State of California
Department of Water Resources
Division of Planning

Estimation of Delta Island Diversions and Return Flows

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Foreword

The Bay–Delta Estuary provides drinking water to two–thirds of the State's population, supplies irrigation water to some of the State's most productive agricultural areas, and is one of the largest ecosystems for fish and wildlife habitat and production in the United States. Effective management of the Estuary requires an understanding of how these competing beneficial uses influence one another. A tool available to decision makers in gaining such an understanding is computer simulation. Therefore, a number of computer models have been (and are being) developed by the Division of Planning to simulate cause–and–effect relationships between water project operations, agricultural activities, and the environment. The purpose of this report is to describe computer models that provide estimates of agricultural diversion and return flows and qualities; these estimates are employed as input to models of Bay–Delta hydrodynamics, water quality, and particle tracking.

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Chapter 1
Introduction and Conclusions

Approximately two–thirds of the land in the Sacramento–San Joaquin Delta supports agriculture. Irrigation diversions and agricultural return flows significantly impact Delta hydrodynamics, water quality, and biological resources. The volume of water depleted by agricultural activities is approximately one-third the volume exported by Delta water projects (see Figure 1–1). Hence, agricultural activities play a significant role in circulation patterns. Agricultural activities also affect water quality. Delta islands act as salt reservoirs by first diverting and storing salts in the summer and then releasing those salts during the winter through leaching and drainage of precipitation (*Quantity* 1956). Delta agricultural drainage also contains elevated levels of organic matter, which contribute to the formation of trihalomethanes and other disinfection by–products in treated drinking water (*Delta Island* 1990; Hutton and Chung 1992). Finally, agricultural activity also affects biological resources. Unscreened agricultural diversions entrain eggs, larvae, and juvenile fish (*Water Quality* 1994).

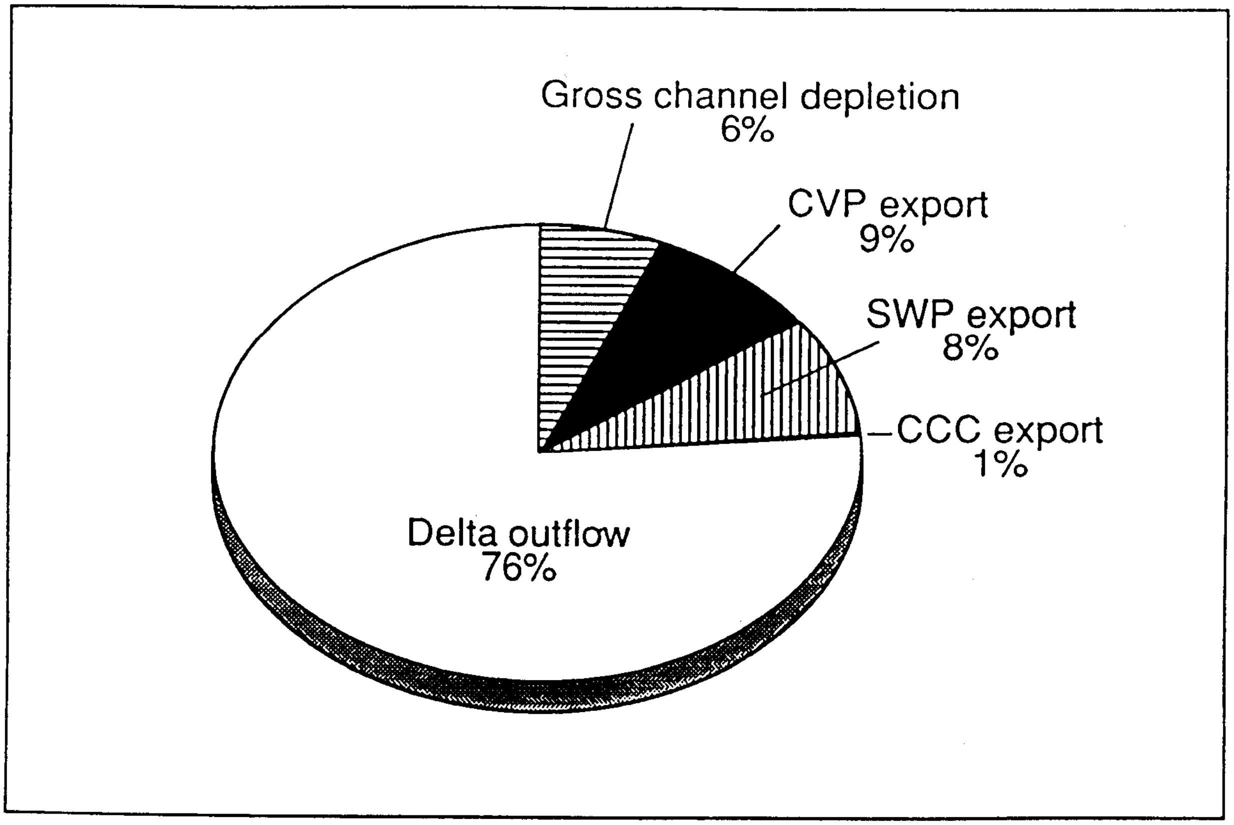

Figure 1–1. Average Annual Delta Depletions, Exports, and Outflow (DAYFLOW 1975–91)

Due to the importance of agricultural activities, several of the Department's Delta computer models rely on estimates of agricultural diversions and return flows and quality to provide an accurate picture of the physical processes occurring within the Delta. For example, the Delta Simulation Model (DWRDSM) is a hydrodynamics and water quality model that requires information on agricultural diversions and returns. The model grid, shown in Figure 1–2, is composed of 416 junctions or nodes, 496 channels, and 13 open water areas. Agricultural diversion and return flows and concentrations of conservative water quality constituents (e.g. salinity and total organic carbon) can be input to the model at any node (Hutton and Chung 1992). The Delta Island Consumptive Use (DICU) model and associated routines, the subjects of this report, were developed to (1) estimate agricultural diversion and return volumes and (2) assign these volumes and associated water quality concentrations to DWRDSM nodes. While locations and magnitudes of agricultural diversions influence Delta hydrodynamics and water quality, they also affect the transport and fate of biological resources in the Delta. Transport and entrainment of biological resources is simulated with DWR's Particle Tracking Model, a model which employs the same hydrodynamics, geometry and channel depletion information as DWRDSM (Bogle et al. 1993).

Scope of Report

This report describes the DICU model and associated computer programs developed and employed by the Division of Planning to estimate Delta agricultural diversion and return volumes. Details on program logic, input data, model validation, and sensitivity analyses are presented.

Chapter 2 defines a number of physical processes and farming activities related to consumptive use such as precipitation, seepage, evapotranspiration, irrigation practices, soil moisture storage, leach water application and drainage, and runoff. Mathematical relationships between processes are presented in this chapter. The Department and others have published several methods of estimating Delta consumptive use; these are summarized in Chapter 3. Motivation for using the DICU model to estimate Delta consumptive use is discussed.

Chapters 4 through 6 provide details on the computer programs such as program logic and input data. Figure 1–3 diagrams program inter–relationships. Chapter 7 documents an attempt to validate the DICU model. Field data collected on Twitchell Island in 1960 are compared with model results for the same time period. Comparison plots of precipitation, evapotranspiration, soil moisture budget, applied water, return flows and seepage illustrate the strengths and weaknesses of the DICU model.

Validation results are used in Chapter 8 to examine the sensitivity of Delta diversion and return estimates to changes in the following factors: land use, farm irrigation efficiency, seepage, precipitation, leach water, evapotranspiration, and soil moisture limits. Chapter 9 concludes the report with a discussion of future tasks related to model enhancement.

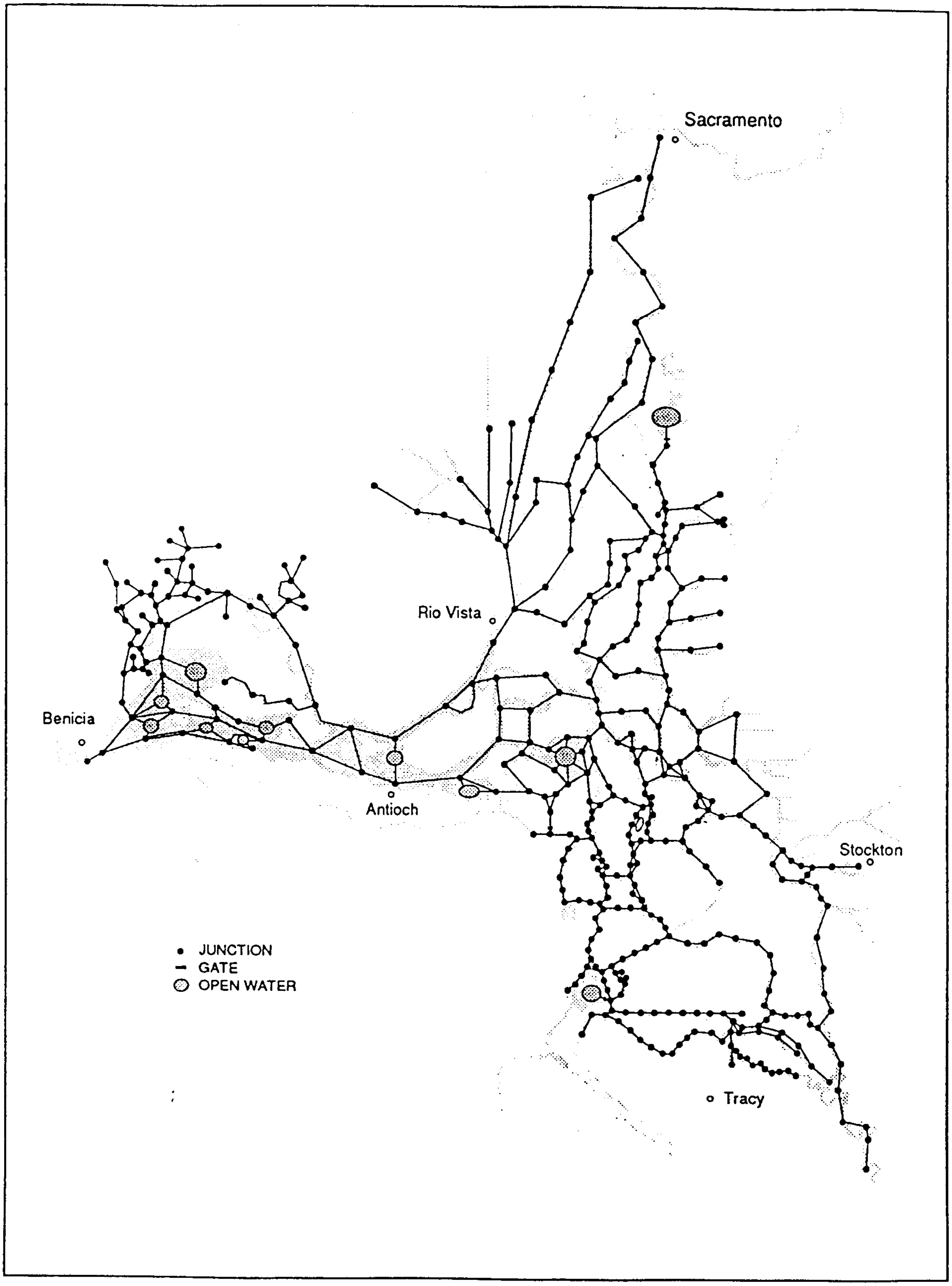

Figure 1–2. DWRDSM Delta Model Grid

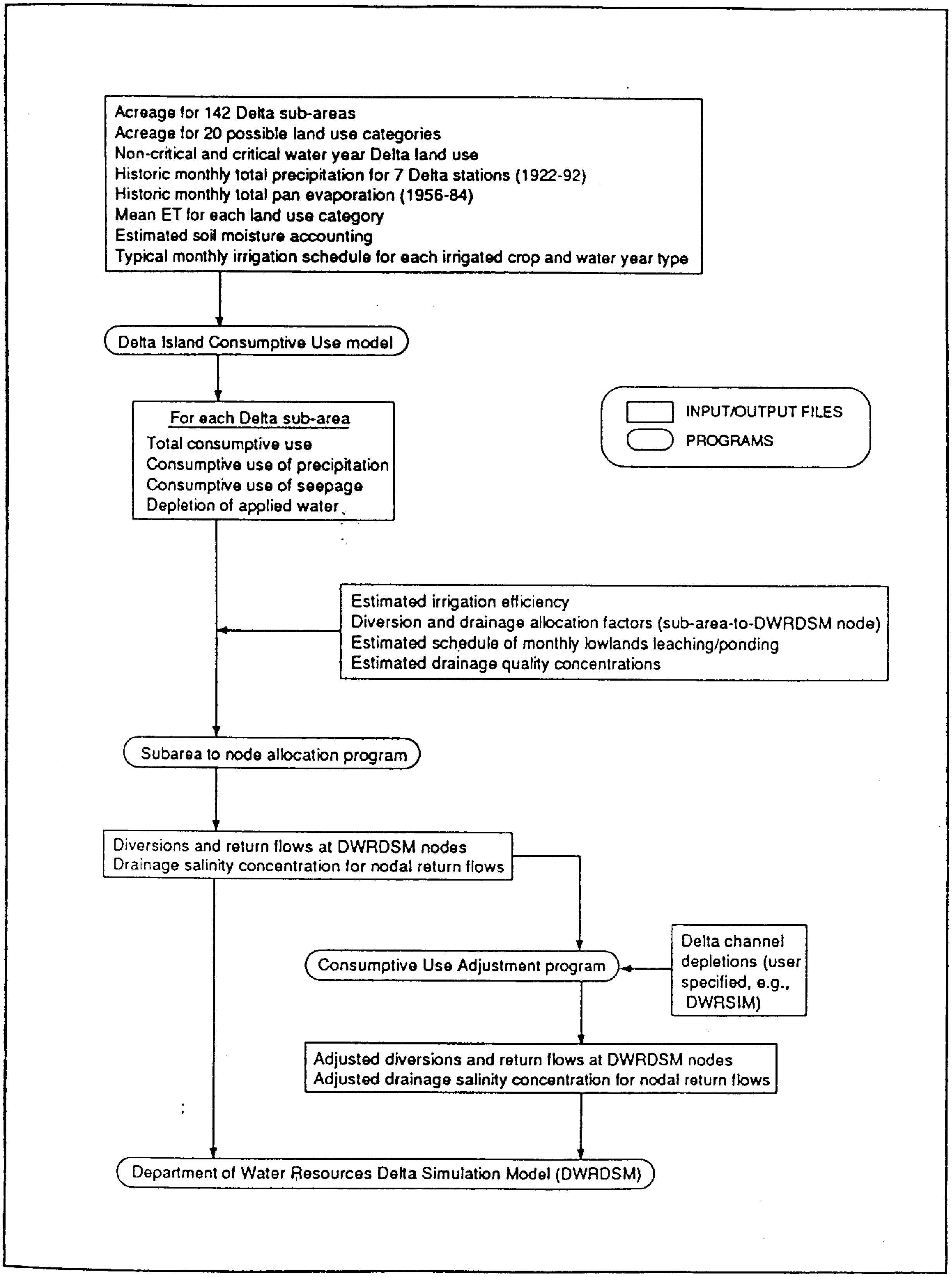

Figure 1–3. Programs Flowchart

Summary of Conclusions

- The DICU model can be used to estimate Delta diversion and return volumes on a detailed spatial level, given information on land use, farming practices, and climatic conditions. Input data is needed on a detailed level to accurately model Delta hydrodynamics, water quality and particle fate and transport.
- Validation shows that Twitchell Island soil moisture changes are being modeled reasonably well. On an annual basis, the model also performs reasonably well in predicting Twitchell Island applied water requirements. However, the model tends to over predict early in the growing season and under predict late in the growing season. Model validation also suggests that seepage and return volumes are consistently under predicted.
- Sensitivity analyses indicate that the model is highly responsive to changes in (1) evapotranspiration and irrigation efficiency during the growing season and (2) leaching practices following the growing season.
- When water is not being applied for irrigation, diversion estimates are sensitive to changes in seepage. Because the current version of the DICU model only accounts for seepage that is available to plants for consumptive use, return flows are not particularly sensitive to changes in seepage. This limitation on seepage currently imposed by the model may cause both diversion and return flows to be consistently under predicted.
- The DICU model lumps siphon inflows and seepage into a single channel diversion. To accurately simulate the significance of agricultural diversions on particle fate and transport, channel diversion estimates must be disaggregated into siphon inflow and seepage estimates (as only siphon inflows entrain particles).

