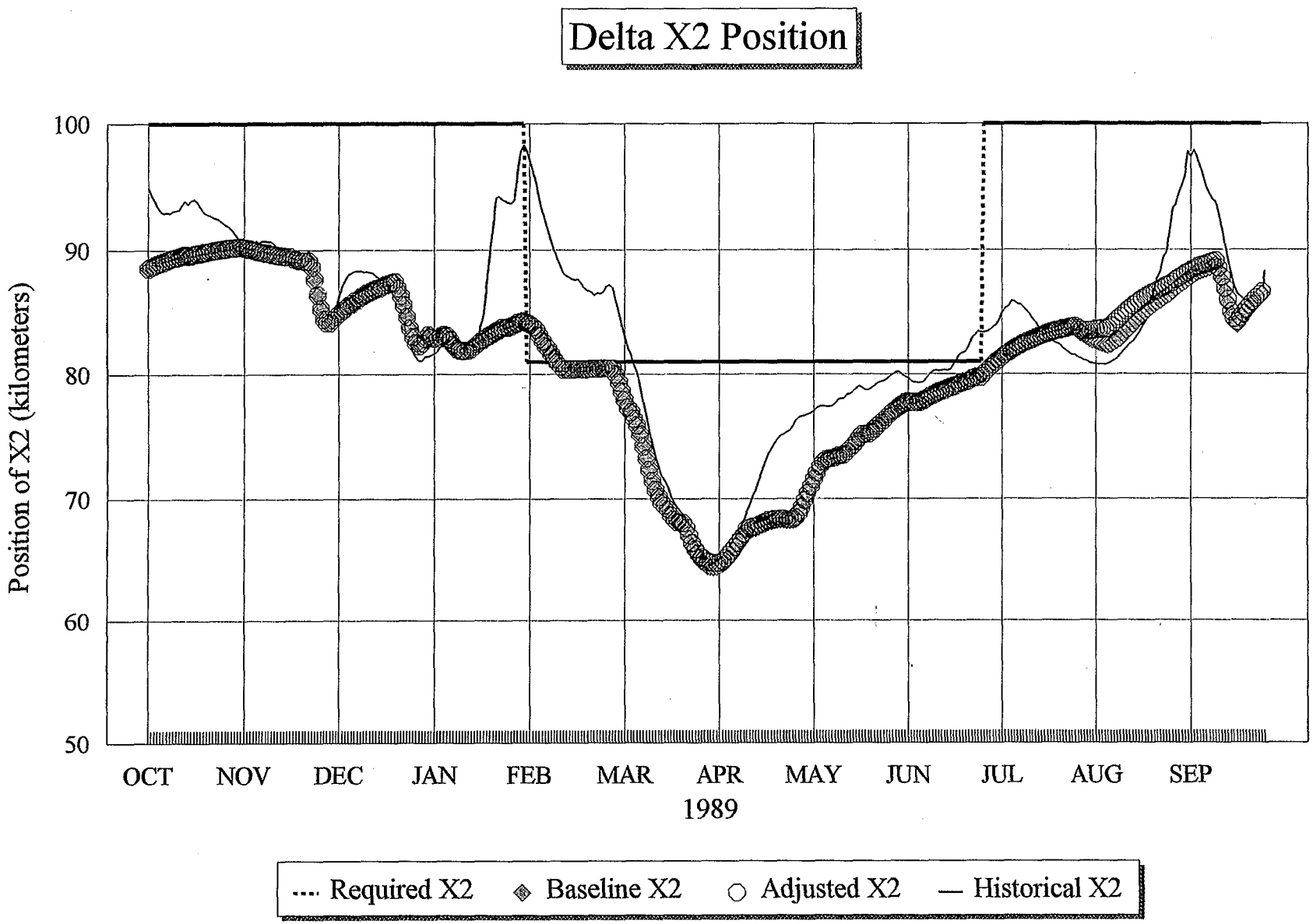
Jones & Stokes

Figure F-9a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1989

C-063307

C-063307

C-063308

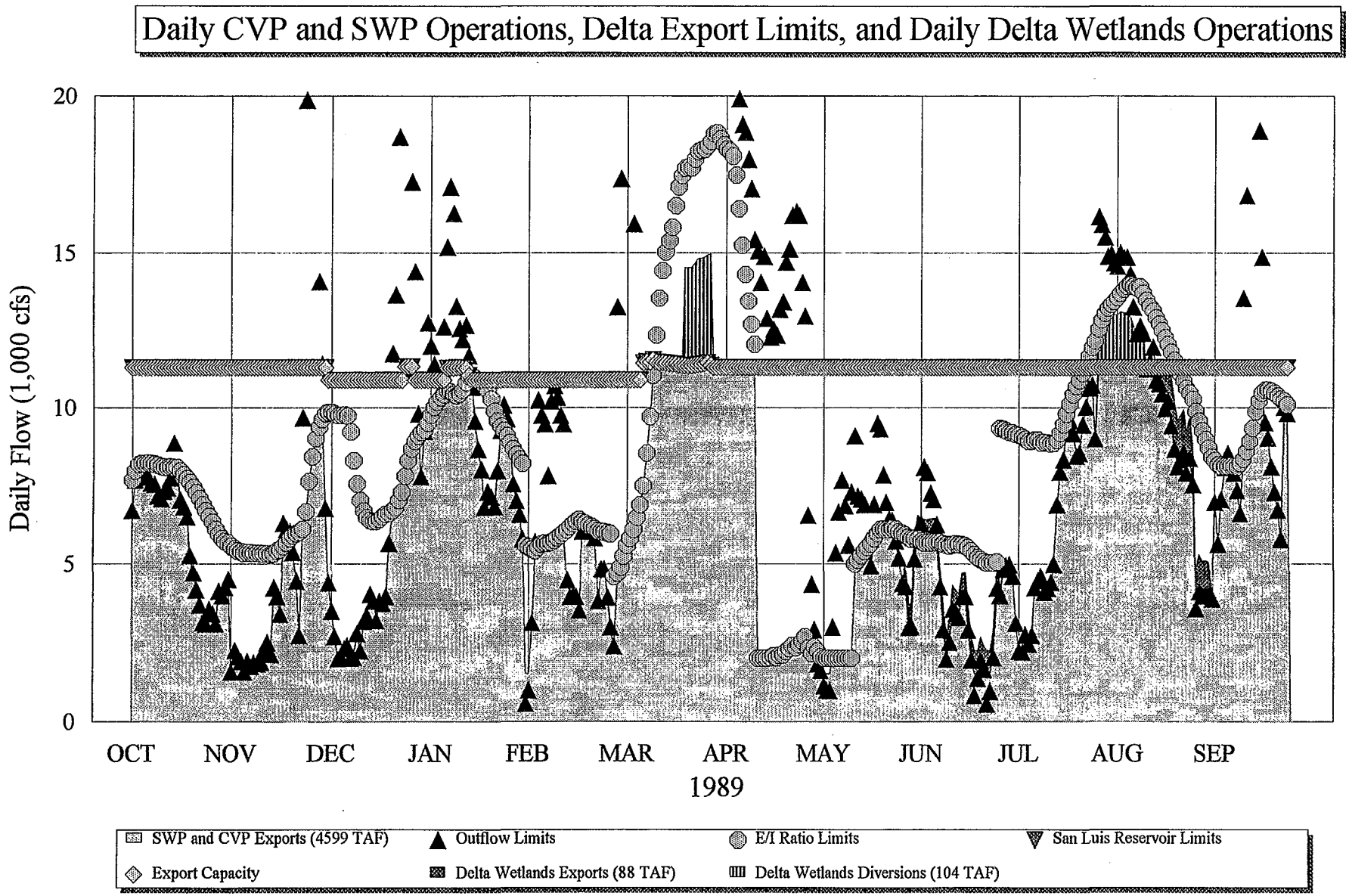


C-063308

Jones & Stokes

Figure F-9b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1989

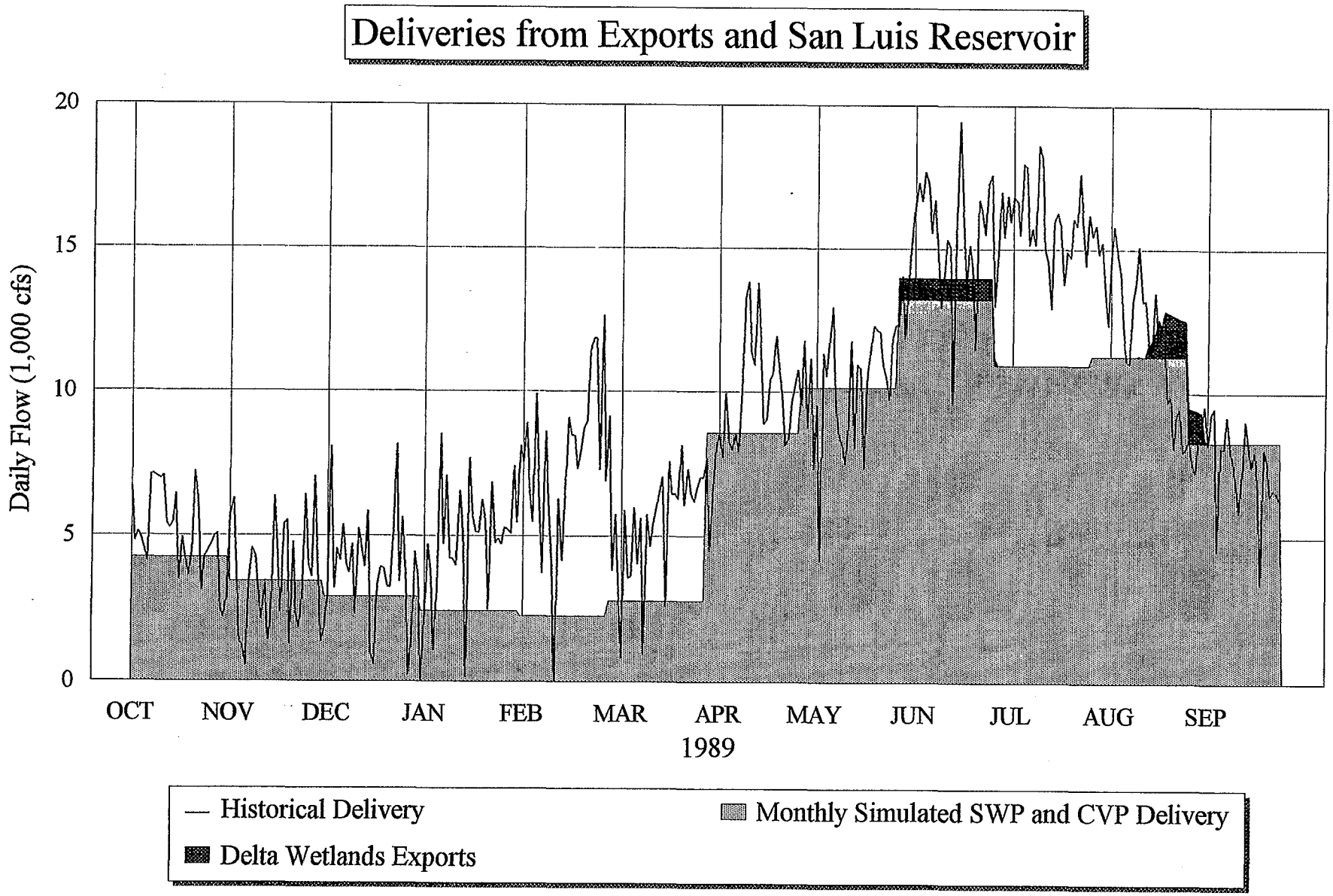
C-063309



C—063309

Jones & Stokes

Figure F-10a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1989