Future Activities

Future activities will focus on improving DICU model performance by modifying input data, assumptions, and formulations. Anticipated activities include:

- utilizing diversion and drainage information from the Municipal Water Quality Investigation Program's Delta Island Water Use Study (and other sources) to modify model assumptions on seepage, leaching schedules, and irrigation efficiency;
- modifying the formulation to estimate evapotranspiration based on the Hargreaves–Samani equation;
- extending the land use input to better represent historic conditions;
- modifying the output structure so that water quality constituents other than salt are assigned to agricultural return nodes, including electrical conductivity, minerals, organics, nutrients, dissolved oxygen, temperature, and algae; and
- modifying the output structure to disaggregate channel diversion estimates into siphon inflow and seepage inflow.

Chapter 2
Physics Of Consumptive Use

Consumptive use (CU) of water includes both evaporation and transpiration; evaporation from the soil, water surfaces and hard tops (roofs and other impervious surfaces in urban areas), and transpiration through plant surfaces. Sometimes the phrase consumptive use is used interchangeably with evapotranspiration (ET). However, the ET demand of a plant is not always met (as in the case of non–irrigated crops during summer) and therefore a distinction is made between the two in this report.

Figure 2–1 is a representation of the hydrologic cycle that illustrates some of the physical processes related to consumptive use (*Vegetative* 1967). A simplified version of the hydrologic cycle for a typical Delta island, shown in Figure 2–2, is used to estimate Delta consumptive use. Factors such as precipitation, seepage, evapotranspiration, irrigation, soil moisture storage, leach water and runoff are identified on the simplified hydrologic cycle. A few comments about the nature of each factor follow.

Consumptive Use Factors

Applied irrigation water (I_A): The volume of water diverted from Delta channels and applied as irrigation water depends on the availability of other sources of moisture to a crop such as precipitation, seepage, and soil moisture. In determining the volume of water to divert, farmers may also take into account the method of irrigation, soil type, crop root depths, and cost of the available water supply (*Vegetative* 1967). This volume of water is typically greater than the minimum irrigation requirement (I_R) caused by irrigation efficiency (η).

Leach water: In the Delta Lowlands, it is a common practice to leach salts from the root zone periodically by making heavy applications of water for extended periods (*Documentation* 1966). Aerial observations indicate that leach water is applied (LW_A) from October through December and is drained (LW_D) from January through April (*Joint* 1981).

Seepage (S): The seepage rate from channels to islands in the Delta Lowlands depends on soil characteristics and the head difference between water elevations in the channels and water elevations in drainage ditches in the islands. The Delta Lowlands are defined as those areas in the Delta with lands lying below an elevation of plus five feet, mean sea level datum (*Quantity* 1956). The mean monthly head differential is essentially constant throughout the year, varying not more than about five percent in any month which indicates a uniform seepage rate (*Salinity* 1962). Owen and Nance assume that the seepage rate is relatively constant throughout the year because drainage pumps keep the ground water level relatively constant (Owen and Nance 1962).

Evapotranspiration (ET): Factors that affect ET can be categorized into climatic, plant, and soil categories. Climatic factors include solar radiation, wind, humidity, temperature, and precipitation. Plant factors include percentage of ground covered by transpiring vegetation, state of plant development, plant physiology, and surface roughness

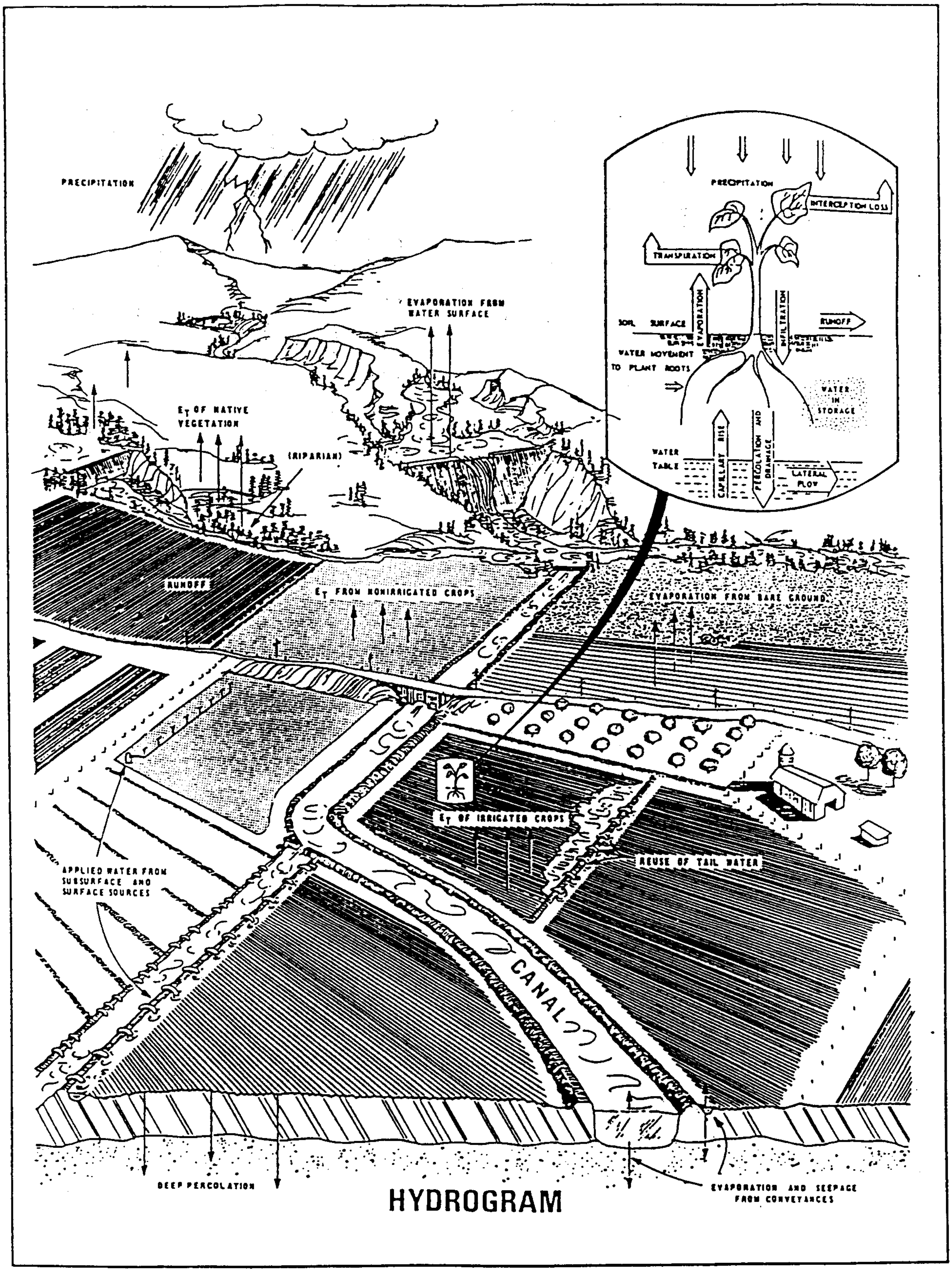

Figure 2–1. Hydrologic Cycle

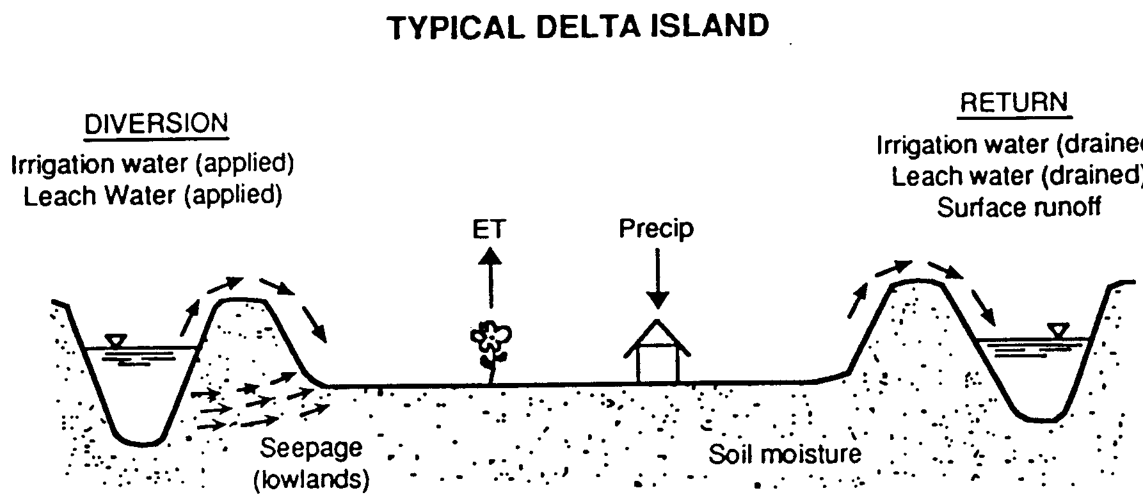

Figure 2-2. Simplified Hydrologic Cycle for a Typical Delta Island

of the crop. Soil factors include available moisture content of the soil mass within the root zone and the transmissibility rate of moisture through the soil to plant roots. Of the three types of categories, climatic factors generally have the greatest influence on ET with solar radiation being the most dominant of those climatic factors (*Vegetative* 1967).

Precipitation (P): Precipitation in the Delta is not uniform. Theissen polygon interpolation routines, using data obtained from stations located in and around the Delta, are used to estimate the spatial distribution of precipitation.

Soil moisture (SM): The availability of soil moisture to plants depends on the amount that either can be or is stored in the soil. Various internal and external factors may also limit the availability of such moisture. Examples of such factors are (1) amount and intensity of precipitation, (2) rooting depths of crops, (3) soil infiltration rates, and (4) available moisture–holding capacity of the soil (*Vegetative* 1967).

Surface runoff (RO): Runoff occurs when there is precipitation in excess of that which can be used by plants or stored as soil moisture. On most Delta islands, runoff flows into drainage ditches and is pumped into neighboring channels.

Irrigation drainage (I_D): Agricultural drainage water must be pumped from farmlands over levees into the nearby channels since most agricultural areas in the Delta are at or below sea level.

Mathematical Relations Between Consumptive Use Factors

In this report, total consumptive use for each island is defined by the following equation:

$$TCU = Diversions - Drainage + P \qquad (2\text{–}1)$$

Diversions and drainage associated with each island can be expressed in terms of the CU factors and an irrigation efficiency (η):

$$Diversions = I_A + LW_A + S \qquad (2\text{–}2)$$

$$Drainage = (1-\eta)\, I_A + LW_D + RO \qquad (2\text{–}3)$$

$$\text{where } I_A = I_R/\eta \qquad (2\text{–}4)$$

Furthermore, the change in soil moisture over any time interval can be calculated from the following water balance derived from Figure 2–2:

$$\Delta SM = Diversions + P - ET - Drainage \qquad (2\text{–}5)$$

On a Delta–wide basis, TCU is synonymous with the terms Delta CU, Delta water requirement and gross channel depletions (GCD). TCU will be separated, later in this document, in terms of the consumptive use satisfied by precipitation (CU_P), seepage (CU_S), applied water (CU_{AW}) and ΔSM. Net channel depletions (NCD) is simply the difference between total diversion and total drainage or TCU minus Delta precipitation and is synonymous with the term internal Delta net use.

The equations above will be discussed in more detail in Chapter 4 and Chapter 5.

Chapter 3
Delta Channel Depletion Estimates: Overview

Channel Depletions

Diversions of water onto agricultural lands for irrigation are difficult to measure because the diversions are made through siphons, pumps, and floodgates operating under continuously fluctuating water levels in the channels (*Salinity* 1962). The diversions are withdrawn at more than 1,800 locations in the Delta (*Sacramento–San Joaquin Delta Atlas* 1993). Seepage from the channels onto islands in the Delta Lowlands, which also contributes to channel depletions, is even more difficult to measure. Since these flows cannot be measured directly, an approach widely used is to first estimate water use by crops and then use the results to estimate irrigation diversions. Many Delta channel depletion estimates use this approach, such as:

- San Francisco Bay–Delta tidal hydraulic model estimates;
- DWR DAYFLOW historical channel depletion estimates;
- USBR/DWR channel depletion estimates for real–time operations; and
- DWR Division of Planning channel depletion estimates.

A discussion of each approach follows.

San Francisco Bay–Delta Tidal Hydraulic Model Estimates

Delta agricultural diversions and returns are simulated in the US Army Corps of Engineers Bay–Delta physical model. Diversions are simulated at 12 locations and returns at 24 locations. The magnitudes of the flow at each location are usually varied for dynamic simulations. However, the model is mostly run in steady–state mode for which a fixed low–flow hydrology (net Delta outflow of 4,400 cfs) is simulated. For the low–flow hydrology, total Delta diversions amount to 4,600 cfs and total Delta returns amount to 1,200 cfs. The preceding values yield a Delta NCD of 3,400 cfs. The locations of the diversions and returns were established by an interagency technical committee (*San Francisco*).

DWR DAYFLOW Channel Depletion Estimates

The DWR DAYFLOW model computes daily Delta NCD based on an annual set of monthly GCD estimates. Each month is assigned an average GCD value determined by DWR's Central District Office (*Dayflow* 1985). Monthly GCD estimates do not vary from year to year. The same annual pattern is used regardless of meteorological and hydrological conditions.

Mean daily estimates of GCD were determined graphically by fitting the monthly averages with a continuous curve. Daily NCD is computed as the difference between GCD and Delta precipitation; these estimates vary annually. Daily estimates of NCD are available for October 1930 through 1992. An assumption is made that all the precipitation is available to meet consumptive needs (*Dayflow* 1985). Monthly averages of DAYFLOW daily net channel depletions over the period water year 1930 through 1992 are listed in Appendix A, Table A–1.

DWR/USBR Channel Depletion Estimates for Real–Time Operations

The DWR Division of Operation and Maintenance predicts a value known as the Delta Outflow Index (DOI). The DOI represents the daily mean net flow of Delta water into San Pablo Bay and is calculated and used daily in SWP operations. In April 1969, United States Bureau of Reclamation (USBR) and DWR agreed to use the same consumptive use values to compute the DOI (*Federal* 1969). By October 1969, both agencies agreed on a method of computing daily NCD (Hammond 1969).

The NCD estimates were developed by averaging monthly GCD for the Uplands for 1922–1968 and then subtracting the average monthly precipitation for the same time period. The same was done for the Lowlands. Monthly NCD values for the Delta were calculated as the sum of Uplands and Lowlands estimates. Daily estimates were determined graphically by fitting the monthly averages with a continuous curve (Hammond 1969). The daily values do not vary from year to year. The same annual pattern is used regardless of meteorological and hydrological conditions. Table A–2 lists monthly averages of the net Delta channel depletion estimates that are used to compute the DOI.

DWR Division of Planning Channel Depletion Estimates

The Delta channel depletion estimates generated by the Division of Planning are based on a soil moisture budget model which was developed initially to estimate consumptive use in the Central Valley (*Consumptive Use Program* 1979). The same soil moisture accounting method is used by the Consumptive Use (CU) Model (*Consumptive Use Model* 1991) and the DICU model.

The CU Model. The CU Model is used to estimate consumptive use in 36 areas in the Central Valley known as "Depletion" or "Drainage Study" areas. One such area is the Delta. The Delta consumptive use estimates are generated using a soil moisture accounting method on which the DICU model is based (discussed in Chapter 4). The only difference between the two models is the input data used. Differences in the input data exist because:

- the CU Model estimates consumptive use for two areas in the Delta (the Delta Uplands, and the Delta Lowlands) while the DICU model does it for 142 subareas.
- the CU Model is used to estimate historical consumptive use as well as projected consumptive use for future levels of development. However, the DICU model is currently only being used to estimate historic consumptive use.