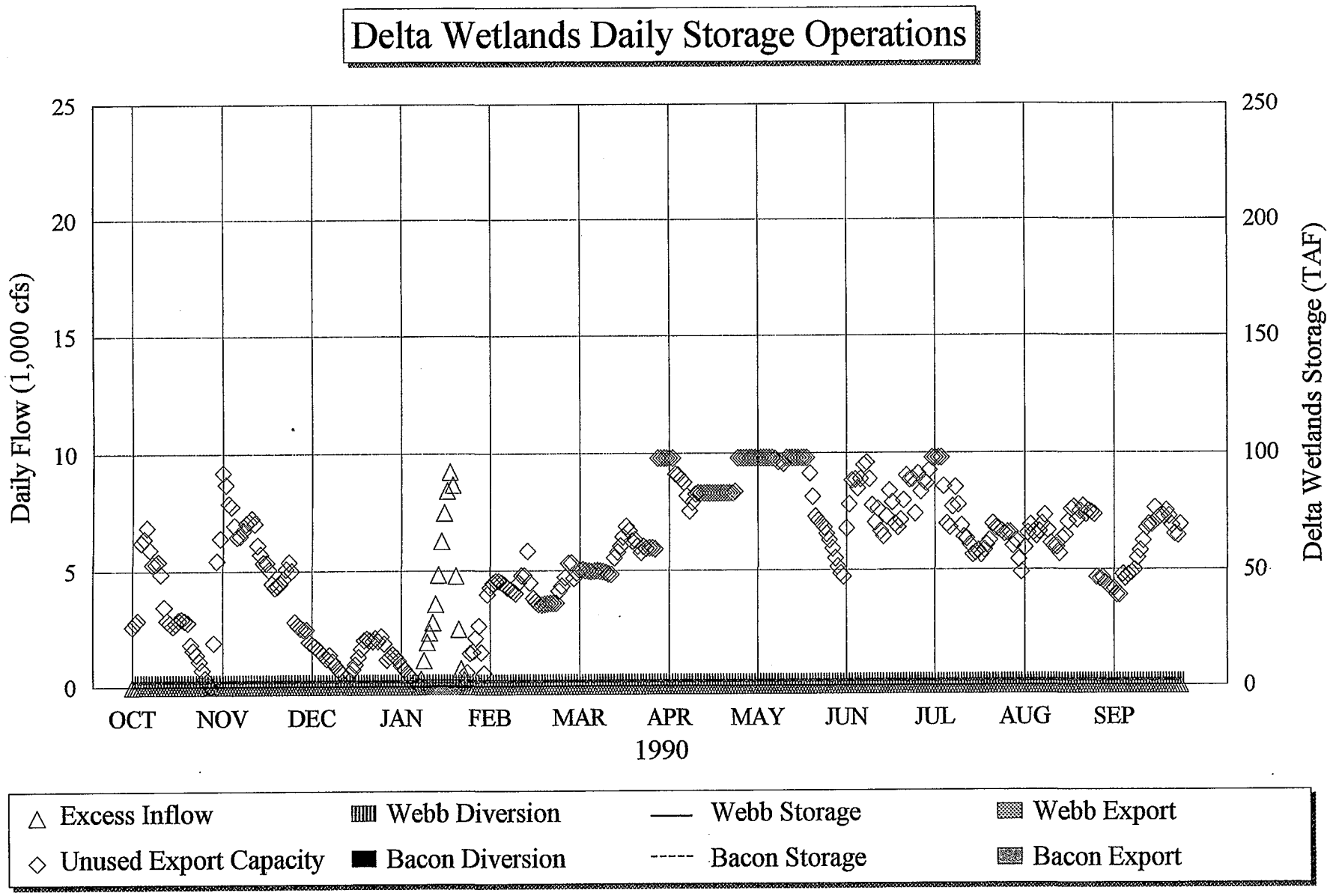


Jones & Stokes

Figure F-10b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1989

C-063310

C-063310

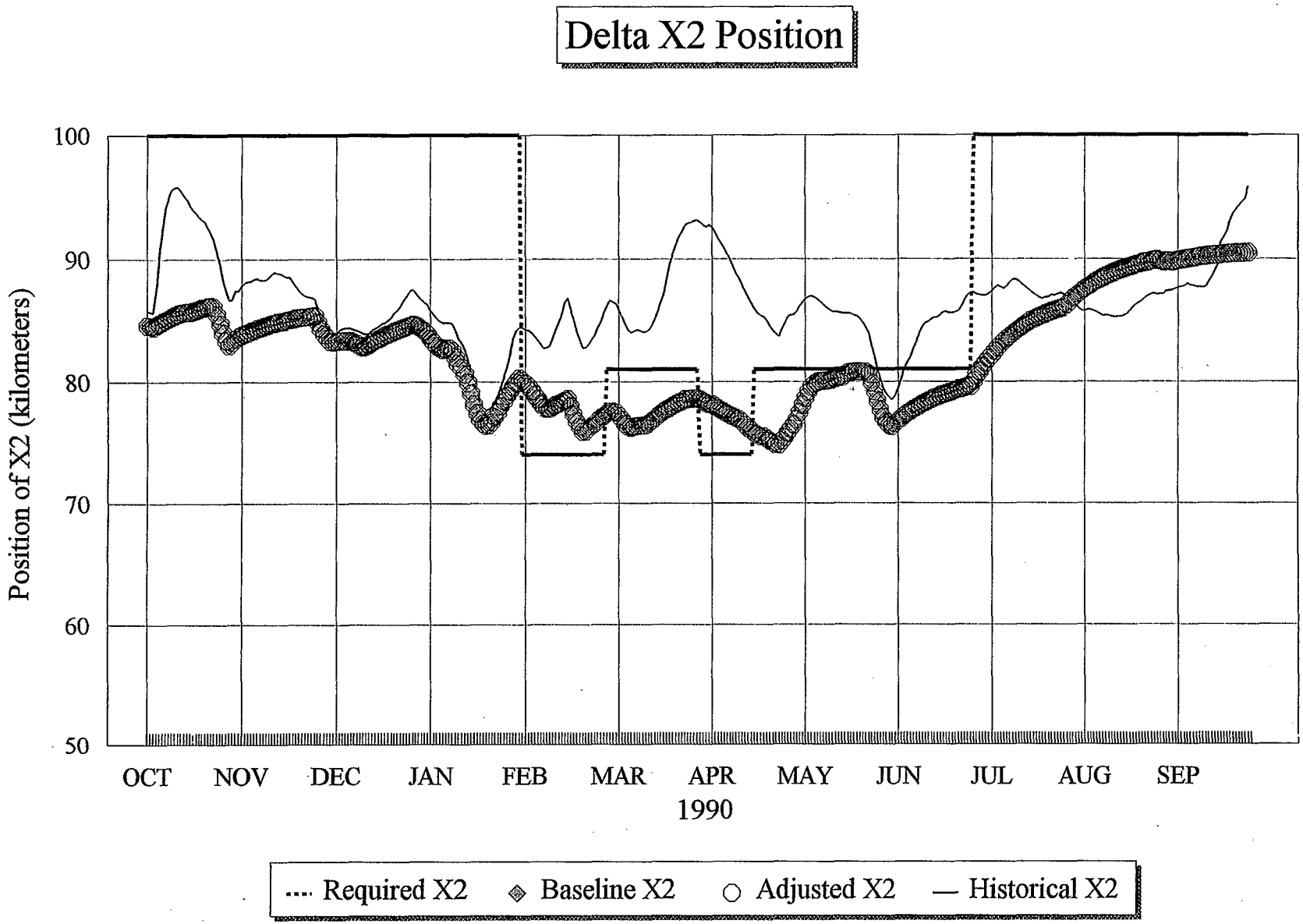


Jones & Stokes

Figure F-11a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1990

C-063311

C-063311

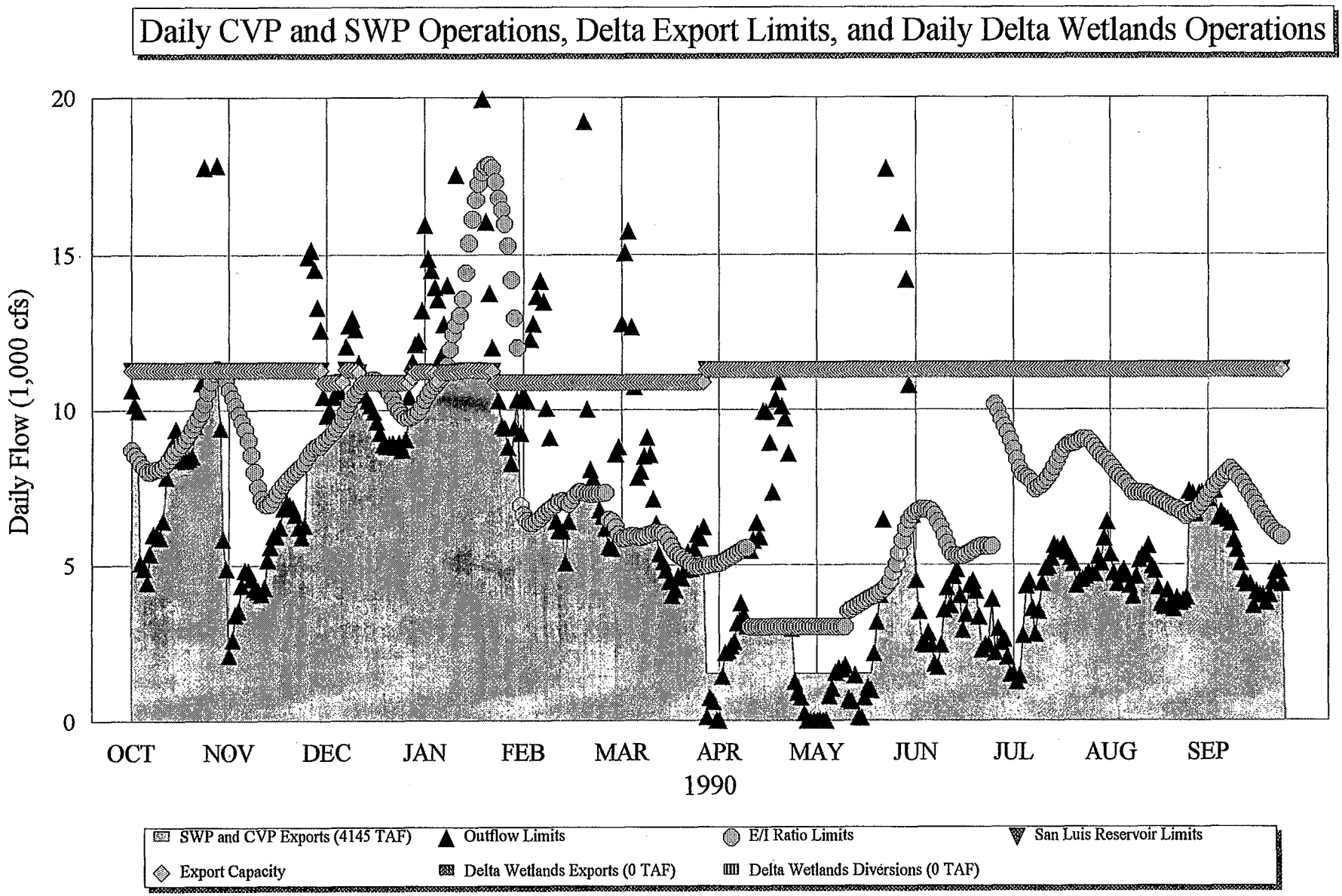


Jones & Stokes

Figure F-11b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1990

C-063312

C—063312



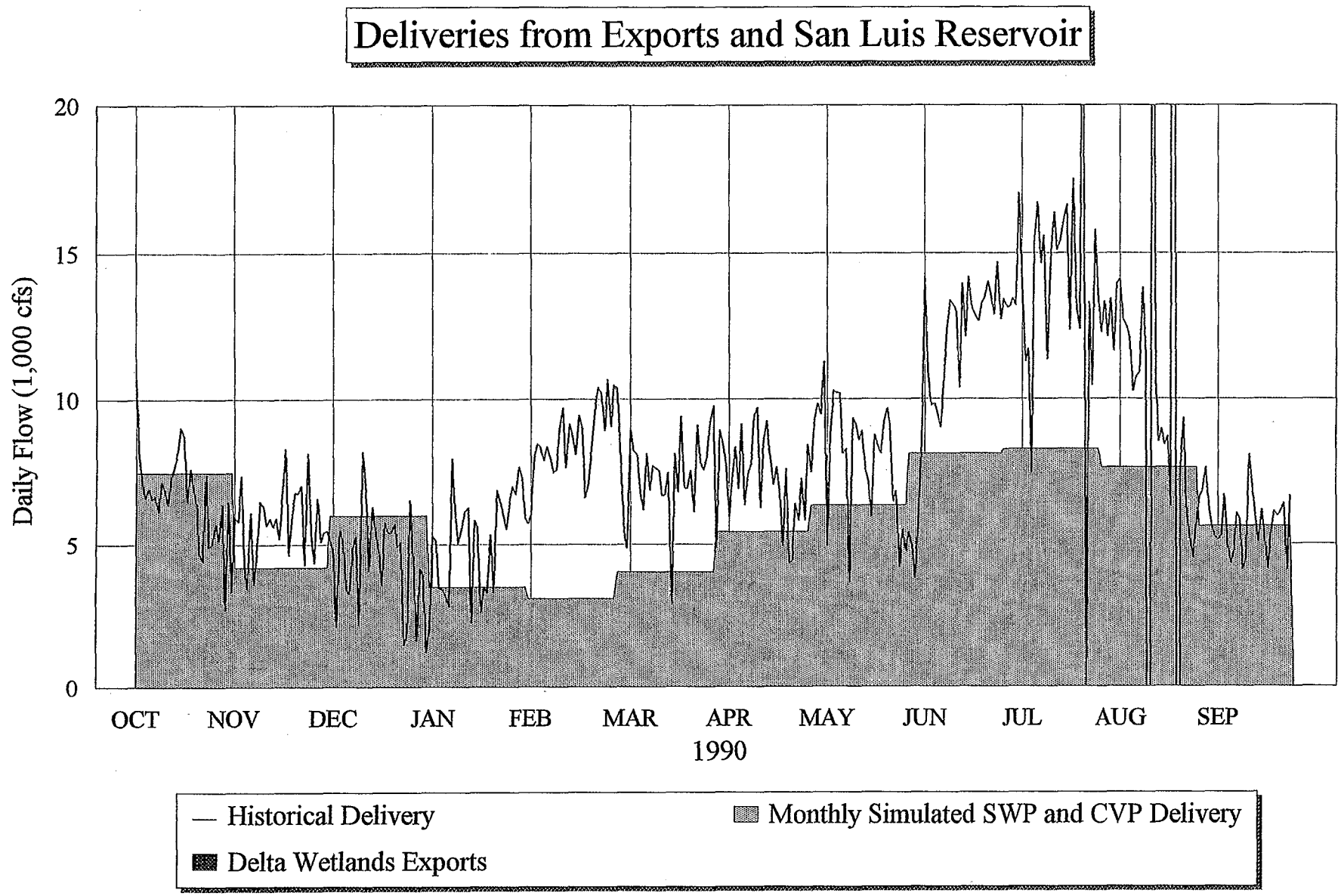
Jones & Stokes

Figure F-12a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1990

C-063313

C-063313

C-063314

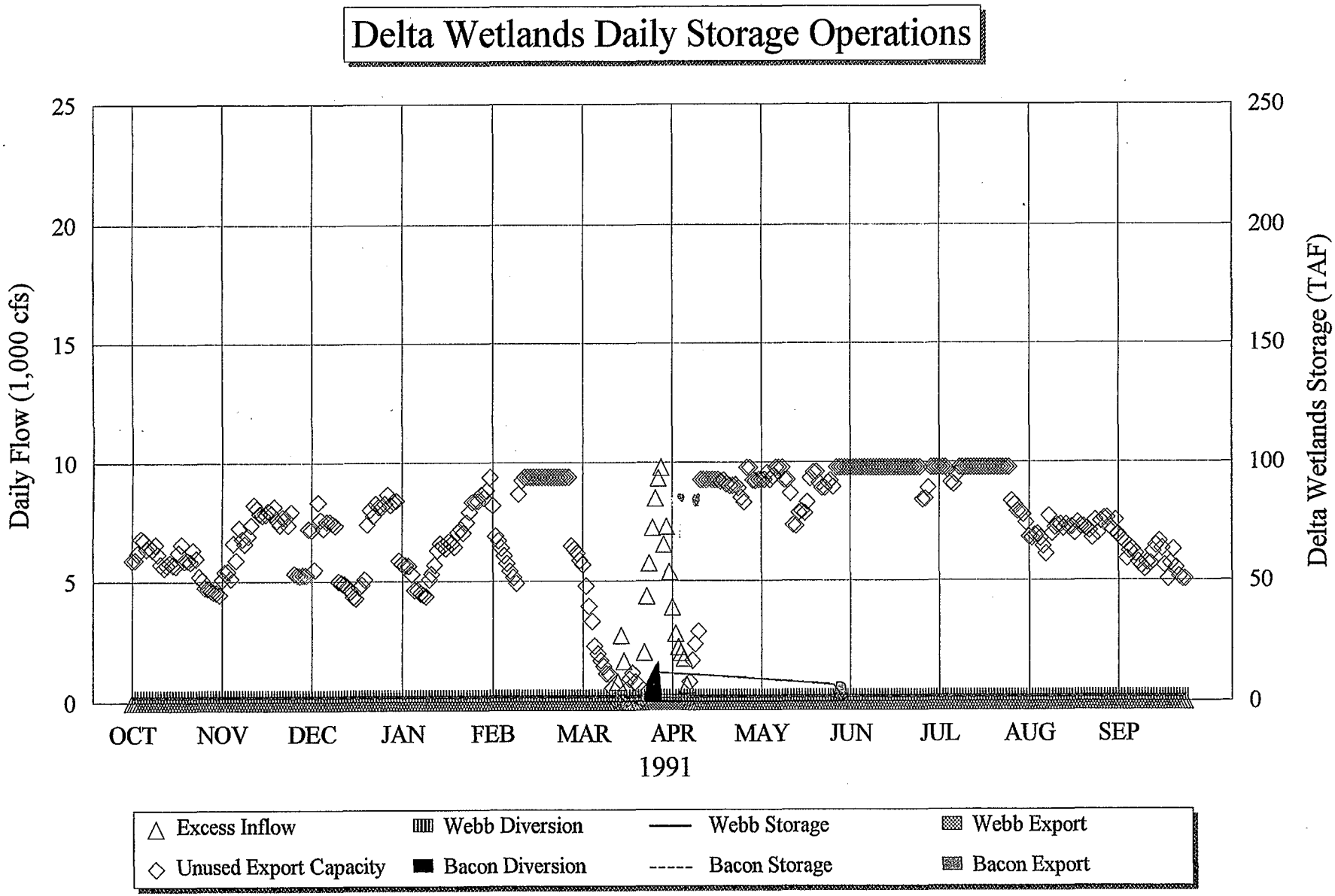


Jones & Stokes

Figure F-12b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1990

C—063314

C-063315

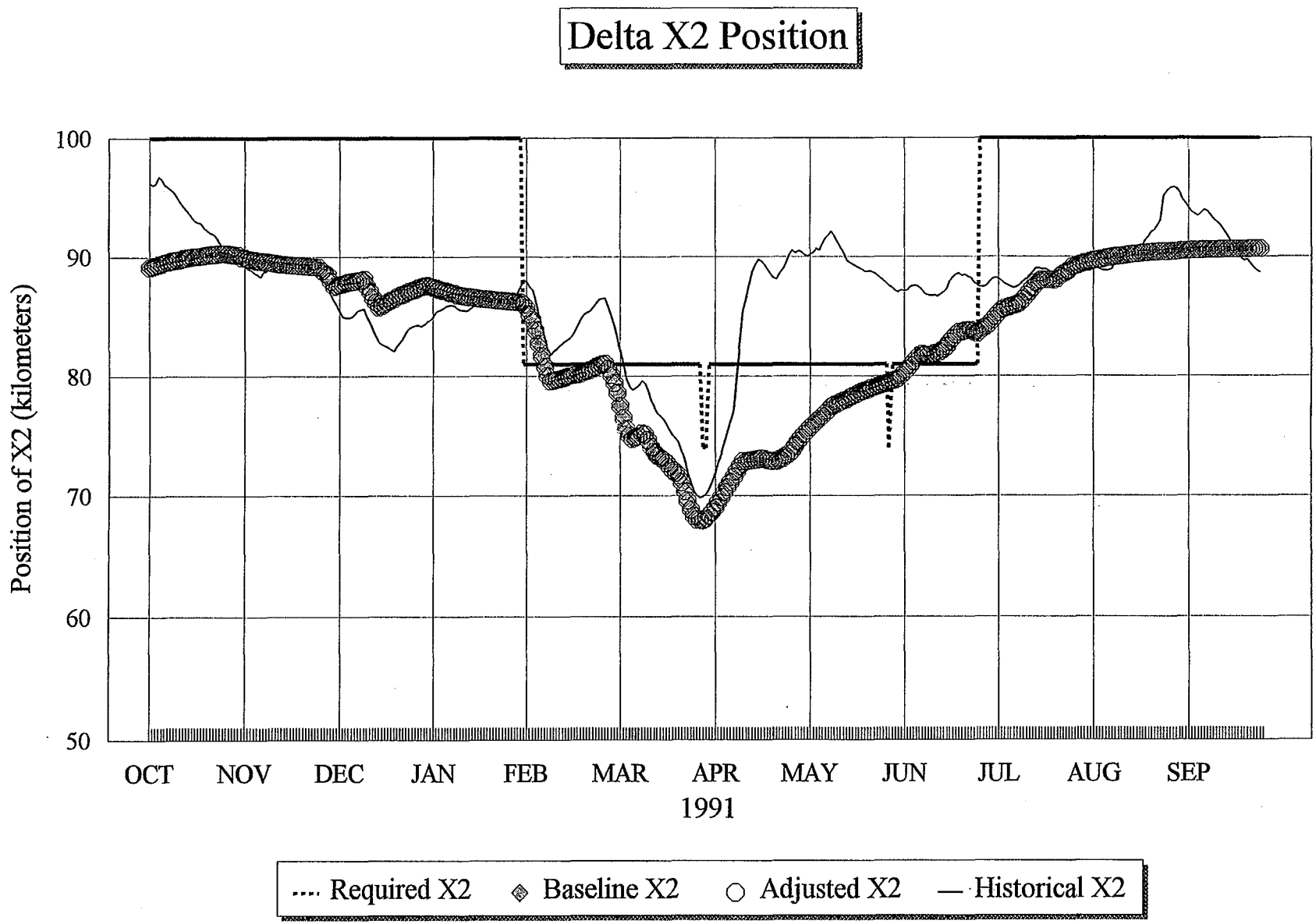


C—063315

Jones & Stokes

Figure F-13a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1991

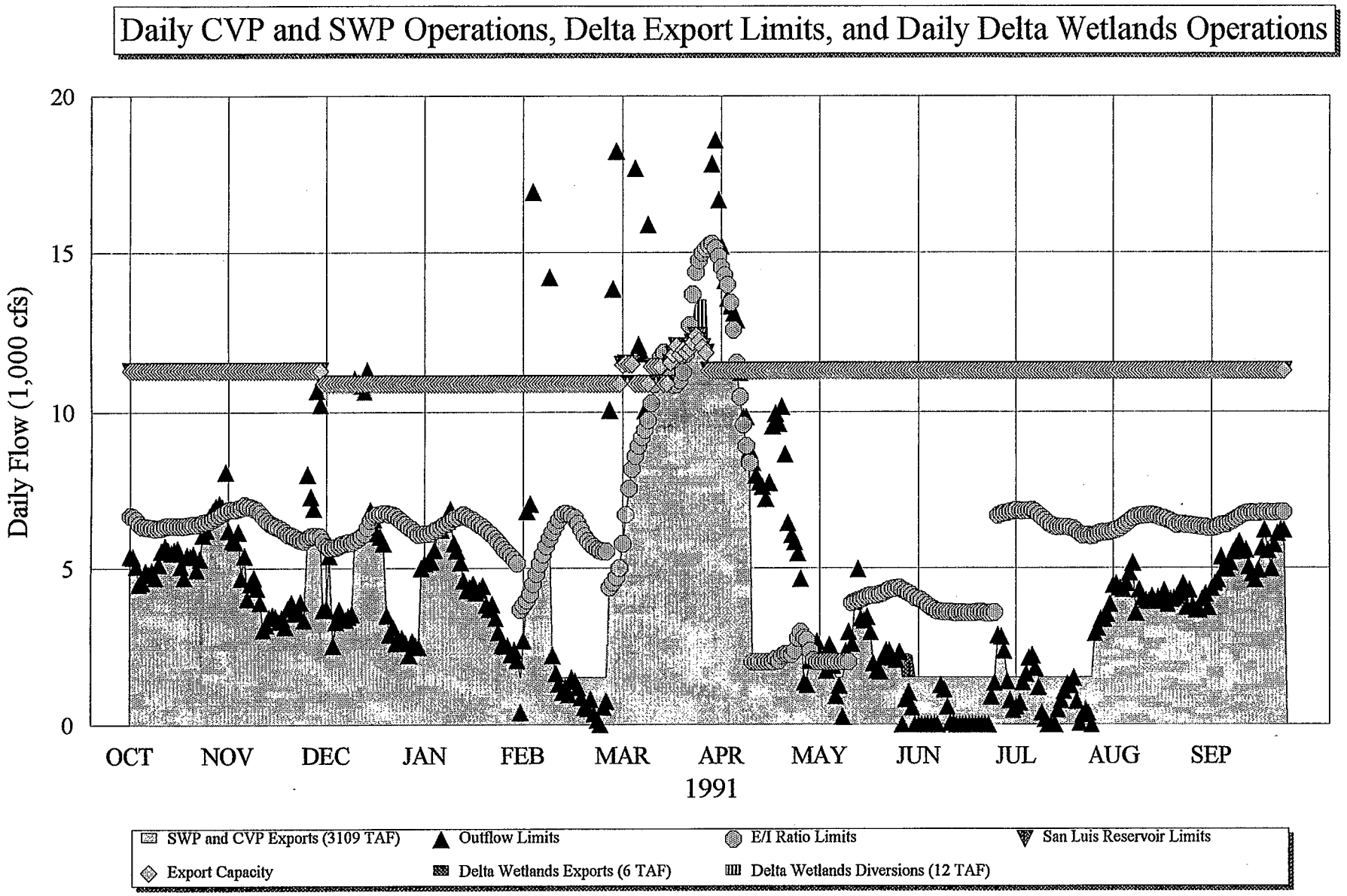