The CU model has been used to estimate several values of Delta channel depletions by simulating various assumptions. One set of estimates, shown in Table A–3, is the result of using a set of crop ET estimates that vary monthly but not from year to year (constant ET estimates). Recently, the CU model was used to compute a new set of net Delta channel depletion estimates based on the Hargreaves–Samani ET equation (*Reference* 1985) and new crop coefficients. Those preliminary estimates are listed in Table A–4.

The DICU Model and Associated Routines. Unlike any of the above models, the DICU model subdivides the Delta into 142 regions, or subareas, and estimates consumptive use on each subarea. Only the DICU model and associated routines calculate channel depletions on a detailed spatial level, which is needed as input data to accurately model Delta hydrodynamics, water quality, and particle tracking. Monthly NCD estimates are listed in Table A–5. Chapter 4 covers the DICU model in more detail.

Chapter 4
Delta Island Consumptive Use Model

Description of the DICU Computer Program

DICU analysis involves keeping track of water that enters, leaves, or is stored on each of 142 Delta subareas on a monthly time step. Factors such as precipitation, seepage, evapotranspiration, irrigation, soil moisture storage, leach water, runoff, crop type, and acreage are utilized. Table 4–1 is a list of 142 Delta subareas and Figure 4–1 shows their locations in the Delta. The 142 subareas cover the Delta Service Area which consists of all lands in the Lowlands and Uplands (*Sacramento–San Joaquin Delta Area* 1965).

DICU analysis is composed of two main steps. First, the DICU model is used to determine TCU, CU_P, CU_S and CU_{AW} for each subarea. Then, an associated routine (NODCU) uses the results to calculate diversion and return flows for each subarea and allocates them to DWRDSM nodes (approximately 250 diversion nodes and 200 drainage nodes). The routine also assigns representative total dissolved solids (TDS) and chloride (CL) concentrations to the nodal return flows from a study reported in Bulletin 123 (*Delta and Suisun* 1967). These results, in turn, are used as input to the DWRDSM model for historic simulations and planning studies (See Figure 1–3).

The DICU model computes CU_{AW} knowing ET, CU_P, CU_S, and ΔSM based on the following equation:

$$TCU = CU_P + CU_S + CU_{AW} + \Delta SM \quad (4\text{–}1)$$

Equation 4–1 is equivalent to equation 4–2 when all the ET is met.

$$TCU = ET + \Delta SM \quad (4\text{–}2)$$

The equations are applied to each crop on each subarea for the purpose of calculating the minimum irrigation requirement using the following equation:

$$I_R = CU_{AW} + \Delta SM \quad (4\text{–}3)$$

Knowing I_R and assuming a farm irrigation efficiency factor (η), diversions and drainage are then calculated by the NODCU program using equation 2–2 and 2–3 in Chapter 2. The NODCU program is discussed in detail in Chapter 5.

Figure 4–2 is a flowchart showing how the DICU model uses the input data for soil moisture accounting. In general, precipitation, seepage and applied (irrigation) water can be either used by the plant (ET), stored as soil moisture, or drained as runoff. The procedure shown in the flowchart is used for **each** land use category, **each** of the 142 subareas, and **each** month. Details of the accounting procedure along with sample calculations are provided in Appendix B.

Table 4-1. DICU Model Subareas

Subarea #	Region *	Subarea name
1	L	UNION ISLAND (EAST)
2	L	UNION ISLAND (WEST)
3	L	GRAND ISLAND
4	U	MOSSDALE
5	L	MERRITT ISLAND
6	L	LISBON DISTRICT
7	L	ANDRUS ISLAND (LOWER)
8	L	SHERMAN ISLAND
9	L	NEW HOPE TRACT
10	L	SUTTER ISLAND
11	L	ROUGH AND READY
12	L	MOSS TRACT (BOGGS)
13	L	ANDRUS ISLAND (MIDDLE)
14	L	RYER ISLAND
15	L	ROBERTS ISLAND (MIDDLE)
16	L	EGBERT TRACT
17	U	EGBERT TRACT
18	L	ROBERTS ISLAND (UPPER)
19	L	TERMINOUS TRACT
20	L	PIERSON DISTRICT
21	L	WALNUT GROVE
22	L	ANDRUS ISLAND (UPPER)
23	L	TYLER ISLAND
24	L	POCKET DISTRICT
25	L	ROBERTS ISLAND (LOWER)
26	L	SCRIBNER
27	L	HOOD JUNCTION
28	L	RANDALL ISLAND
29	L	BOULDIN ISLAND
30	L	GLIDE DISTRICT
31	L	EL PESCADERO
32	L	HOTCHKISS TRACT
33	L	BRYON TRACT
34	L	CLIFTON COURT
35	L	INACTIVE
36	U	WEBER TRACT
37	L	JERSEY ISLAND
38	L	WEST SACRAMENTO
39	L	NETHERLANDS (COUNTIES 48 & 5
40	L	UNNAMED
41	U	PICO AND NAGLEE
42	L	TWITCHELL ISLAND
43	L	SMITH RANCH
44	U	PRIVATELY OWNED
45	U	SMITH TRACT
46	L	PROSPECT ISLAND
47	L	MILDRED ISLAND
48	L	VENICE ISLAND
49	L	ORWOOD TRACT
50	L	HOLLAND TRACT
51	L	WEBB TRACT
52	L	MANDEVILLE ISLAND
53	L	BACON ISLAND
54	L	EMPIRE TRACT
55	L	MCDONALD TRACT
56	L	BRACK TRACT
57	L	PALM TRACT
58	L	RINDGE TRACT
59	L	JONES TRACT (LOWER)
60	L	JONES TRACT (UPPER)
61	L	VICTORIA ISLAND
62	L	MEDFORD ISLAND
63	L	BISHOP TRACT
64	L	KING ISLAND
65	L	PESCADERO DISTRICT
66	U	PESCADERO DISTRICT
67	L	BRADFORD ISLAND
68	L	HASTINGS TRACT
69	L	STEWART TRACT
70	U	RIVER JUNCTION
71	L	VEALE TRACT
72	L	BRANNAN ISLAND
73	U	YOLANO (COUNTIES 48 & 57)
74	L	WOODWARD ISLAND
75	L	SARGENT-BARNHART TRACT
76	U	MCMULLIN RANCH
77	U	INACTIVE
78	L	UNNAMED
79	U	KASSON
80	L	CANAL RANCH
81	U	CANAL RANCH
82	L	STARK TRACT
83	L	LIBERTY ISLAND (COUNTIES 48 & 57)
84	U	WALTHALL TRACT
85	U	PARADISE JUNCTION
86	U	WETHERBEE LAKE
87	L	CACHE-HAAS AREA
88	U	CACHE-HAAS AREA
89	U	PETER POCKET
90	L	MOSSDALE 2
91	U	MOSSDALE 2
92	L	UNDESIGNATED AREA
93	U	UNDESIGNATED AREA
94	L	EHRHARDT CLUB (ARD)
95	U	COSUMNES-MOKELUMNE
96	L	DEAD HORSE ISLAND
97	L	HOOD AREA
98	L	IDA ISLAND
99	L	LOCKE AREA
100	L	MCCORMACK-WILLIAMSON TRACT
101	U	STONE LAKE AREA
102	L	UNDESIGNATED AREA
103	U	UNDESIGNATED AREA
104	L	ACKER ISLAND
105	L	ATLAS TRACT
106	U	ATLAS TRACT
107	L	DREXLER TRACT
108	L	ELMWOOD TRACT
109	L	FERN ISLAND
110	L	HEADREACH ISLAND
111	L	HENNING TRACT
112	L	HOG ISLAND
113	L	HONKER LAKE TRACT
114	L	MORRISON ISLAND
115	L	RIO BLANCO TRACT
116	L	SHIMA TRACT
117	L	SHIN KEE TRACT
118	L	SPUD ISLAND
119	L	STATEN ISLAND
120	L	WRIGHT TRACT
121	L	UNDESIGNATED AREA
122	U	UNDESIGNATED AREA
123	L	DECKER ISLAND
124	L	LITTLE HOLLAND TRACT
125	L	UNDESIGNATED AREA
126	U	UNDESIGNATED AREA
127	L	LITTLE HOLLAND TRACT
128	U	UNDESIGNATED AREA
129	L	UNDESINATED AREA
130	U	UNDESIGNATED AREA
131	L	BETHEL ISLAND
132	L	CONEY ISLAND
133	L	DUTCH SLOUGH AND PORTION OF SAND MOUND SLOUGH
134	L	FALSE RIVER,PIPER SL.,SAND MOUND SL.,& ROCK SLOUGH
135	L	FISHERMAN CUT WATERWAY
136	L	FRANKS TRACT
137	L	OLD RIVER, HOLLAND CUT, AND INDIAN SLOUGH
138	L	QUIMBY ISLAND
139	L	RHODE ISLAND
140	L	SAN JOAQUIN RIVER WATERWAY
141	L	SAN JOAQUIN WATERWAY NORTH OF INDUSTRIAL STRIP
142	L	TAYLOR SLOUGH WATERWAY

* Region: L = Lowlands, U = Uplands

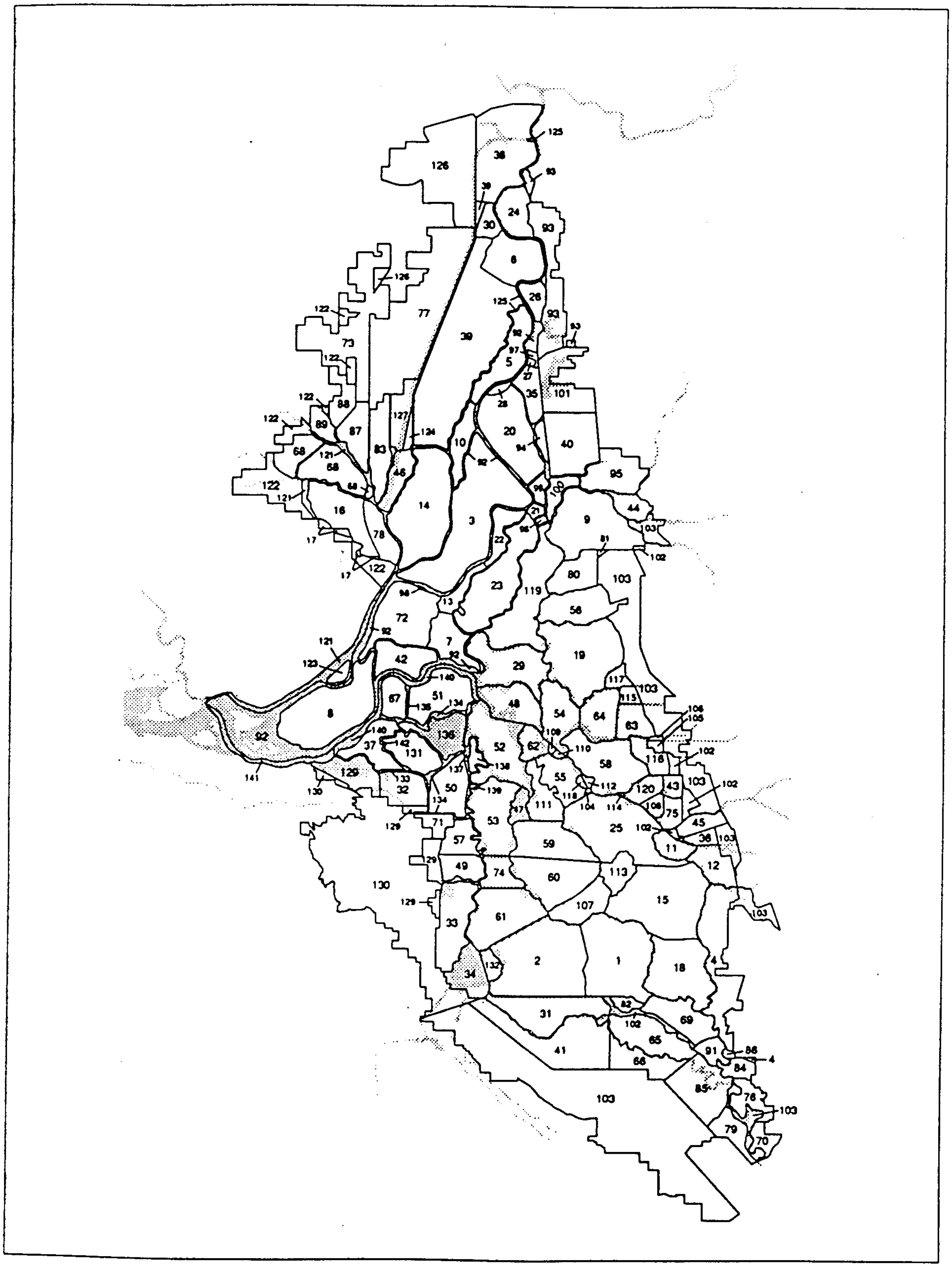

Figure 4–1. DICU Model Consumptive Use Subareas

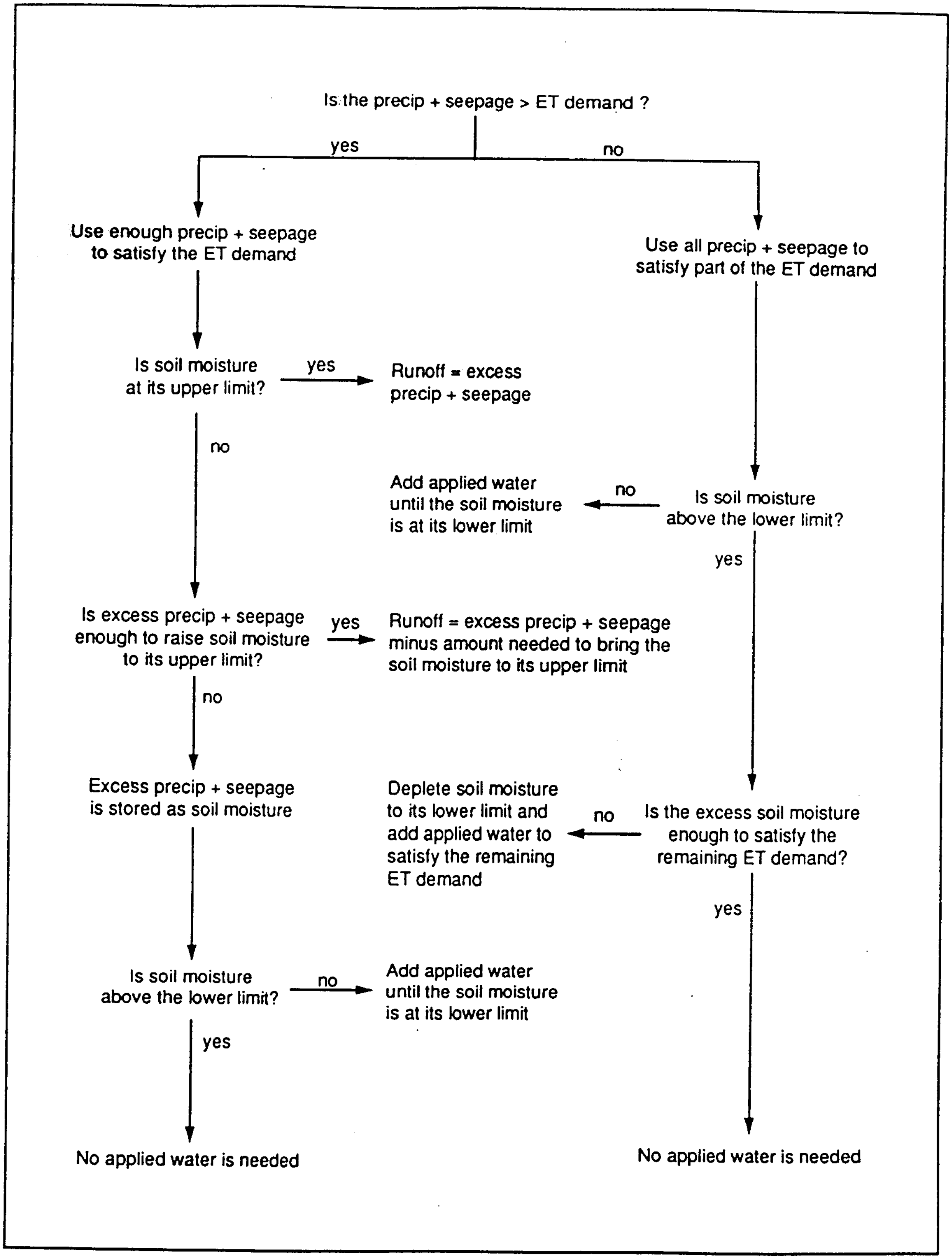

Figure 4–2. DICU Model (soil moisture bookkeeping)

DICU Model Input Data

Sources, annual trends and correlations of the following DICU model input data are discussed in this section:

- Land use
- Plant rooting depths
- Seepage
- Soil moisture
- Irrigation season
- Evapotranspiration
- Precipitation.