C-063316



C—063316

Jones & Stokes

Figure F-13b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1991

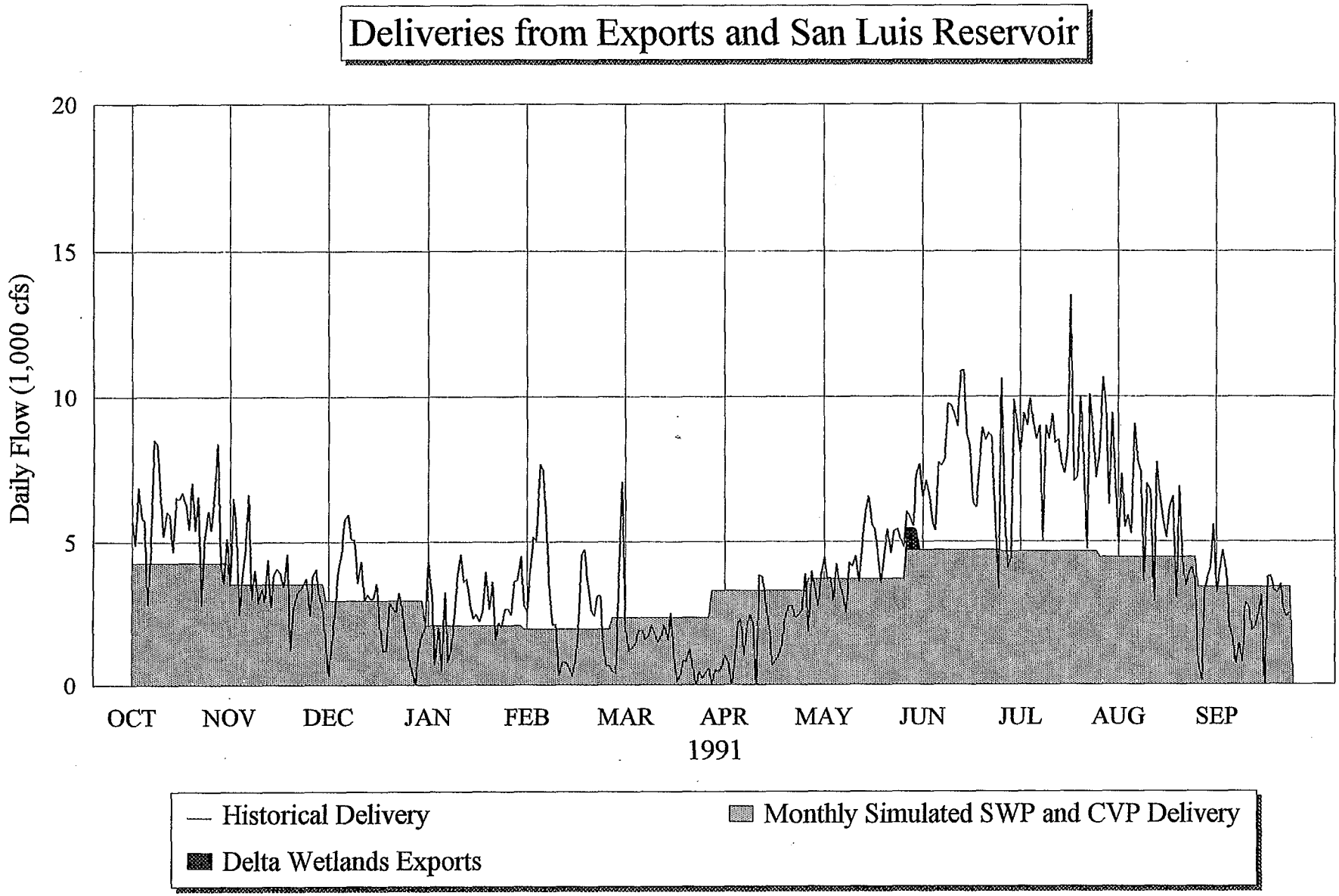


Jones & Stokes

Figure F-14a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1991

C-063317
C-063317

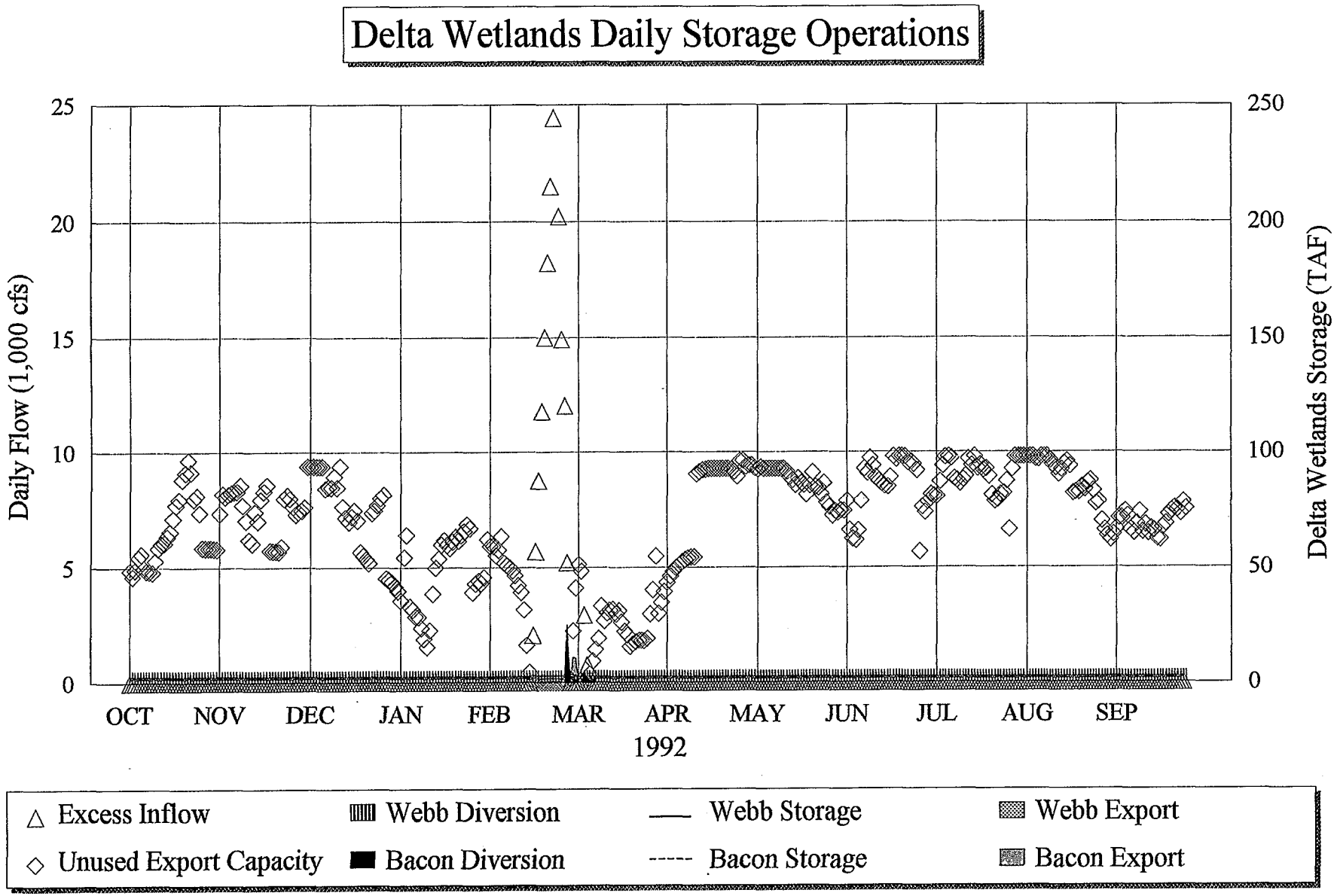
C-063318



C-063318

Jones & Stokes

Figure F-14b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1991



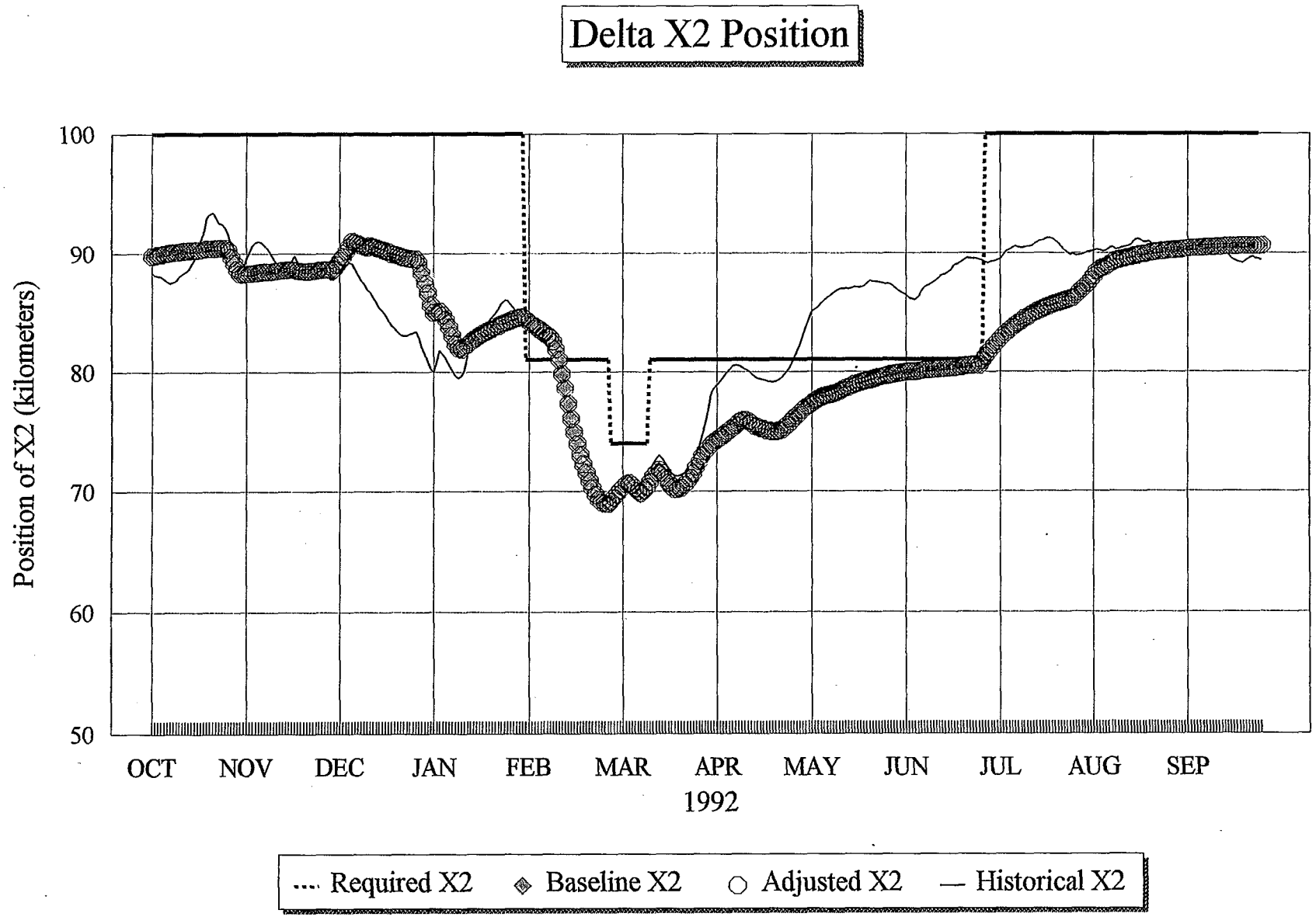