Land use. The DICU model depicts the Delta as 142 subareas. Some subareas coincide with islands, tracts, and reclamation and levee maintenance districts. The land use of each subarea is assigned to 20 possible land use categories. Listed in Table 4–2 are the categories used to assort Delta land areas and land use identification, which will be needed to read data in some of the tables in this report.

Table 4–2. DICU Land Use Categories

Irrigated Crops	Land Use ID	Irrigated Crops	Land Use ID
1. Pasture	PA	13. Non–irrigated Pasture	PP
2. Alfalfa	AL	14. Non–irrigated Vineyards	VV
3. Field	FI	15. Non–irrigated Orchards	OO
4. Sugar Beets	SB	16. Dry Grass	DG
5. Grain	GR	17. Water Surfaces	WS
6. Rice	RI	18. Native Vegetation	NV
7. Truck	TR	19. Riparian Vegetation	RV
8. Tomato	TO	20. Urban Land Use	UR
9. Orchards	OR		
10. Vineyards	VI		
11. Safflower	SF		
12. Corn	CR		

Most of the categories in Table 4–2 are based on the DWR standard land use legend (*DWR Standard* 1981). However, there may be some differences. For example, in the DWR legend, *pasture* could include one or more of the following crops: *alfalfa and alfalfa mixtures, clover, mixed pasture, native pasture, induced high water native pasture,* and *turf farms*. However, in the DICU model, alfalfa is assigned a category of its own.

The acreage for each category is varied according to two water year types: critical and non–critical. Critical water years are defined in the program as water years classified as *dry* and *critical* according to the D1485 water year classifications (*Water Right* 1978). Non–critical water years are those classified as *below normal, above normal,* and *wet* according to the same classifications.

For water years classified as critical, acreage is based on 1977 land use surveys performed by DWR, Central District. The 1977 surveys were the last surveys to encompass the entire Delta Service Area in one year for which Delta subarea data are available. Acreage for non–critical water years is based on a collection of surveys done in the late 1970s and early 1980s (Guivetchi 1993).

More land use data is provided in Figures 4–3 and 4–4 and Appendix C, Tables C–1 and C–2. Figure 4–3 shows crop acreage by percent distribution for non–critical and critical water years, respectively, for the Delta as a whole. Figure 4–4 shows crop acreage by percent distribution for non–critical and critical water years respectively, for a sample subarea (Union Island, east). Tables C–1 and C–2 in Appendix C list the acreage for each crop on each region for non–critical and critical water years, respectively. Figures 4–3 and 4–4 show that the Delta–wide land use distribution is similar between water years. However, on an island–by–island basis, the land use changes significantly.

Rooting depths. Estimates of plant root depths are necessary to estimate the quantity of water available for plant use that is held in the soil. The following definition is used by land and water use analysts: "Root depths are defined as the near optimum extent of rooting depth for a number of different plants within a major crop category at the height of the growing season." (*Consumptive Use Program* 1979). Root depths used by the DICU model are listed in Table 4–3 and are based on various land and water use analysts (*Documentation* 1966; *Consumptive Use Program* 1991; *De Rutte* 1967; *Kodani* 1977). The rooting depths in the Lowlands are smaller than those in the Uplands possibly because the ground water table is higher in the Lowlands.

Seepage. The DICU model assumes that seepage from adjacent Delta channels that is available to plants in the Lowlands is 0.3 inches per foot of crop rooting depth per month. This value was determined from studies conducted to calibrate soil moisture storage by adjusting the seepage (De Rutte 1967). The model assumes there is no seepage in the Uplands.

The DICU model predicts that seepage used by plants in the Lowlands ranges from 300 to 500 cfs (based on model results over the period, 1922 – 1992). Results of studies conducted in the 1950s and 1960s suggest that the total Lowlands seepage is between 635 cfs and 840 cfs (*Salinity* 1962; Owen and Nance 1962; *Quantity* 1956). The seepage estimate of 840 cfs is based on seepage in the central part of the Lowlands which has higher seepage than on the fringes (*Quantity* 1956). Results of studies conducted in the 1920s suggest that seepage is about half of the total inflow to the islands (*Variation* 1931). The seepage estimates from past studies suggest that the DICU model seepage estimate is too low.

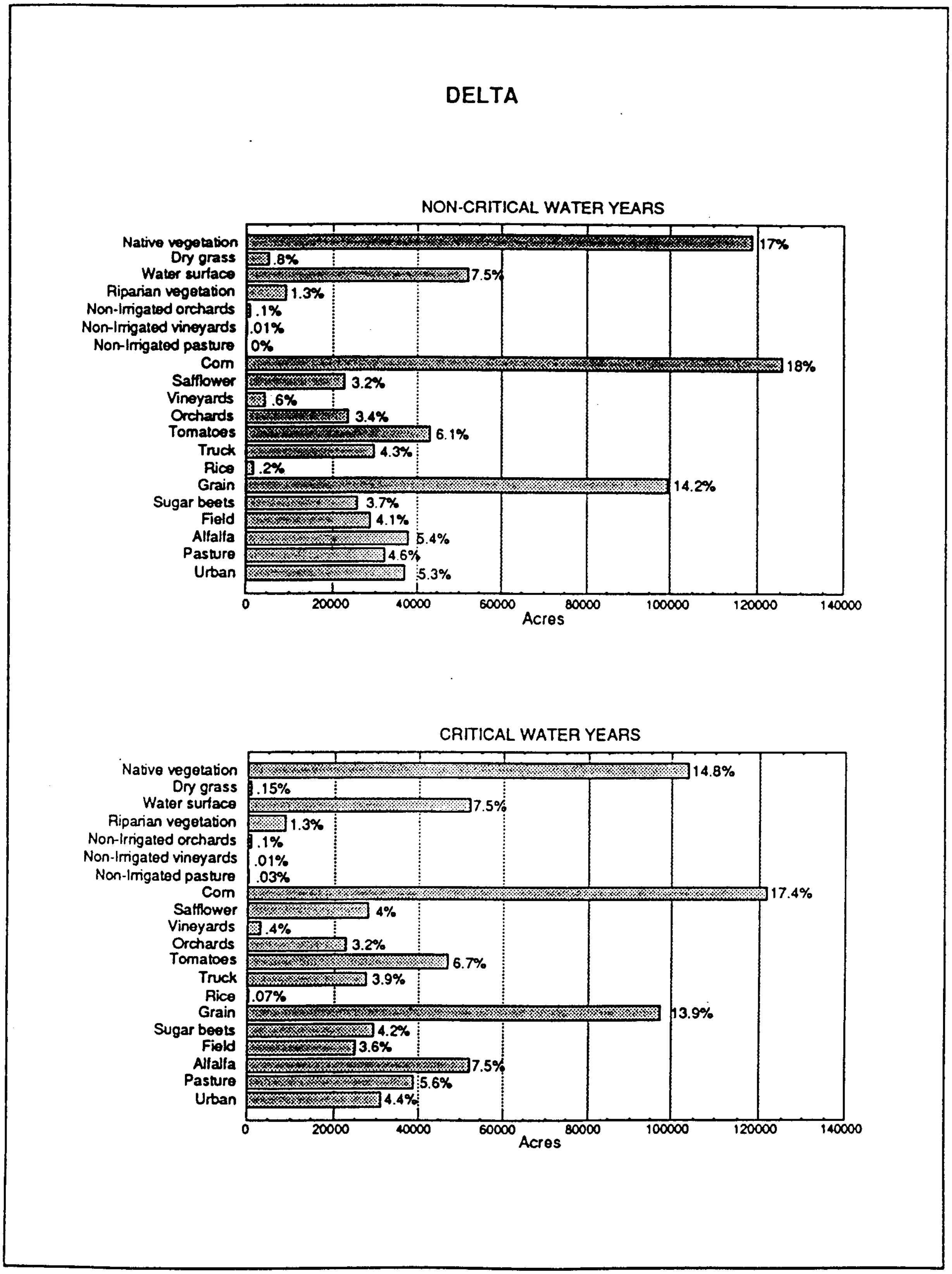

Figure 4–3. DICU Model Land Use for the Delta

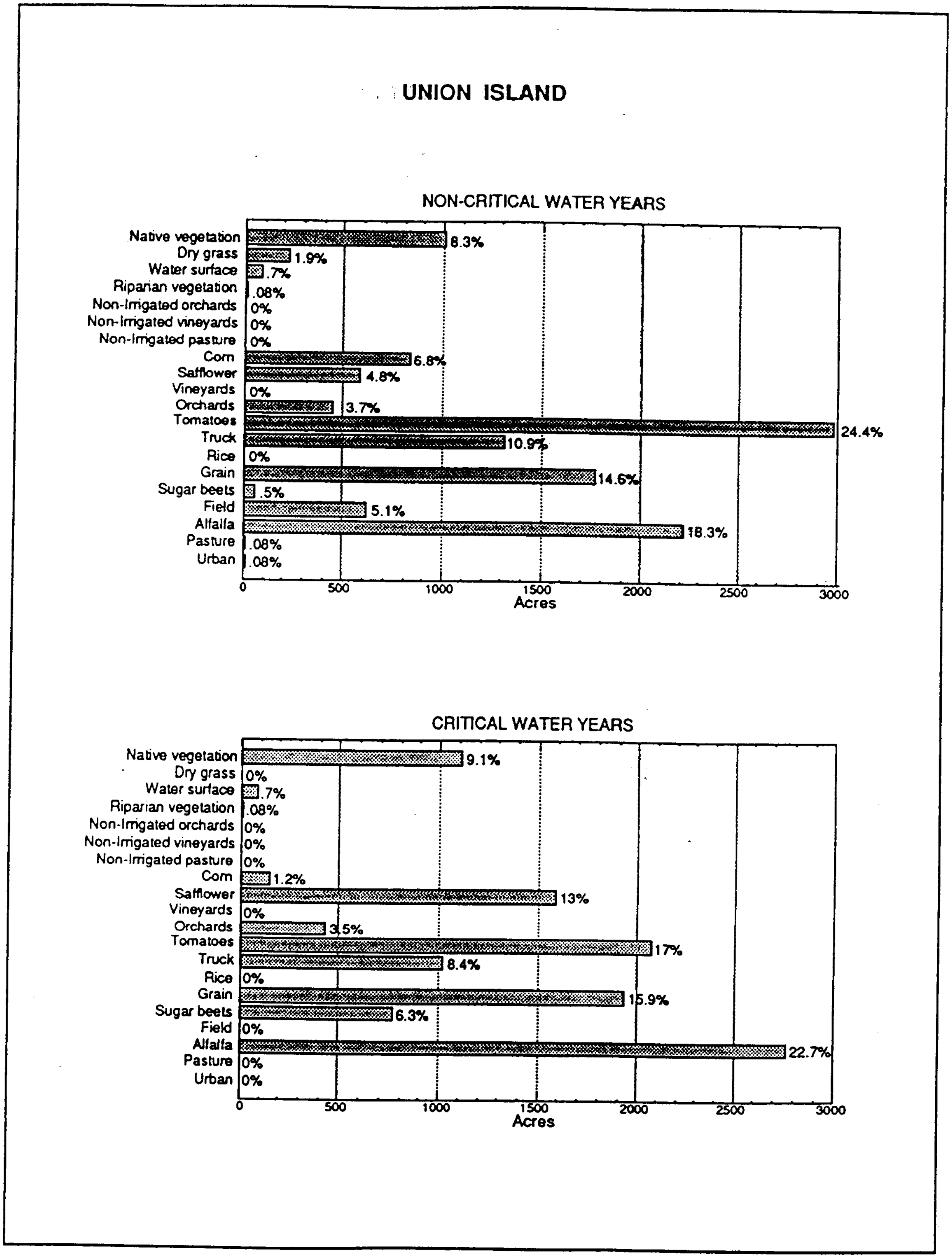

Figure 4–4. DICU Model Land Use for East Union Island

Table 4–3. DICU Crop Rooting Depths
(in feet)

Crop Category	Lowlands	Uplands
Pasture	2.0	2.0
Alfalfa	4.0	6.0
Field	2.0	4.0
Sugar Beets	4.0	5.0
Grain	2.0	4.0
Rice	1.0	2.0
Truck	4.0	5.0
Tomatoes	4.0	5.0
Orchards	5.0	6.0
Vineyards	4.0	5.0
Safflower	4.0	5.0
Corn	3.0	4.0
Non–irrigated Pasture	2.0	2.0
Non–irrigated Vineyards	4.0	5.0
Non–irrigated Orchards	5.0	6.0
Dry Grass	2.0	2.0
Native Vegetation	2.5	2.0

Soil Moisture. The quantity of soil moisture available to plants is normally considered to be the amount of moisture held by the soil between field capacity and the permanent wilting point. Fine–textured soils generally have a greater available soil moisture–holding capacity than coarse–textured soils. Accounting for soil moisture is essential in estimating Delta consumptive use because organic soils with high water holding capacities cover a large portion of the Delta. It is common for the percent moisture of Delta organic soils to be between 500 and 2,000 percent of dry weight (Owen & Nance 1962). In 1966, neutron probe measurements were collected in the Delta to estimate soil moisture. The following excerpt, taken from a DWR memorandum discusses the study (*Results* 1976).

> *In August 1966, an office memorandum report was published by the Sacramento District entitled "Documentation of Delta Joint Hydrology Meetings". The report pointed out that until 1963, all the factors necessary for computing lowlands CD [channel depletions] had been considered in detail except change in soil moisture storage.*
>
> *In 1963 neutron probes were placed throughout the Delta to estimate the Delta lowlands volume change in soil moisture storage. The report presents the results in graphical form for the period October 1963–November 1965.*

Our studies were conducted by comparing computed amounts of volume change in soil moisture with the measured amounts. Each computer run was carried out for 12 water years (1955–1966). Some judgmental adjustments to the programs' lower soil moisture limits were made for various crop categories, but only to the extent which seemed reasonable for current agricultural practices.

Listed in Table 4–4 are the soil moisture limits used by the DICU model that were derived from the report discussed above. The reader should be aware that the soil moisture limits are not physical properties of the soil for each month but are imposed by the DICU model to reflect field observations of trends in soil moisture. A discussion on maximum and minimum soil moisture levels follows.

Maximum Soil Moisture Limits. The maximum level of available soil moisture is considered to be a direct function of the normal crop rooting depth and the moisture–holding capacity of the soil (*Consumptive Use Program* 1979). The effective moisture–holding capacity, that is, moisture available in the soil to most plants, varies from a low of 3/4 of an inch per foot in coarse textured sandy soils to over 3 inches per foot in fine textured clays. The DICU model estimates the maximum soil moisture level (soil at field capacity) in the Lowlands, which contain mainly peat soils, to be 3 inches per foot rooting depth. In the Uplands, which contain mainly sands and alluvial type soils, 1.5 inches is used. These values are used by the model as upper limits to the amount of soil moisture stored.

Minimum Soil Moisture Levels. Month–end minimum levels were established to show, in a general way, the effect of summer irrigation on soil moisture. An irrigation practice assumed to be employed in the Delta is the "mining" of stored soil moisture. At the beginning of the irrigation season, the soil moisture is usually close to capacity; during the season it falls until a small amount of water approaching a stress level (above wilting point) is reached by the end of the season (*Consumptive Use Program* 1979). Figures 4–5 and 4–6 show graphically how the soil moisture limits are used by the model to simulate soil moisture mining for various crops, which again, are based on field observations.

Irrigation Season. Table 4–4 also shows the limits of the irrigation season used by the DICU model for critical and non–critical water year classifications. The irrigation season used by the model for critical water years covers more fall and winter months because the assumption is made that farmers divert water when precipitation is insufficient to satisfy ET. In terms of the DICU model, this means that water is diverted for ET purposes only during the irrigation season. During months that fall outside the irrigation season, the model does not simulate diversions for ET purposes but it does for maintaining the soil moisture lower limit.

Evapotranspiration. In 1981, USBR worked with DWR to reach mutually agreeable Delta ET values (*Joint* 1981). USBR's ET values incorporated the effects of various atmospheric factors such as temperature, dew point, and solar radiation, while DWR's values were based on pan evaporation (*Estimation* 1976).

The fixed (long term average) ET values used by the DICU model (listed in Table 4–5) are a set of long–term monthly average crop ET estimates, most of which are based on the values agreed on in 1981. The exceptions are the *rice* and *safflower* categories. The ET estimates for rice are based on DWR's estimates. The ET estimates for safflower are based on a 1976–77 study documented in Bulletin 168 (*Sacramento Valley* 1968).

Table 4–4. DICU MOdel Soil Moisture and Irrigation Season Limits

Delta Lowlands

Crop Identification	PA	AL	FI	SB	GR	RI	TR	TO	OR	VI	SF	CR	PP	VV	OO
Effective rooting depth (feet)	2.0	4.0	2.0	4.0	2.0	1.0	4.0	4.0	5.0	4.0	4.0	3.0	2.0	4.0	5.0
Maximum soil moisture (inches) *	6.0	12.0	6.0	12.0	6.0	3.0	12.0	12.0	15.0	12.0	12.0	9.0	6.0	12.0	15.0
Minimum soil moisture (inches)															
Jan	0.0	0.0	0.0	0.0	3.0	1.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	4.0	1.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0
Mar	6.0	12.0	0.0	0.0	3.0	1.0	0.0	0.0	15.0	0.0	12.0	0.0	0.0	0.0	0.0
Apr	6.0	11.0	4.0	12.0	0.0	9.0	12.0	12.0	14.0	12.0	11.0	4.0	0.0	0.0	0.0
May	5.0	10.0	4.0	11.5	0.0	10.5	12.0	12.0	13.5	12.0	10.0	4.0	0.0	0.0	0.0
Jun	4.5	9.0	5.0	11.0	0.0	12.0	12.0	12.0	13.0	11.0	8.0	6.0	0.0	0.0	0.0
Jul	4.0	8.0	6.0	10.0	0.0	12.0	10.0	10.0	12.0	10.0	3.0	5.0	0.0	0.0	0.0
Aug	3.5	7.0	3.0	8.0	0.0	10.5	8.0	8.0	10.0	9.0	0.0	3.0	0.0	0.0	0.0
Sep	3.0	6.0	2.0	7.0	0.0	3.0	6.0	6.0	9.0	8.0	0.0	2.0	0.0	0.0	0.0
Oct	4.0	6.0	1.0	7.0	0.0	1.0	1.0	1.0	8.0	7.0	0.0	1.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Delta Uplands

Crop Identification	PA	AL	FI	SB	GR	RI	TR	TO	OR	VI	SF	CR	PP	VV	OO
Effective rooting depth (feet)	2.0	6.0	4.0	5.0	4.0	2.0	5.0	5.0	6.0	5.0	5.0	4.0	2.0	5.0	6.0
Maximum soil moisture (inches) ♣	3.0	9.0	6.0	7.5	6.0	3.0	4.5	7.5	9.0	7.5	7.5	6.0	3.0	7.5	9.0
Minimum soil moisture (inches)															
Jan	1.0	2.0	1.0	2.0	3.0	1.0	1.0	1.0	2.0	2.0	3.5	1.0	0.0	0.0	0.0
Feb	1.0	2.0	1.0	2.0	3.0	1.0	1.0	1.0	2.0	2.0	5.0	1.0	0.0	0.0	0.0
Mar	2.0	6.0	4.0	4.0	3.0	1.0	1.0	1.0	5.0	2.0	7.5	4.0	0.0	0.0	0.0
Apr	3.0	8.0	4.0	4.0	3.0	9.0	3.0	3.0	8.0	5.0	7.0	4.0	0.0	0.0	0.0
May	3.0	9.0	4.0	7.5	1.0	10.5	4.0	7.5	9.0	7.5	6.0	4.5	0.0	0.0	0.0
Jun	2.5	8.0	5.0	7.5	1.0	12.0	4.5	7.5	8.0	7.0	3.5	5.0	0.0	0.0	0.0
Jul	2.0	7.0	4.5	6.0	1.0	12.0	4.0	6.5	7.0	6.0	2.0	4.5	0.0	0.0	0.0
Aug	2.0	6.0	3.0	5.0	1.0	10.5	4.0	5.5	6.0	5.0	0.0	3.0	0.0	0.0	0.0
Sep	2.0	5.0	2.0	4.0	1.0	3.0	2.0	3.0	5.0	4.0	0.0	2.0	0.0	0.0	0.0
Oct	1.5	4.0	1.0	3.0	1.0	1.0	1.0	1.0	4.0	3.0	0.0	1.0	0.0	0.0	0.0
Nov	1.0	2.0	1.0	2.0	1.0	1.0	1.0	1.0	2.0	2.0	0.0	1.0	0.0	0.0	0.0
Dec	1.0	2.0	1.0	2.0	2.0	1.0	1.0	1.0	2.0	2.0	0.0	1.0	0.0	0.0	0.0

* Computed by multiplying soil depth by 3 inches per foot
♣ Computed by multiplying soil depth by 1.5 inches per foot

Shaded area indicates critical water year irrigation season
Dark lines indicate limit of the non-critical water year irrigation season

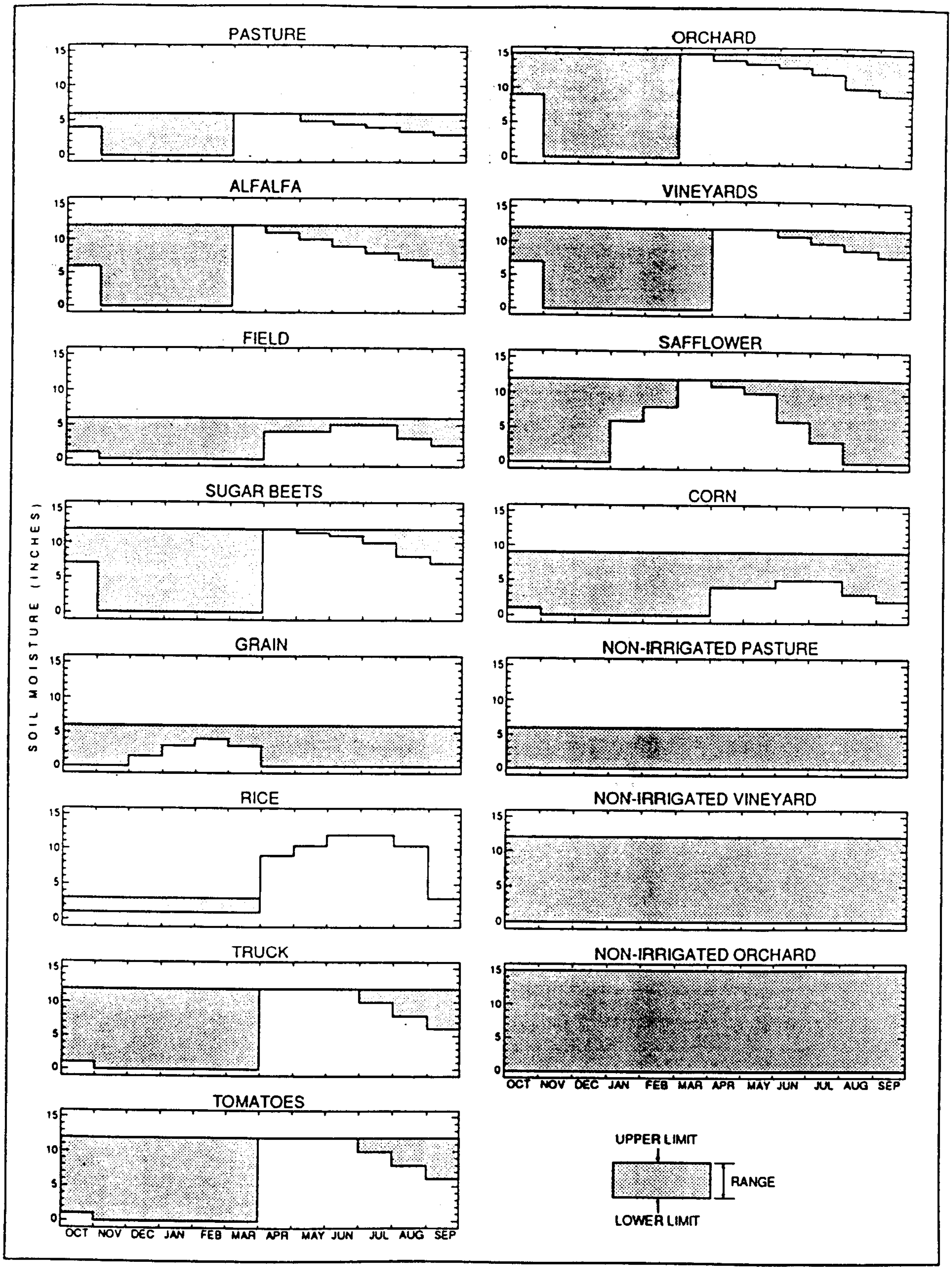

Figure 4–5. DICU Model Soil Moisture Limits for the Delta Lowlands

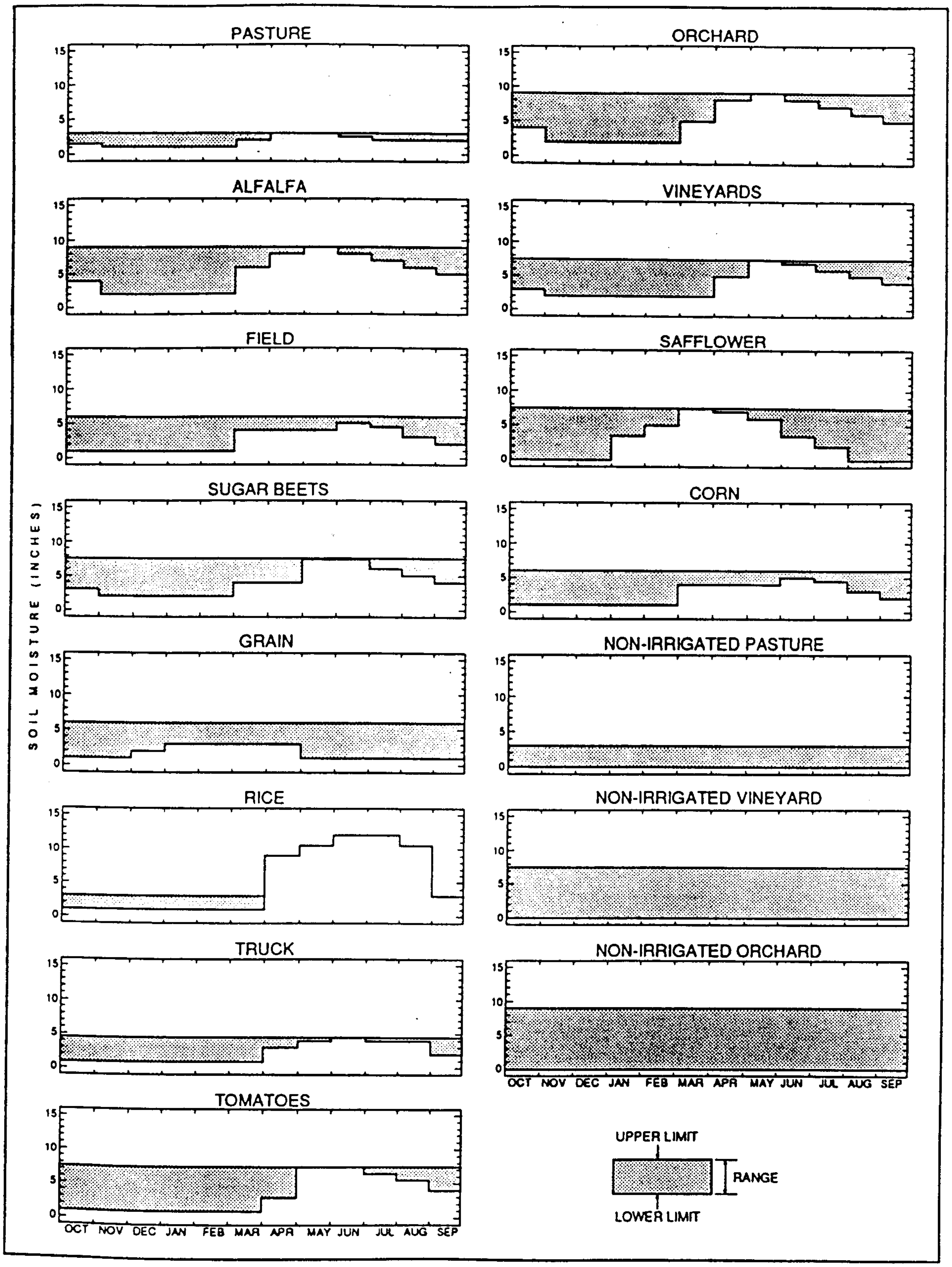

Figure 4–6. DICU Model Soil Moisture Limits for the Delta Uplands

Table 4–5. DICU Model Total Monthly Unit ET Per Crop

(in inches)

Crop	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Total
Pasture	2.80	1.40	0.60	0.70	1.50	2.70	4.10	5.50	6.40	7.60	6.60	4.80	44.7
Alfalfa	2.80	1.40	0.60	0.70	1.50	2.70	4.10	5.50	6.40	7.60	6.60	4.80	44.7
Field	1.10	1.10	0.60	0.70	1.50	1.70	1.60	2.60	5.50	7.30	4.90	2.20	30.8
Sugar Beets	2.30	1.10	0.60	0.70	1.50	1.70	1.30	3.20	6.00	7.90	6.60	4.80	37.7
Grain	1.00	1.10	0.60	0.70	1.50	2.70	4.60	5.00	2.20	1.00	1.00	1.00	22.4
Rice	1.90	1.40	0.60	0.70	1.50	2.10	2.10	6.40	8.20	9.70	8.40	5.40	48.4
Truck	1.00	1.10	0.60	0.70	1.50	1.60	1.30	3.20	6.40	8.30	5.50	1.70	32.9
Tomatoes	1.00	1.10	0.60	0.70	1.50	1.60	1.30	3.20	6.40	8.30	5.50	1.70	32.9
Orchards	2.50	1.20	0.60	0.70	1.50	1.70	2.70	4.90	5.90	7.00	6.10	4.40	39.2
Vineyards	1.10	1.10	0.60	0.70	1.50	1.70	1.50	3.60	4.90	6.40	5.30	3.60	32.0
Safflower	1.90	1.50	1.00	0.70	1.50	1.90	2.50	4.80	8.70	7.70	4.40	2.50	39.1
Corn	1.10	1.10	0.60	0.70	1.50	1.70	1.60	2.60	5.50	7.30	4.90	2.20	30.8
Non–irrigated Pasture	2.80	1.40	0.60	0.70	1.50	2.70	4.10	5.50	6.40	7.60	6.60	4.80	44.7
Non–irrigated Vineyards	1.10	1.10	0.60	0.70	1.50	1.70	1.50	3.60	4.90	6.40	5.30	3.60	32.0
Non–irrigated Orchards	2.50	1.20	0.60	0.70	1.50	1.70	2.70	4.90	5.90	7.00	6.10	4.40	39.2
Dry Grain	1.00	1.10	0.60	0.70	1.50	2.70	4.60	5.00	2.20	1.00	1.00	1.00	22.4
Native Vegetation	2.80	1.40	0.60	0.70	1.50	2.70	4.10	5.50	6.40	7.60	6.60	4.80	44.7
Riparian Vegetation	3.70	1.70	0.90	1.00	1.90	3.40	5.10	6.90	7.90	9.00	8.00	5.90	55.4
Water Surface	3.70	1.70	0.90	1.00	1.90	3.40	5.10	6.90	7.90	9.00	8.00	5.90	55.4

The fixed long term average ET values are adjusted using monthly averaged pan evaporation data. The adjustment using pan evaporation data is based on the assumption that monthly crop ET values will vary at the same rate as monthly pan evaporation. The equation used to adjust the fixed ET values follows:

$$\text{ET(crop, month, yr)} = \begin{matrix}\text{long term average}\\ \text{ET(crop, month)}\end{matrix} \times \frac{\text{pan evaporation(month, yr)}}{\begin{matrix}\text{long term average}\\ \text{pan evaporation(month)}\end{matrix}} \qquad (4\text{–}1)$$

The following excerpt from a 1985 memorandum gives details of the adjustment (*ET* 1985).