Jones & Stokes

Figure F-15a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1992

C-063319

C-063319

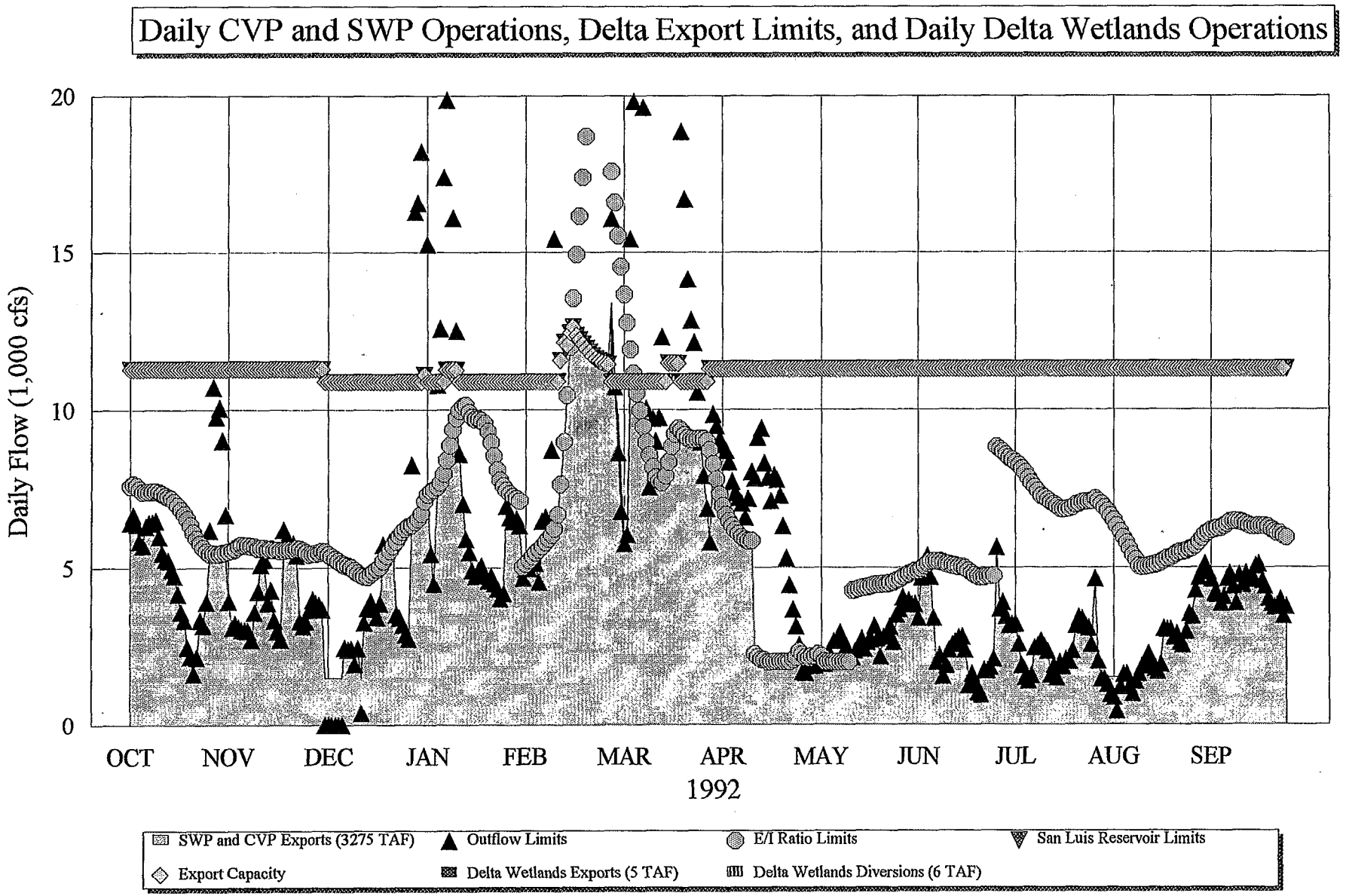
C-063320



C—063320

Jones & Stokes

Figure F-15b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1992

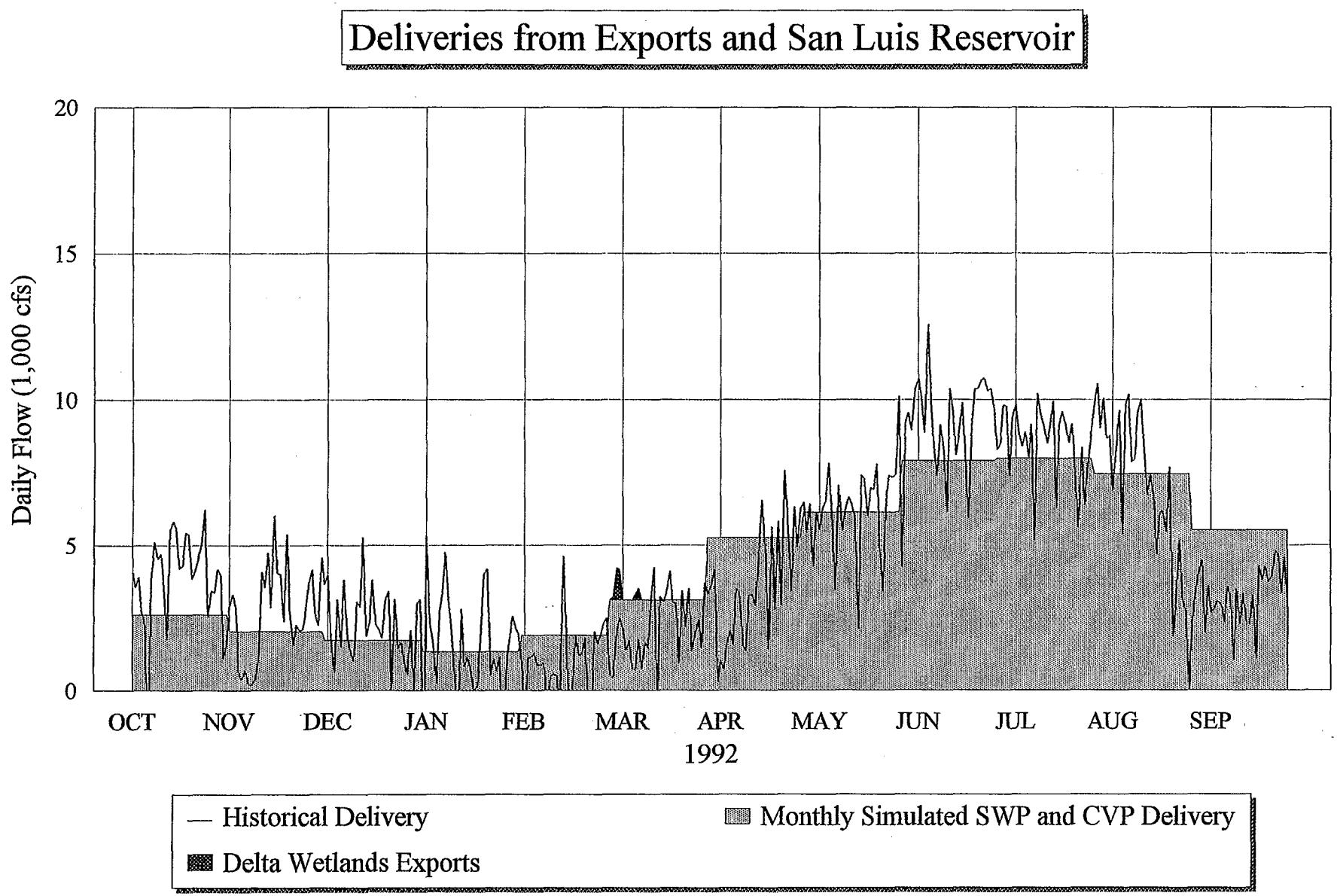


Jones & Stokes

Figure F-16a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1992

C-063321

C-063321

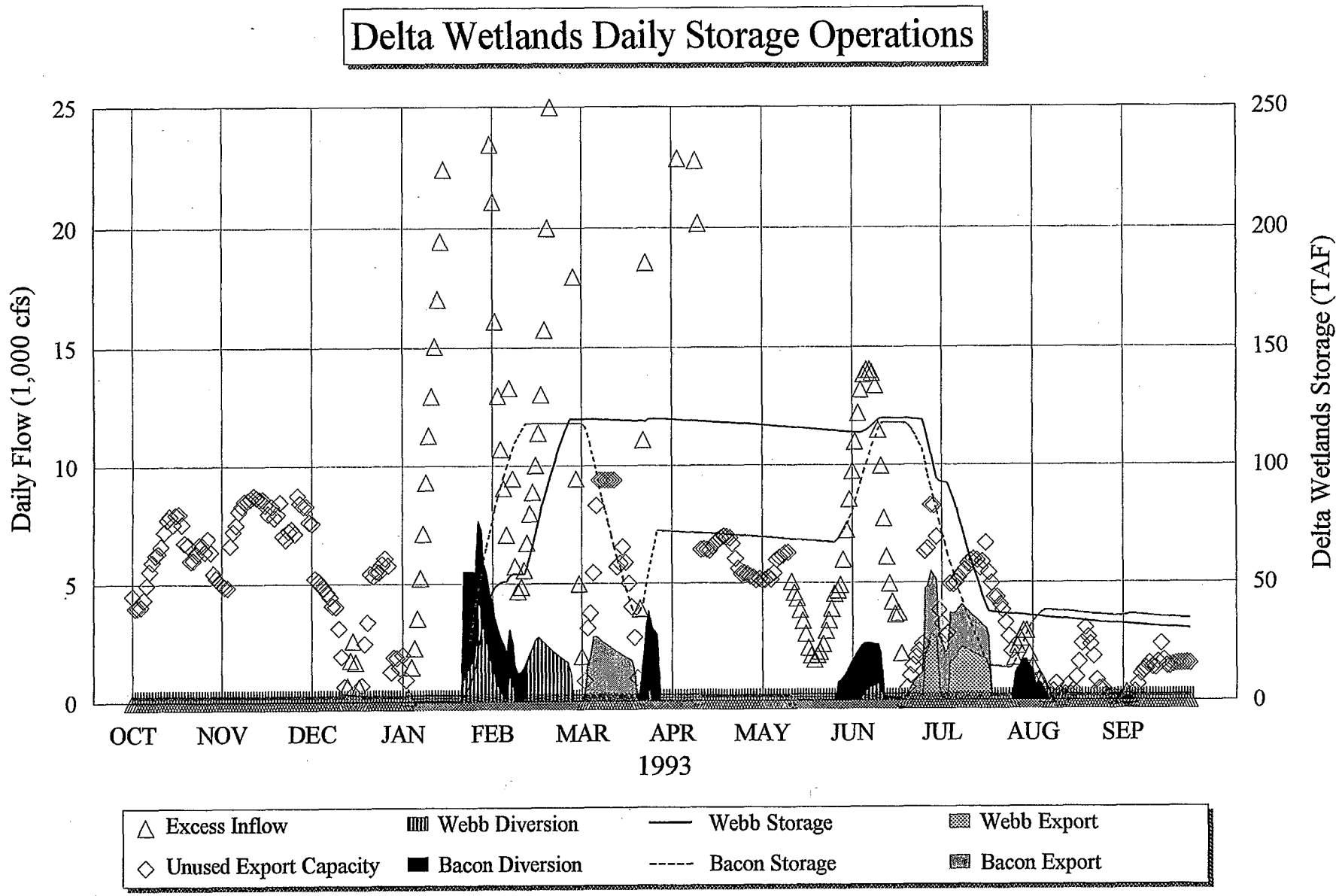