> *The purpose of this activity was to provide factors for the months October 1955 through September 1984 which can be used to determine monthly variations in crop ET values which reflect actual conditions needed for the Delta Channel Depletion Program model. To do this it was assumed that monthly crop ET values would vary at the same rate as monthly pan evaporation; therefore, pan evaporation figures could be used to develop the factors. It would have been desirable to have an evaporation pan site located in an irrigated grass area with a data record of which encompassed all of the time period used for the model. No one site in the Delta or near the Delta fulfilled these criteria. Therefore, two sites located at U.C. Davis were used: Davis Hydromet and Davis 2WSW. It was assumed that the U.C. Davis sites are near enough to the Delta to be representative of the percentage variations in evaporation in the Delta even though the magnitude of evaporation might be different.*

Data from the two Davis sites were used to calculate long term average monthly pan evaporation. For water years 1922 through 1955, pan evaporation data is not available and therefore the pan evaporation for those years is based on the average pan evaporation of all the water year types in the period 1956 to 1984 (Guivetchi 1993).

Precipitation. Precipitation for each of the 142 sub–areas is determined by weighting the precipitation of seven Delta stations using the Theissen Polygon interpolation routine. The seven precipitation stations used by the interpolation routine are at Davis, Rio Vista, Stockton, Lodi, Galt, Tracy–Carbona, and Brentwood shown in Figure 4–7. For sub–areas spanning two or more polygons, the precipitation is determined proportionally by area. For example, if a region has 60 percent of its area in the Galt polygon and 40 percent in the Lodi polygon, then the precipitation for that region is 60 percent of the Galt station precipitation plus 40 percent of the Lodi precipitation station.

Precipitation data for the stations are compiled in the National Oceanic Atmospheric Administration (NOAA) annual climatological data summaries for California. NOAA data are provided through the California Data Exchange Center. Figure 4–8 shows a sample set of annual precipitation data.

Missing data are resolved by using correlations with other stations. For example, the Brentwood station was discontinued in 1987; therefore, the precipitation at that location is estimated using precipitation from the Tracy station. The ratio of Brentwood precipitation to Tracy precipitation based on the long–term average annual precipitation is 1.37.

Since the DICU model runs on a monthly time–step, the assumption is made that the total precipitation for a month is available to the plants for that month. This means that even if it rained on the last day of a month, the rainfall would be available to satisfy crop ET demands for the entire month.

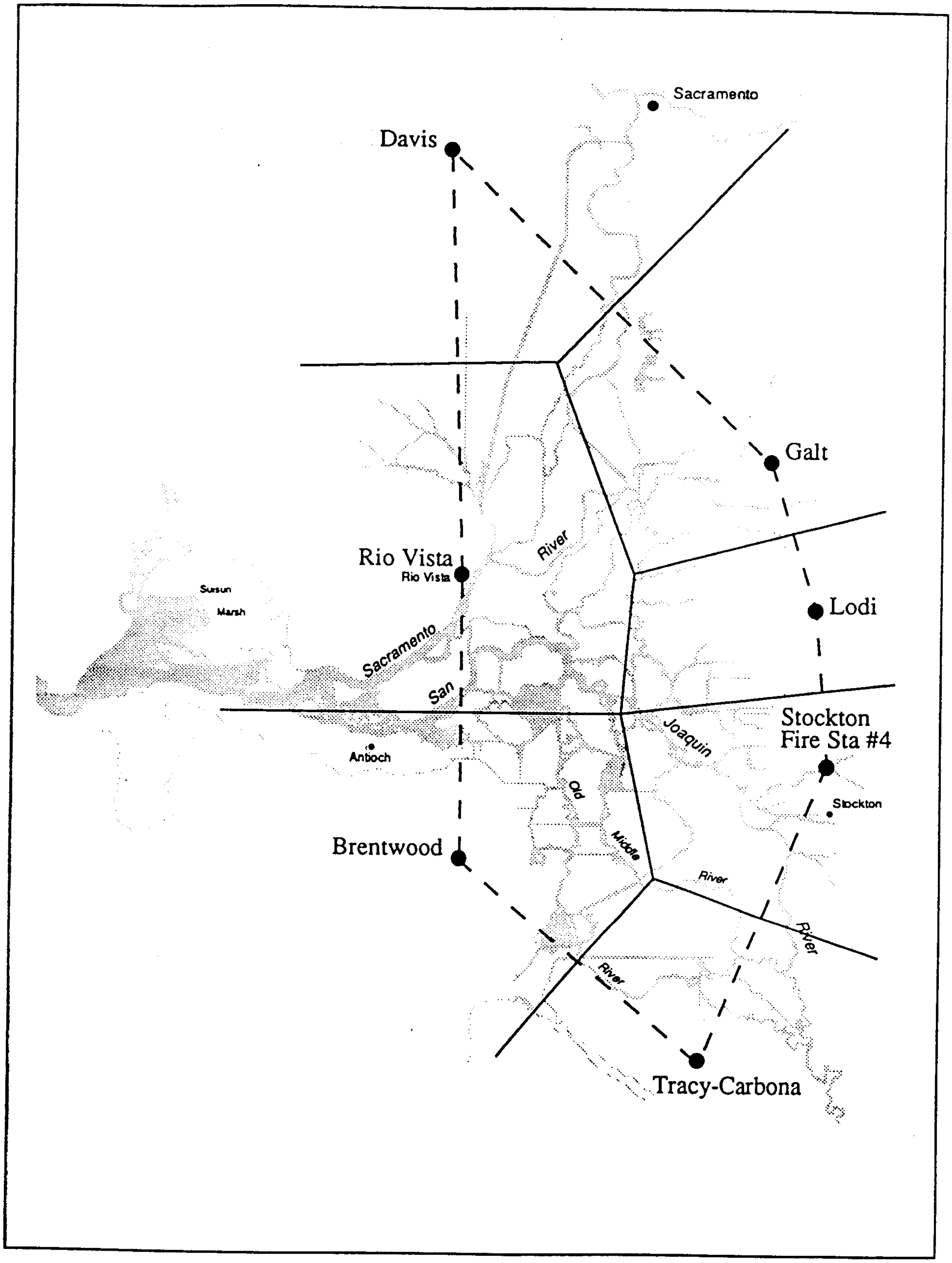

Figure 4–7. Precipitation Stations and Theissen Polygon Boundaries

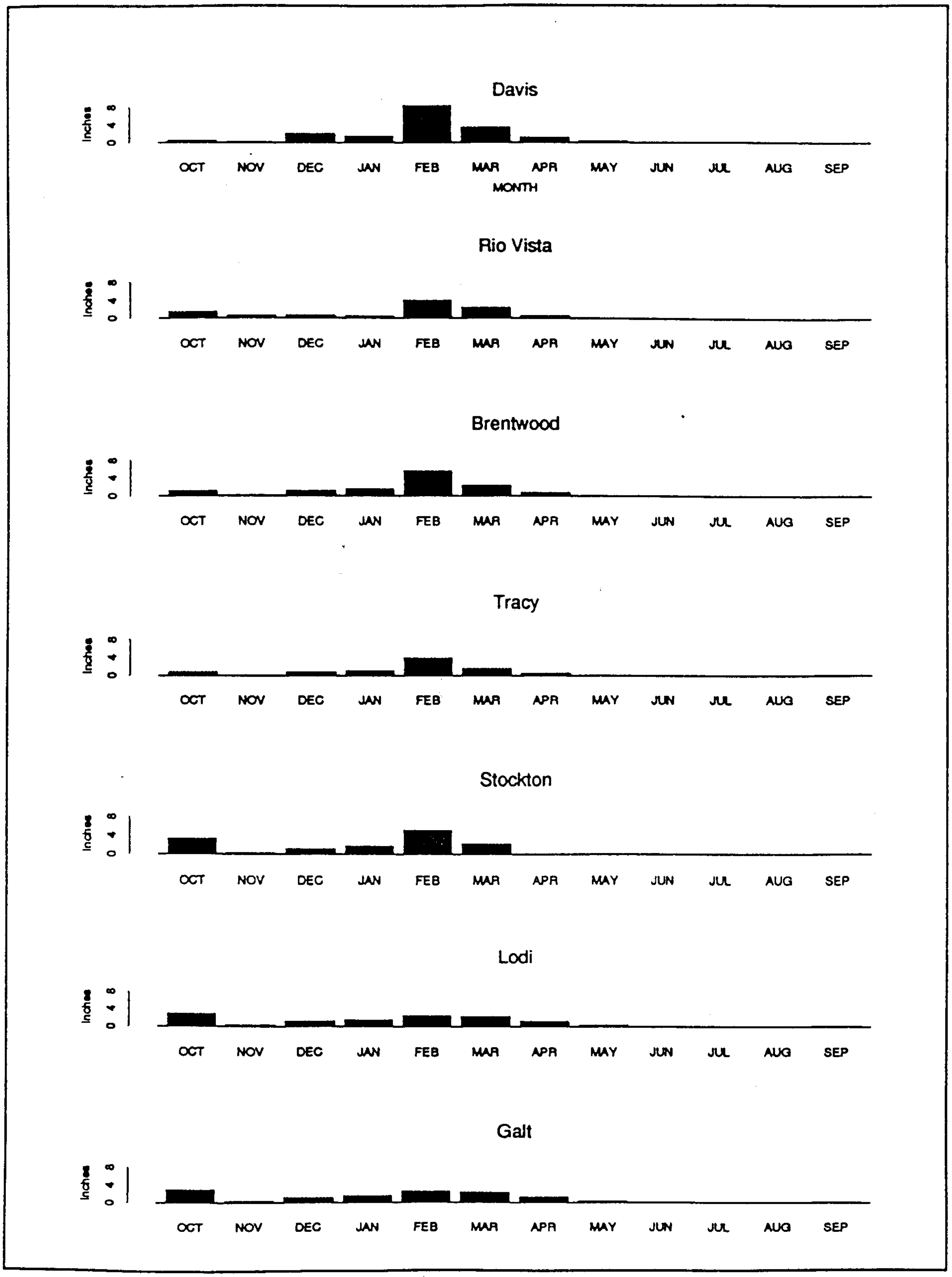

Figure 4–8. Water Year 1992 Precipitation

Chapter 5
The Subarea to Node Allocation Program

DICU model results are generated for 142 subareas. For this information to be used as input to the DWRDSM model, irrigation diversions and returns need to be spatially distributed to DWRDSM nodes. The subarea to node allocation FORTRAN program (NODCU) was developed in 1988 to determine irrigation diversion and drainage volumes, assign drainage salinity concentrations for each subarea, and allocate volumes and concentrations to DWRDSM nodes (*NODCU* 1988). The program utilizes equations 2–2 and 2–3 and the following information:

- DICU subarea results
- Lowlands leaching volumes and monthly schedule
- Irrigation efficiency
- Subarea to node allocation factors for diversions and returns
- DWR Bulletin 123 drainage salinity concentrations.

Input data needed by the program are discussed below.

DICU Output

Precipitation, seepage, applied water, and total consumptive use for each subarea are generated by the DICU model discussed in Chapter 4. DICU output files are read directly by the node allocation program.

Lowlands Leaching Volumes and Schedule

In the Delta Lowlands, salts leach from the root zone periodically by heavy applications of water over the winter months. Leaching practices can be observed by areal observations. Leach water estimates used by the node allocation program are based on areal surveys done by DWR Central District. Appendix D contains a description of the study undertaken to determine the magnitude of the leaching practices in the Delta (*Joint* 1981).

Based on the leach water estimates discussed above, the DICU leach water schedule for each subarea in the Delta Lowlands was determined. For each month, the total Delta Lowlands leach water applied or drained was distributed proportionally by area to each subarea. For example, subarea 1 (Union Island, east) contains 3.6 percent of the total area in the Lowlands. Therefore, in October, the leach water applied to that subarea is 3.6 percent of 11,200 acre–feet or 291 acre–feet. The leach water flows, applied to and drained from each of the 142 subareas, are listed in Table 5–1. Upland subareas are not assigned leach water flows.