Jones & Stokes

Figure F-16b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1992

C-063322

C—063322



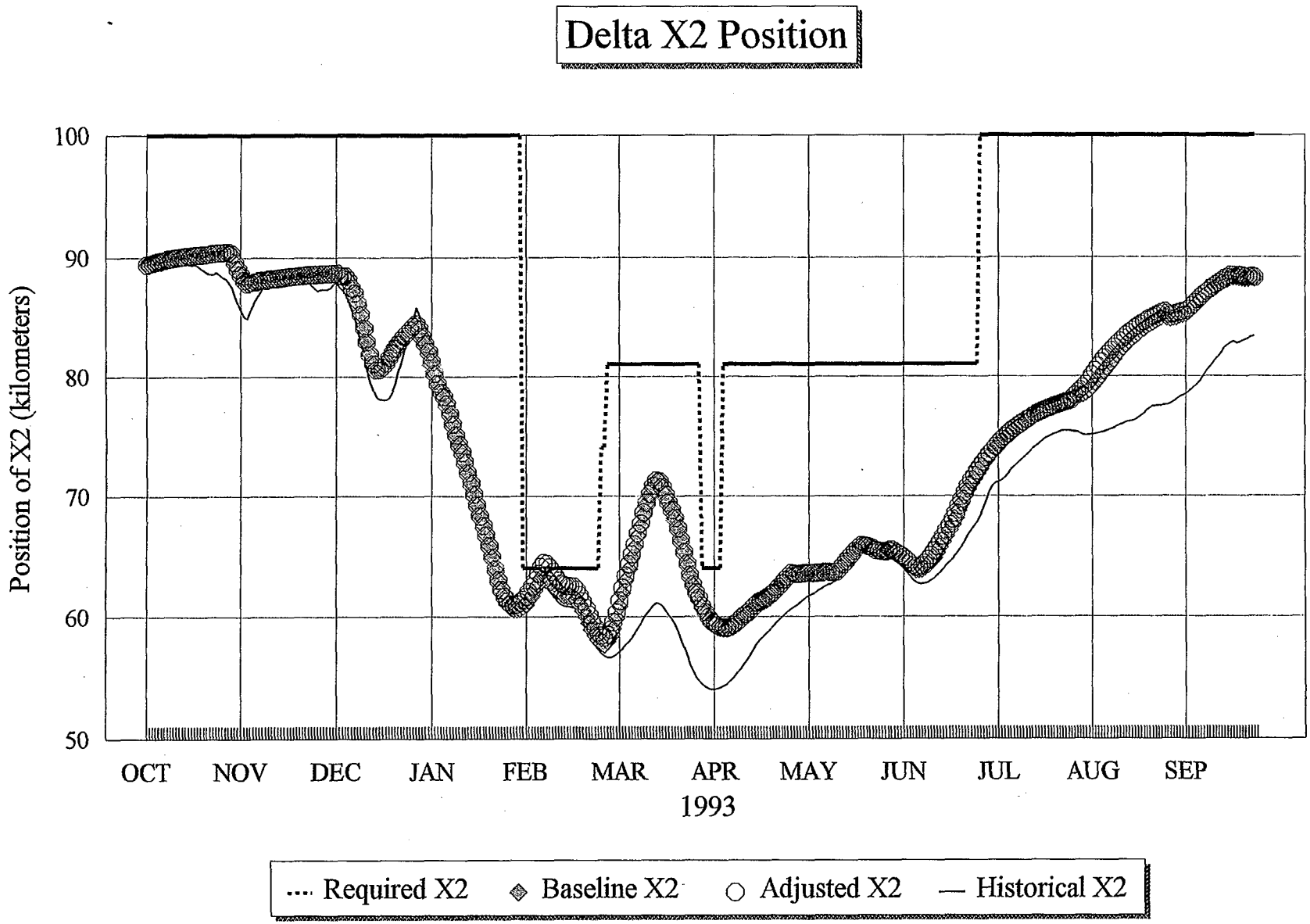
Jones & Stokes

Figure F-17a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1993

C-063323

C-063323

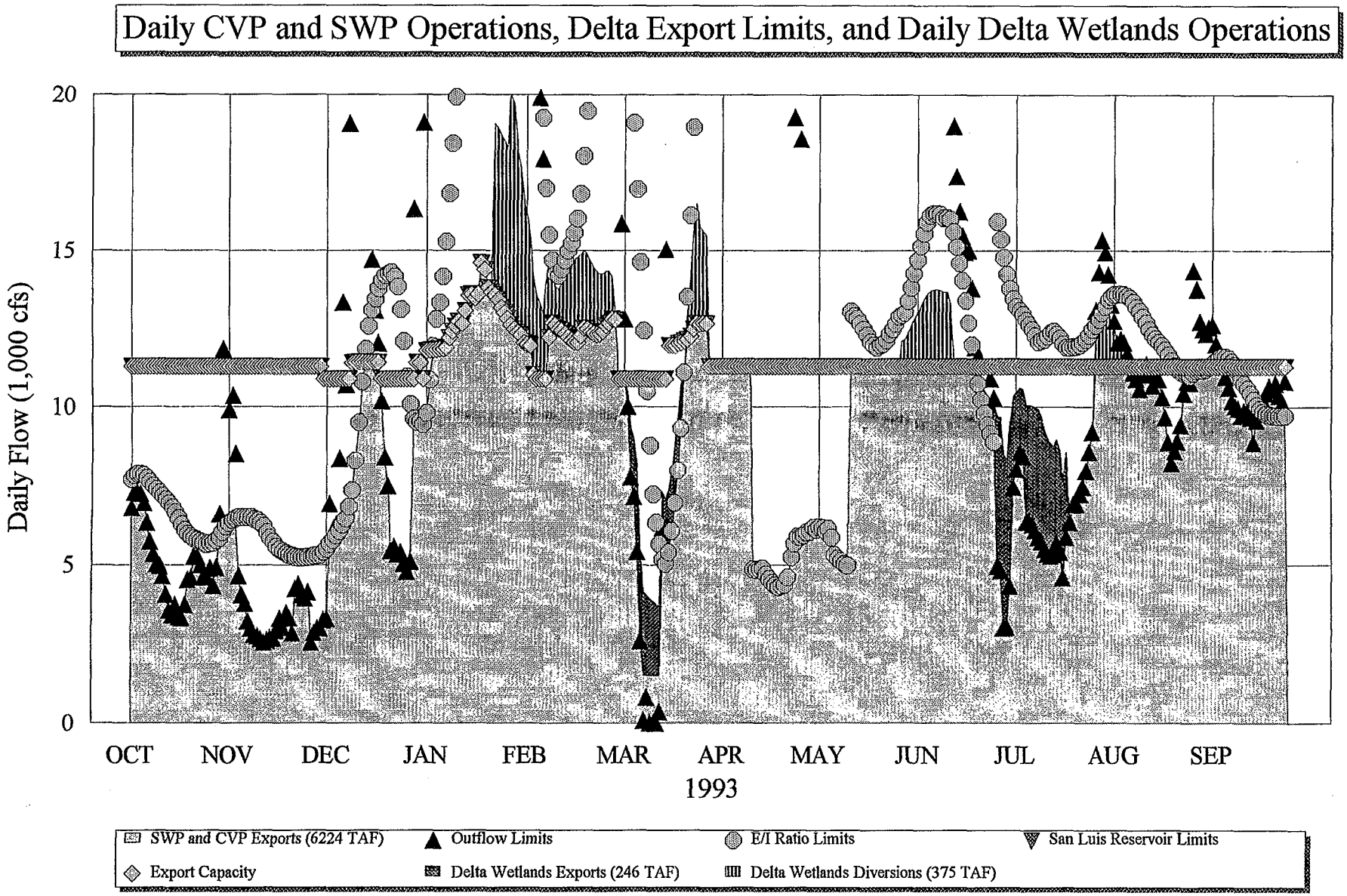
C-063324



C—063324

Jones & Stokes

Figure F-17b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1993

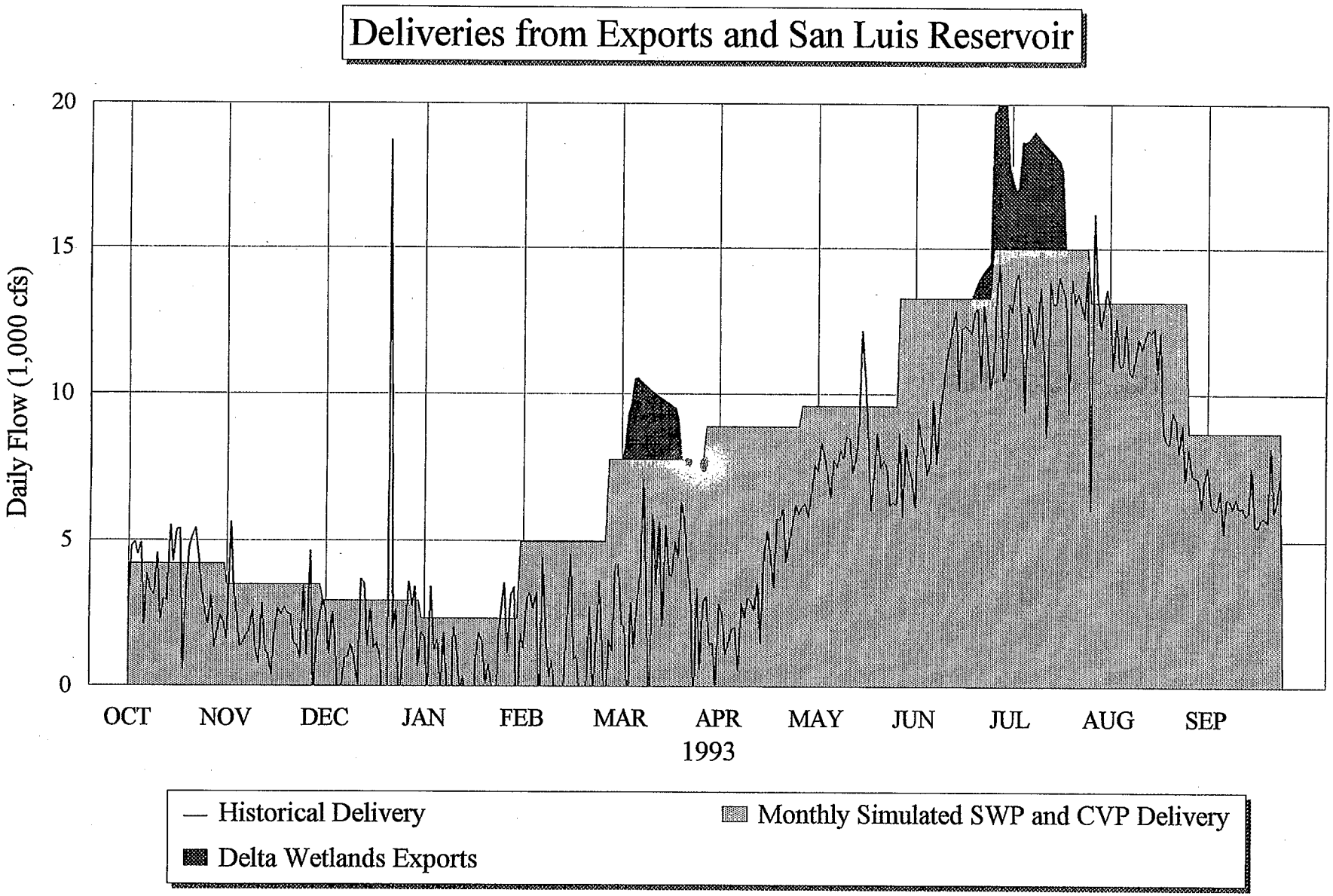


Jones & Stokes

Figure F-18a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1993

C-063325

C-063325



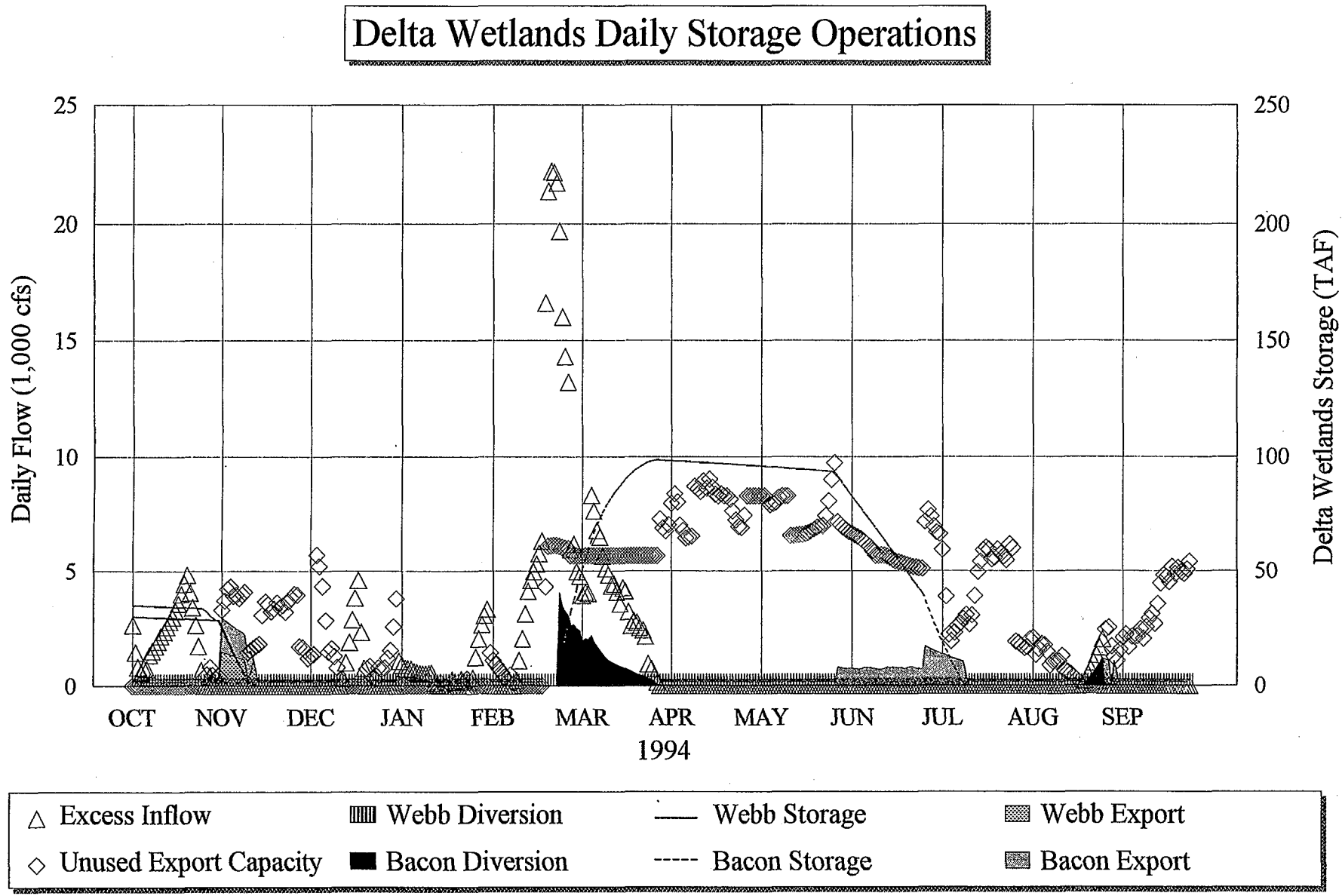
Jones & Stokes

Figure F-18b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1993

C-063326

C-063326

C-063327

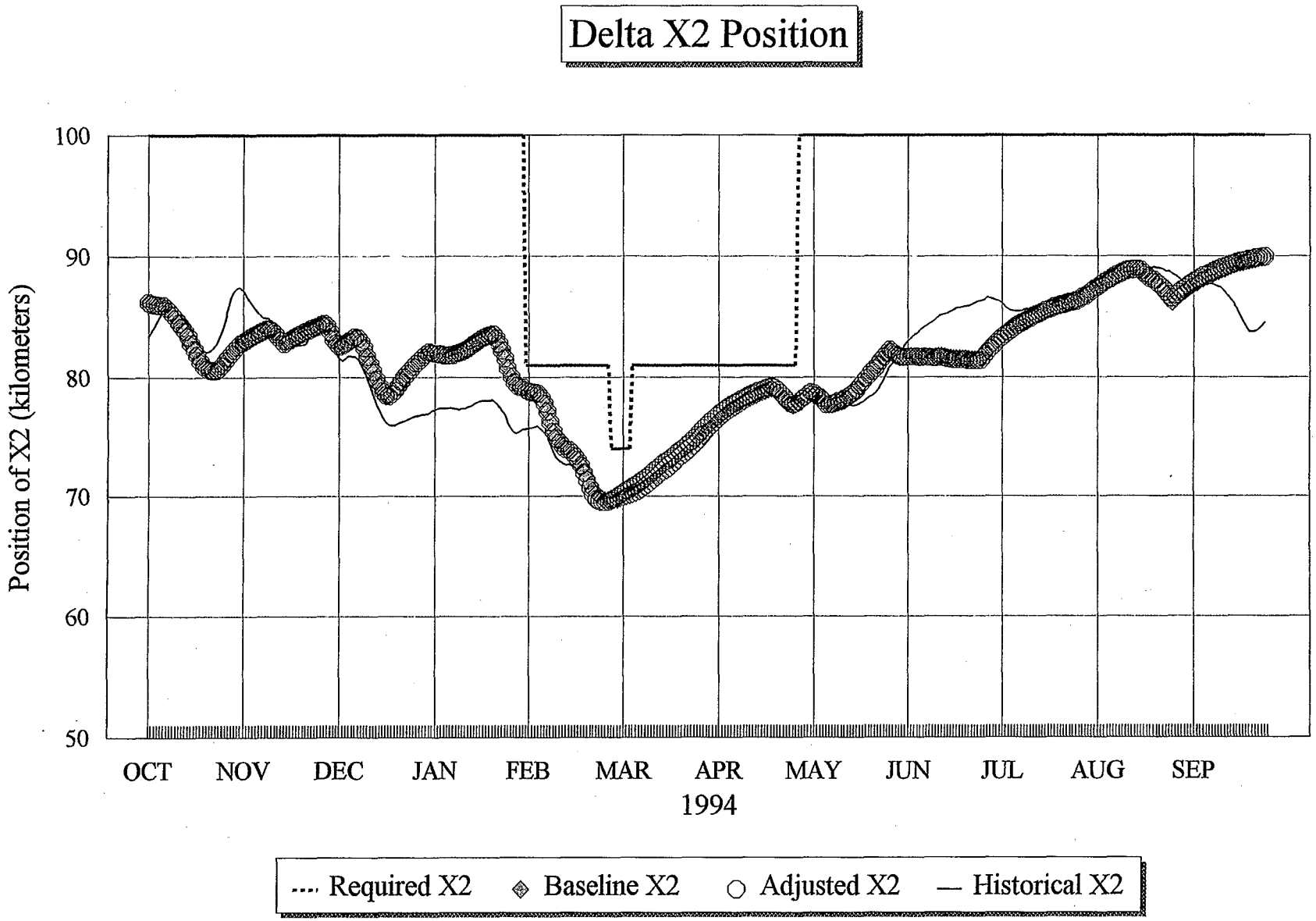


Jones & Stokes

Figure F-19a
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1994

C—063327

C-063328

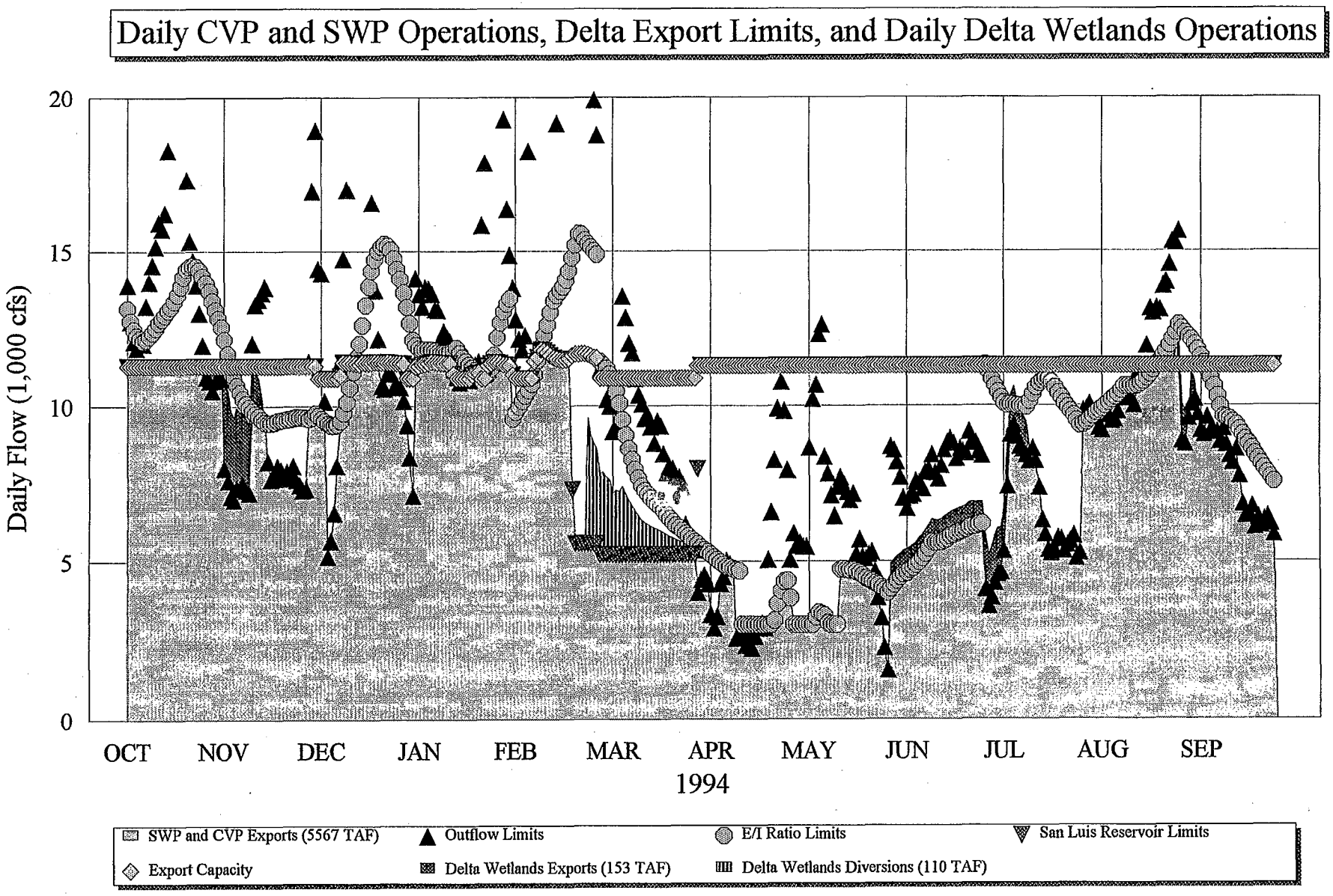