Table 5–1. Schedule of Leach Water Application and Drainage *(in acre–feet)*

Sub-area	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	291	415	685	-779	-405	-192	-18	0	0	0	0	0
2	332	474	782	-889	-462	-219	-18	0	0	0	0	0
3	404	577	952	-1082	-563	-267	-22	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	118	169	278	-316	-164	-78	-6	0	0	0	0	0
6	146	209	344	-391	-203	-97	-8	0	0	0	0	0
7	86	122	201	-229	-119	-56	-5	0	0	0	0	0
8	255	364	600	-682	-355	-168	-14	0	0	0	0	0
9	243	347	573	-651	-338	-160	-13	0	0	0	0	0
10	59	84	138	-157	-82	-39	-3	0	0	0	0	0
11	41	59	97	-110	-57	-27	-2	0	0	0	0	0
12	65	93	153	-174	-91	-43	-3	0	0	0	0	0
13	42	60	98	-112	-58	-28	-2	0	0	0	0	0
14	292	418	689	-783	-407	-193	-16	0	0	0	0	0
15	306	437	721	-819	-426	-202	-16	0	0	0	0	0
16	141	202	333	-379	-197	-93	-8	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	194	277	457	-519	-270	-128	-10	0	0	0	0	0
19	270	386	637	-724	-377	-179	-14	0	0	0	0	0
20	211	302	498	-566	-294	-140	-11	0	0	0	0	0
21	10	15	24	-27	-14	-7	-1	0	0	0	0	0
22	55	79	130	-148	-77	-36	-3	0	0	0	0	0
23	221	318	522	-593	-308	-146	-12	0	0	0	0	0
24	82	117	194	-220	-114	-54	-4	0	0	0	0	0
25	281	402	663	-754	-392	-186	-15	0	0	0	0	0
26	38	55	90	-103	-53	-25	-2	0	0	0	0	0
27	3	5	7	-8	-4	-2	0	0	0	0	0	0
28	10	14	23	-26	-14	-6	-1	0	0	0	0	0
29	166	237	391	-444	-231	-110	-9	0	0	0	0	0
30	33	48	79	-89	-47	-22	-2	0	0	0	0	0
31	161	230	380	-432	-225	-107	-9	0	0	0	0	0
32	82	117	193	-219	-114	-54	-4	0	0	0	0	0
33	157	225	371	-421	-219	-104	-8	0	0	0	0	0
34	84	119	197	-224	-117	-55	-4	0	0	0	0	0
35	52	74	122	-139	-72	-34	-3	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	84	120	198	-225	-117	-56	-5	0	0	0	0	0
38	265	378	624	-709	-369	-175	-14	0	0	0	0	0
39	606	866	1430	-1624	-845	-401	-32	0	0	0	0	0
40	159	228	376	-427	-222	-105	-9	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0
42	87	125	206	-234	-122	-58	-5	0	0	0	0	0
43	23	33	54	-61	-32	-15	-1	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	60	86	141	-161	-84	-40	-3	0	0	0	0	0
47	32	46	75	-86	-44	-21	-2	0	0	0	0	0
48	110	158	260	-296	-154	-73	-6	0	0	0	0	0
49	73	105	173	-197	-102	-48	-4	0	0	0	0	0
50	103	148	244	-277	-144	-68	-6	0	0	0	0	0
51	136	194	320	-364	-189	-90	-7	0	0	0	0	0
52	204	292	481	-547	-284	-135	-11	0	0	0	0	0
53	164	234	387	-440	-229	-108	-9	0	0	0	0	0
54	109	155	256	-291	-151	-72	-6	0	0	0	0	0
55	89	127	210	-238	-124	-59	-5	0	0	0	0	0
56	125	178	294	-334	-174	-82	-7	0	0	0	0	0
57	62	89	147	-167	-87	-41	-3	0	0	0	0	0
58	170	244	402	-457	-237	-113	-9	0	0	0	0	0
59	146	208	344	-391	-203	-96	-8	0	0	0	0	0
60	162	232	383	-435	-226	-107	-9	0	0	0	0	0
61	185	265	437	-496	-258	-122	-10	0	0	0	0	0
62	42	60	98	-112	-58	-28	-2	0	0	0	0	0
63	64	91.	151	-171	-89	-42	-3	0	0	0	0	0
64	94	135	222	-253	-131	-62	-5	0	0	0	0	0
65	135	192	317	-361	-187	-89	-7	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0
67	53	76	125	-142	-74	-35	-3	0	0	0	0	0
68	175	249	412	-468	-243	-115	-9	0	0	0	0	0
69	111	158	261	-297	-154	-73	-6	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0
71	33	47	77	-88	-46	-22	-2	0	0	0	0	0
72	185	265	437	-496	-258	-122	-10	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0
74	52	74	122	-138	-72	-34	-3	0	0	0	0	0
75	32	45	75	-85	-44	-21	-2	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0	0	0	0
78	70	100	165	-187	-97	-46	-4	0	0	0	0	0
79	0	0	0	0	0	0	0	0	0	0	0	0
80	76	108	178	-202	-105	-50	-4	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0	0
82	18	26	43	-48	-25	-12	-1	0	0	0	0	0
83	122	175	289	-328	-171	-81	-7	0	0	0	0	0
84	0	0	0	0	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	0	0	0	0	0
86	0	0	0	0	0	0	0	0	0	0	0	0
87	84	119	197	-224	-117	-56	-4	0	0	0	0	0
88	0	0	0	0	0	0	0	0	0	0	0	0
89	0	0	0	0	0	0	0	0	0	0	0	0
90	10	14	24	-27	-14	-7	-1	0	0	0	0	0
91	0	0	0	0	0	0	0	0	0	0	0	0
92	431	616	1017	-1156	-601	-285	-23	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0	0	0
94	15	21	34	-39	-20	-10	-1	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0
96	5	7	11	-13	-7	-3	0	0	0	0	0	0
97	5	7	12	-14	-7	-3	0	0	0	0	0	0
98	1	2	3	-4	-2	-1	0	0	0	0	0	0
99	17	24	40	-46	-24	-11	-1	0	0	0	0	0
100	38	54	89	-101	-52	-25	-2	0	0	0	0	0
101	0	0	0	0	0	0	0	0	0	0	0	0
102	66	94	155	-176	-92	-44	-4	0	0	0	0	0
103	0	0	0	0	0	0	0	0	0	0	0	0
104	2	3	5	-5	-3	-1	0	0	0	0	0	0
105	9	12	20	-23	-12	-6	0	0	0	0	0	0
106	0	0	0	0	0	0	0	0	0	0	0	0
107	81	115	190	-216	-112	-53	-4	0	0	0	0	0
108	22	31	51	-58	-30	-14	-1	0	0	0	0	0
109	3	5	7	-8	-4	-2	0	0	0	0	0	0
110	5	7	11	-13	-7	-3	0	0	0	0	0	0
111	72	102	169	-192	-100	-47	-4	0	0	0	0	0
112	7	9	16	-18	-9	-4	0	0	0	0	0	0
113	60	86	143	-162	-84	-40	-3	0	0	0	0	0
114	2	3	5	-5	-3	-1	0	0	0	0	0	0
115	19	28	45	-52	-27	-13	-1	0	0	0	0	0
116	47	67	110	-125	-65	-31	-2	0	0	0	0	0
117	27	38	63	-71	-37	-18	-1	0	0	0	0	0
118	4	6	10	-12	-6	-3	0	0	0	0	0	0
119	239	342	564	-641	-333	-158	-13	0	0	0	0	0
120	35	50	82	-93	-49	-23	-2	0	0	0	0	0
121	150	214	354	-402	-209	-99	-8	0	0	0	0	0
122	0	0	0	0	0	0	0	0	0	0	0	0
123	15	21	34	-39	-20	-10	-1	0	0	0	0	0
124	18	26	43	-48	-25	-12	-1	0	0	0	0	0
125	45	65	107	-121	-63	-30	-2	0	0	0	0	0
126	0	0	0	0	0	0	0	0	0	0	0	0
127	38	55	90	-103	-53	-25	-2	0	0	0	0	0
128	0	0	0	0	0	0	0	0	0	0	0	0
129	147	210	347	-395	-205	-97	-8	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0	0
131	83	119	196	-223	-116	-55	-4	0	0	0	0	0
132	29	42	69	-78	-41	-19	-2	0	0	0	0	0
133	0	0	0	0	0	0	0	0	0	0	0	0
134	0	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0	0
136	0	0	0	0	0	0	0	0	0	0	0	0
137	0	0	0	0	0	0	0	0	0	0	0	0
138	19	27	44	-50	-26	-12	-1	0	0	0	0	0
139	2	2	4	-5	-2	-1	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0	0
141	0	0	0	0	0	0	0	0	0	0	0	0
142	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	11198	16003	26397	-30000	-15597	-7395	-599	0	0	0	0	0

Farm Irrigation Efficiency

The irrigation efficiency is a measure of the irrigation requirement compared to the total applied water. To estimate drainage flows, the efficiency of irrigation practices is required. Land and water use analysts working at DWR Central District estimate Delta farm irrigation methods to be 70 percent efficient over the irrigation season (Sato 1985). That value is used for all subareas.

Subarea to Node Allocation Factors

There are about 1,800 agricultural diversion sites and 232 return sites in the Delta as shown in Figures 5–1 and 5–2 (*Sacramento–San Joaquin Delta Atlas* 1993). Diversions at the sites are made using pumps, siphons, and floodgates. Drainage flows are returned to the channels using pumps. To represent the spatial distribution of agricultural diversion and return sites, the flows for 142 subareas were assigned to DWRDSM nodes. Figures 5–3 and 5–4, respectively, show the DWRDSM nodes that are assigned diversion and return flows. Diversions are assigned at approximately 250 nodes and drainage flows at approximately 200 nodes.

Once the diversion and drainage flows associated with each subarea are determined, the node allocation program allocates them to DWRDSM nodes based on predefined allocation factors. The factors indicate the percentage of subarea water diverted and drained in the proximity of a DWRDSM node. The allocation factors were determined originally for the DWR/RMA Hydrodynamics Model. Later, the allocation factors were converted to match the DWRDSM node network. The factors are based on a 1987 field inventory of irrigation siphons and drainage pumps (*Irrigation* 1988). For illustration, typical irrigation facilities found in Clifton Court Forebay USGS Quadrangle are shown in Figure 5–5. For example, Coney Island (subarea 132) houses siphons, diversion pumps, floodgates, and drainage pumps. Appendix E contains a memorandum giving more details about how the allocation factors were determined from Delta quad sheets such as the one shown in Figure 5–5.

The allocation factors are applied to each subarea to spatially distribute diversion and drainage flows through the use of the node allocation program. Figure 1–2 shows the DWRDSM nodes (junctions) surrounding Coney Island and Table 5–2 shows how flows are apportioned to those nodes.

Diversion and drainage allocation factors for *all* the subareas are listed in Appendix C, Tables C–3 and C–4, respectively.