C-063328

Jones & Stokes

Figure F-19b
Daily Simulated Delta Wetlands Operations and Effect on X2 Position as Allowed under Final Operations Criteria for 1994

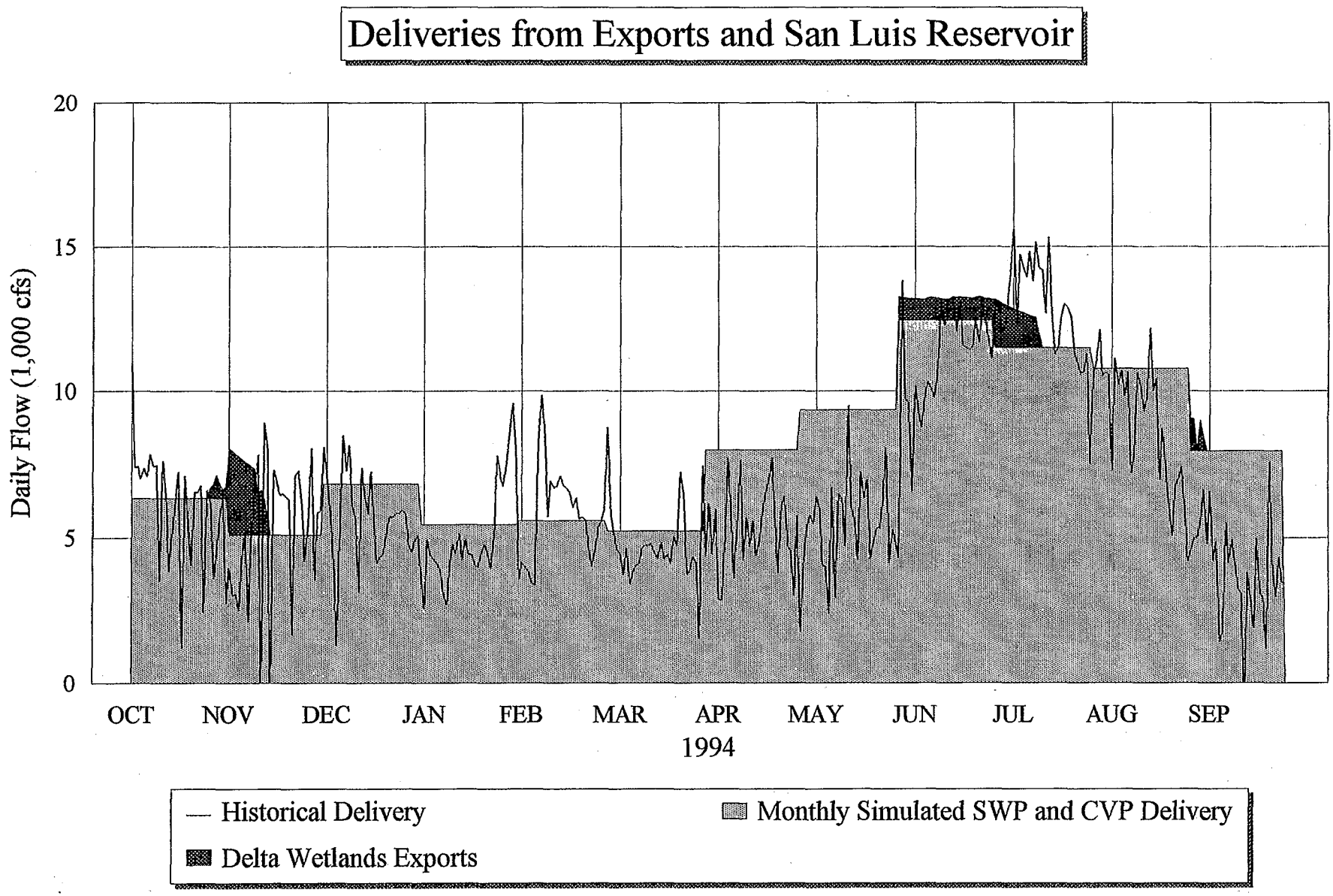
C-063329



Jones & Stokes

Figure F-20a
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1994

C—063329



Jones & Stokes

Figure F-20b
Daily Simulated Delta Wetlands Operations with CVP and SWP Project Operations for 1994

C-063330

C-063330