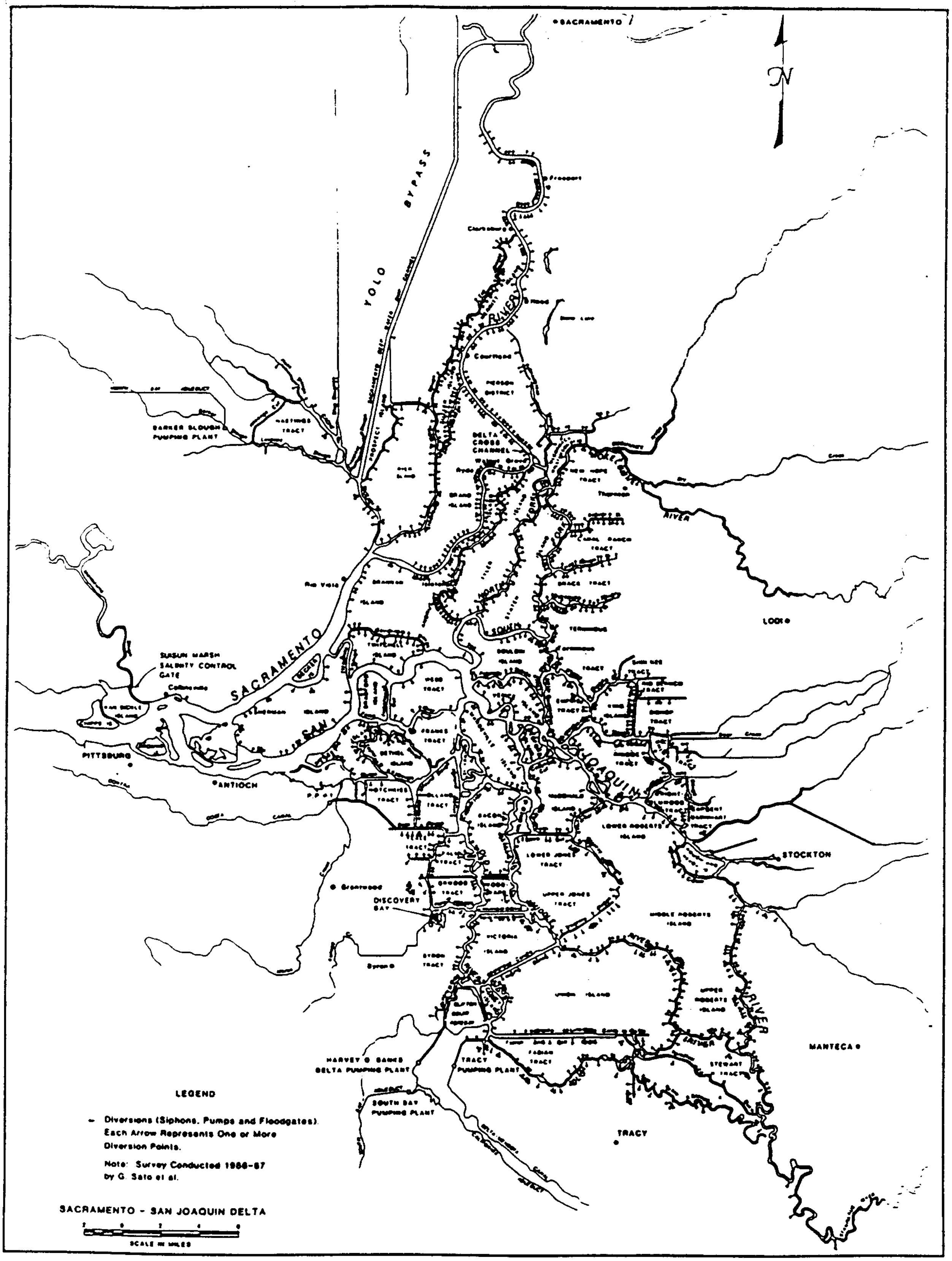

Figure 5–1. Irrigation Diversions

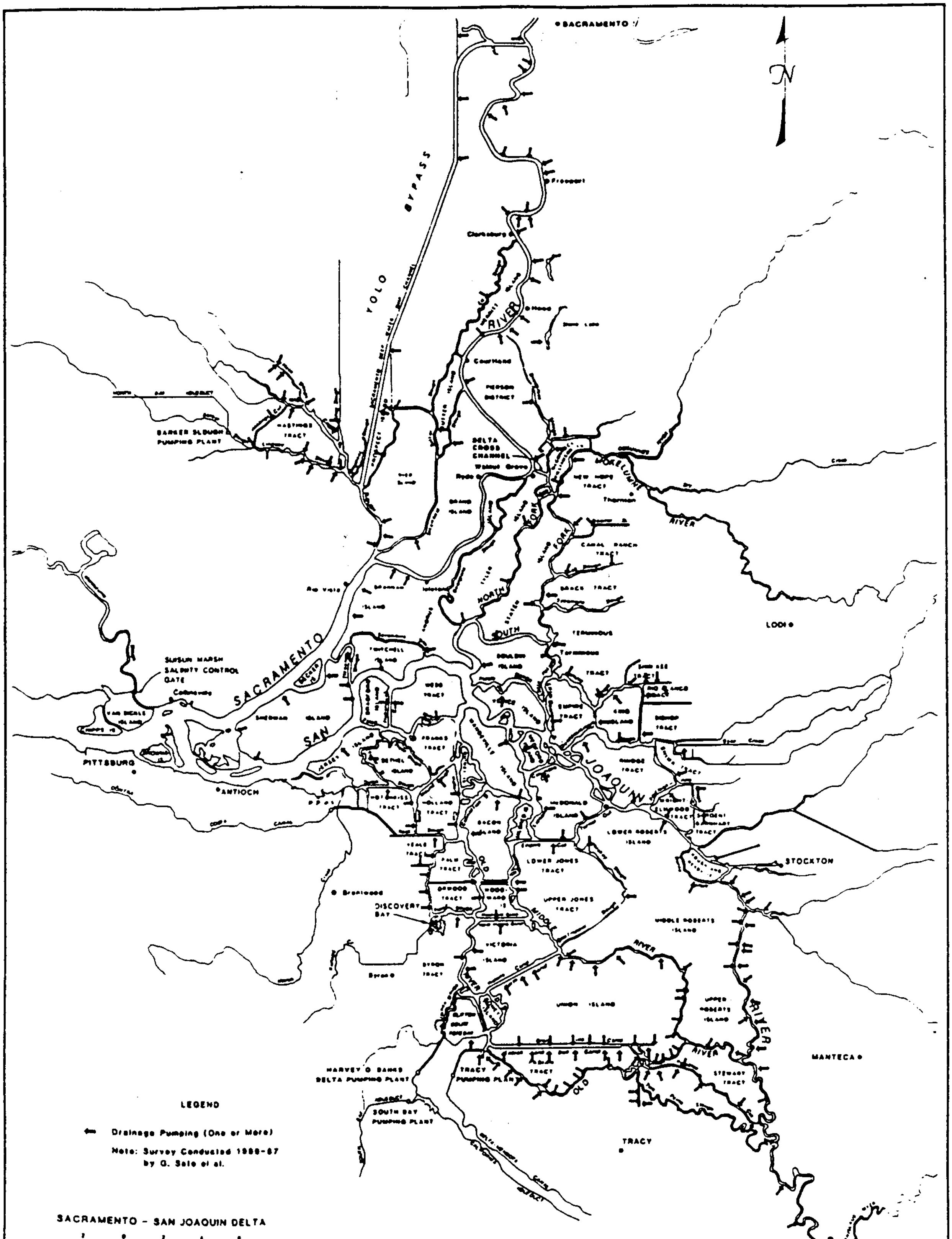

Figure 5–2. Agricultural Drainage Returns

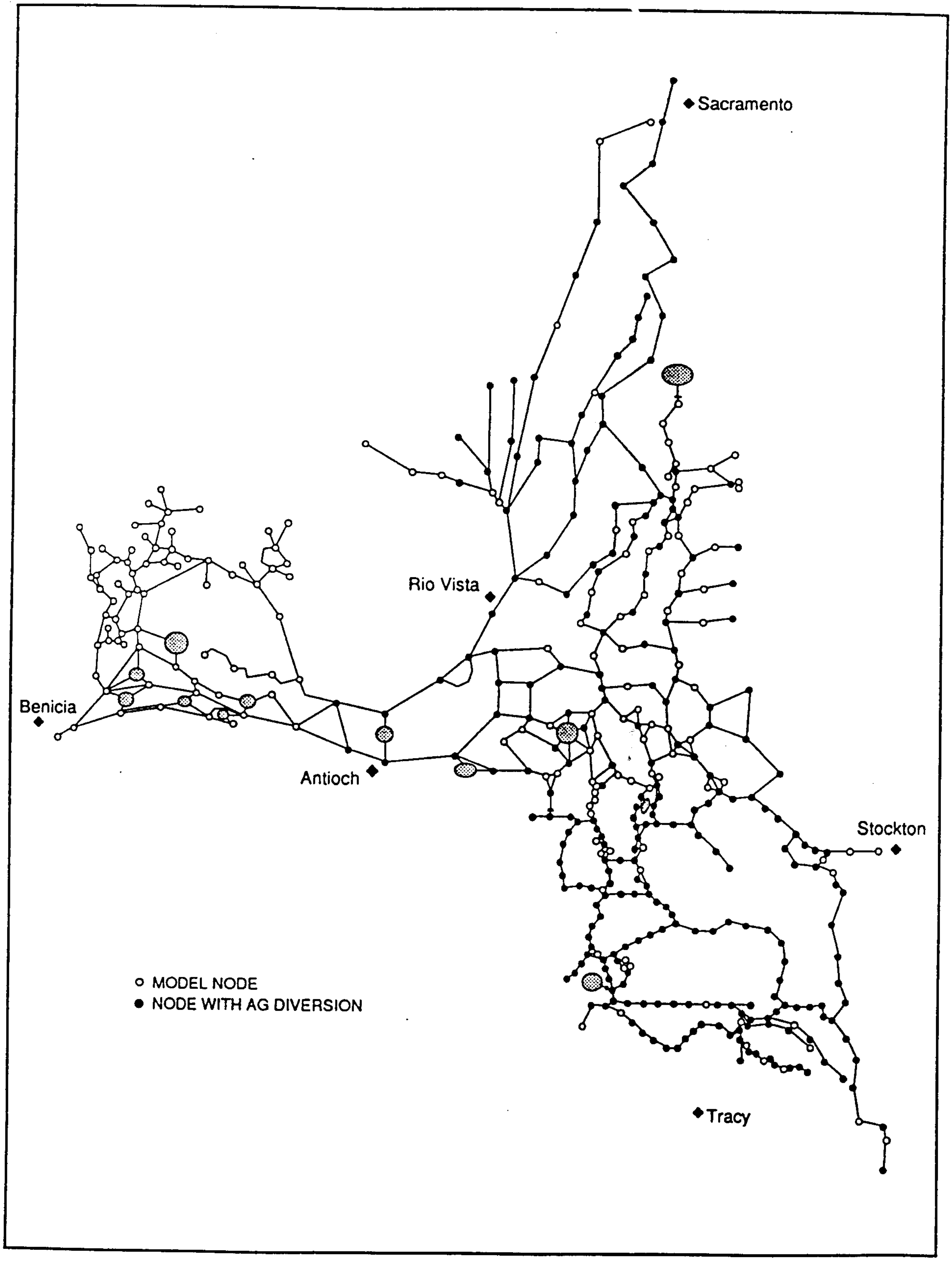

Figure 5–3. DWRDSM, Location of Agricultural Diversions

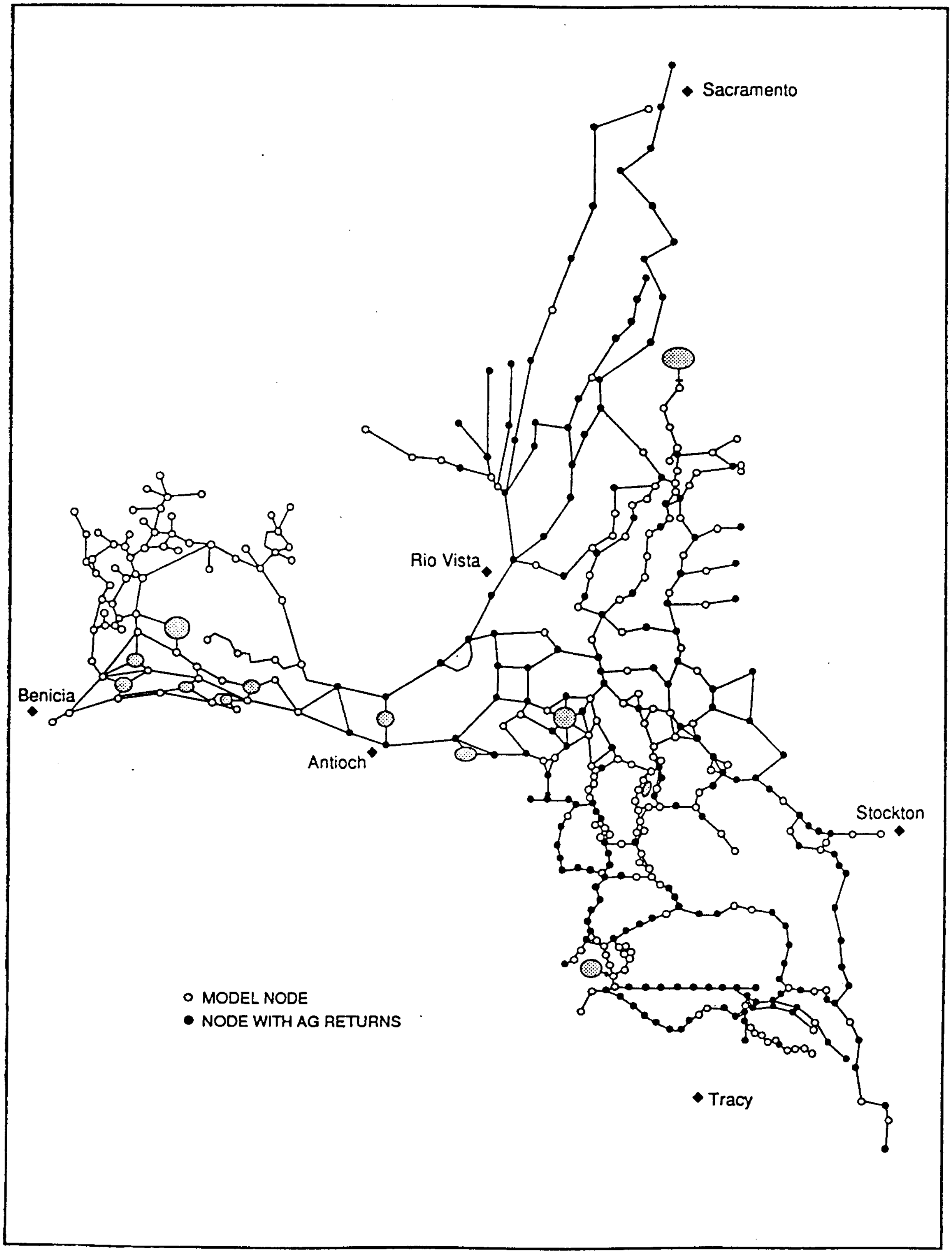

Figure 5–4. DWRDSM, Location of Agricultural Returns

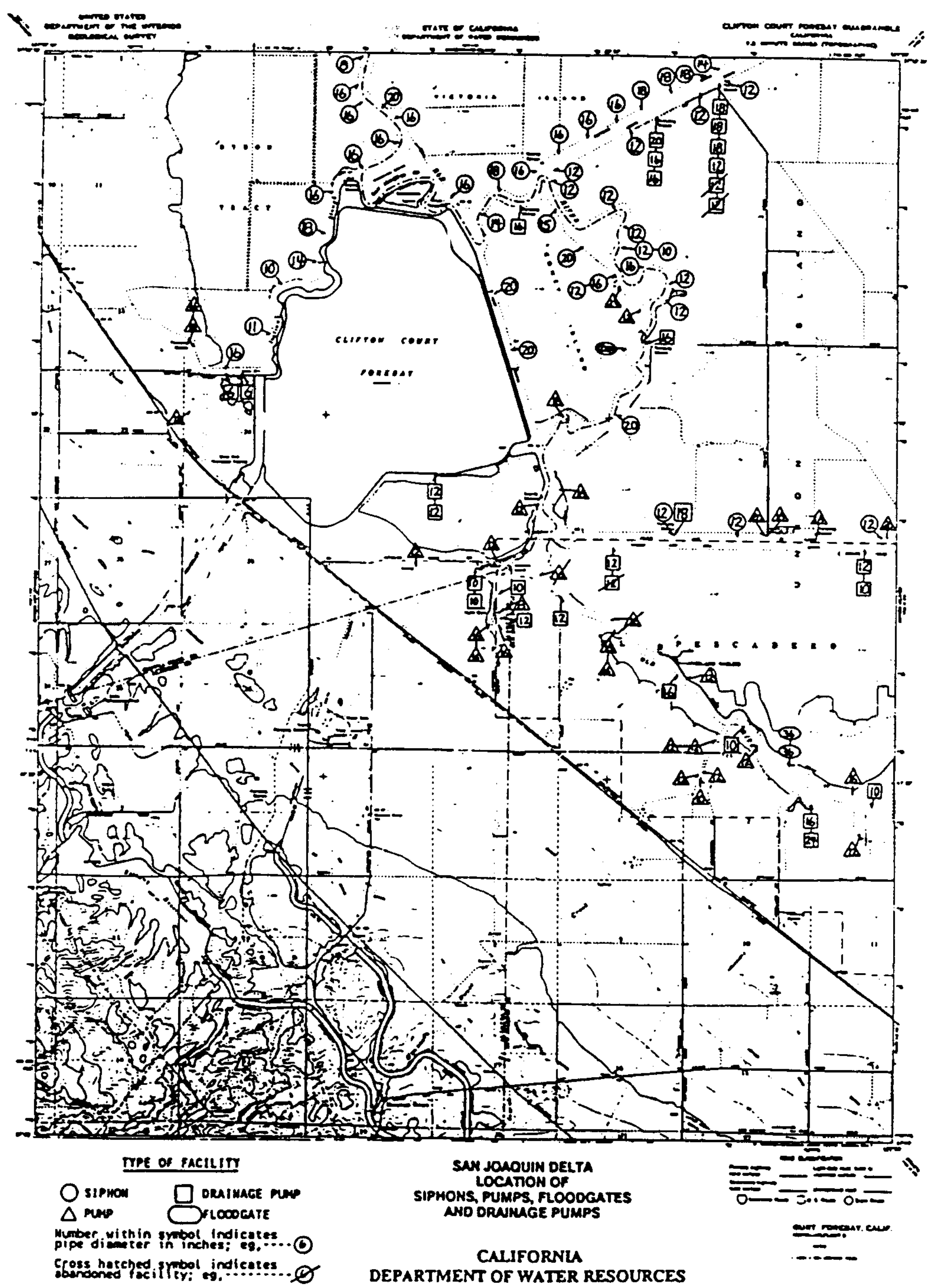

Figure 5–5. Sample Map Showing Location of Siphons, Pumps, Floodgates, and Drainage Pumps

Table 5–2. Diversion and Drainage Distribution to DWRDSM Model Nodes for Coney Island (subarea 132)

Node	Percent Diversion	Percent Drainage
72	8.94	0.00
73	11.17	0.00
74	11.17	0.00
75	5.59	0.00
182	22.38	0.00
183	11.73	0.00
187	22.32	0.00
192	6.70	100.00
Total	**100.00**	**100.00**

An output file from the node allocation program, which is read directly by the DWRDSM model, is shown in Table 5–3. The first column shows the node number and the second and third columns list the drainage and diversion flows (in cfs), respectively, associated with that node. The file represents flows calculated for October of water year 1992. A database containing similar files was generated for water years 1922 through 1992. Table 5–4 shows Delta–wide net channel depletion estimates (in cfs) calculated from all of the files. Recall (from Chapter 2) that net Delta channel depletions are defined as Delta diversions minus Delta returns. Negative numbers represent net returns.

Drainage Salinity Concentrations

The node allocation program also assigns a monthly salinity concentration to all return flows based on a 1954–55 study (*Delta and Suisun* 1967; *Quantity* 1956). Table 5–5 lists average seasonal quantities of Delta agricultural drainage for three Delta regions : North, West, and Southeast. Figure 5–6 shows the three regions. The monthly load of total dissolved solids (TDS) and chlorides (CL) shown in the table were used to assign drainage salinity concentration to DWRDSM nodal drainage flows by using the flows given in the table and the drainage load to calculate monthly drainage concentrations in mg/l for each region.

For nodes that fall on the boundaries of two or three regions, the quality of the drainage flow to the node is weighted by flows. Therefore, nodal drainage values for return flows do not vary annually except for the nodes that lie on boundaries. Tables 5–6 and 5–7 show output files from the node allocation program that are read directly by the DWRDSM model. Table 5–6 contains nodal drainage salinity concentrations in TDS and Table 5–7 lists them in CL. The first column of each table shows the node number and the second and third columns list the drainage salinity concentration (in mg/l) and return flow (in cfs), respectively. These two tables represent flows and qualities calculated for October of water year 1992. A database containing similar files was generated for water years 1922 through 1992.

Table 5–3. Drainage and Diversion Flows for DWRDSM Nodes, *page 1 of 2*

DWR/DSM DELTA MODEL HYDROLOGY ENTRIES BY NODE (CFS)
DRAINAGE (DRN) AND DIVERSIONS (DIV) FOR OCT - WATER YEAR 92

NODE	DRN	DIV	NODE	DRN	DIV	NODE	DRN	DIV
1	1.94	3.55	77	0.00	1.48	153	0.00	2.00
2	0.00	0.00	78	0.15	1.62	154	0.00	0.00
3	0.53	1.09	79	0.46	2.13	155	0.06	1.86
4	0.00	0.00	80	0.40	1.24	156	0.00	1.08
5	0.49	1.64	81	0.00	1.53	157	0.00	0.00
6	0.24	0.88	82	0.00	1.96	158	0.00	1.28
7	0.00	3.77	84	0.00	0.98	159	0.00	2.36
8	0.61	2.16	85	0.06	1.48	160	0.00	0.00
9	0.38	3.02	86	0.08	1.24	162	0.75	2.60
10	0.35	4.45	87	0.00	0.00	163	0.67	5.05
11	0.49	4.52	88	0.00	0.00	164	0.00	3.00
12	0.27	3.35	89	0.00	1.77	165	0.92	0.00
13	0.51	4.76	90	0.00	0.00	166	0.00	0.00
14	0.25	2.17	91	0.00	0.26	167	0.08	2.00
15	0.47	0.00	92	0.00	2.26	168	0.30	0.10
16	0.00	2.88	93	2.05	6.33	169	0.42	0.10
17	0.00	0.00	94	0.00	0.00	170	0.14	3.14
18	0.62	0.07	95	0.00	0.00	171	0.04	1.29
19	0.57	0.01	96	0.00	0.00	172	0.09	4.52
20	0.01	0.27	97	0.00	0.00	173	0.08	0.00
21	4.59	0.71	98	0.86	3.33	174	0.12	1.77
22	0.00	3.15	99	0.00	0.00	175	0.08	2.87
23	0.01	1.26	100	0.68	4.05	176	0.31	2.66
24	0.01	2.84	101	0.00	0.00	177	0.14	4.07
25	0.01	2.24	102	0.00	0.00	178	0.15	0.62
26	0.86	2.33	103	0.00	0.00	179	0.00	3.45
27	0.00	0.00	104	0.01	2.84	181	0.00	0.00
28	0.00	0.00	105	0.01	2.86	182	0.00	1.33
29	0.86	2.03	106	0.06	6.89	183	0.00	0.86
30	0.44	1.55	107	0.04	16.30	184	0.00	0.00
31	0.00	0.00	108	0.01	5.69	185	0.00	0.00
32	0.46	5.84	109	0.00	2.69	186	0.00	0.00
33	0.00	0.00	110	0.00	2.59	187	0.00	2.13
34	0.00	0.00	111	0.10	2.61	188	0.00	1.89
35	1.31	7.86	112	0.15	4.56	189	0.06	1.21
36	0.00	0.00	113	0.33	7.99	190	0.25	1.21
37	0.00	0.00	114	0.00	6.21	191	0.21	1.62
38	0.05	8.20	115	0.04	0.89	192	0.26	2.23
39	0.76	3.78	116	0.00	1.70	193	2.67	5.30
40	0.65	4.70	117	0.00	1.48	194	0.00	1.38
41	0.22	7.87	118	0.00	3.23	195	0.33	1.45
42	0.51	6.42	119	0.00	0.72	196	0.00	0.77
43	0.09	5.20	120	0.00	0.00	197	0.58	1.54
44	1.20	5.78	121	0.28	0.74	198	0.68	10.81
45	2.09	19.38	122	0.00	1.07	199	0.48	5.26
46	0.02	12.16	123	0.00	0.00	200	0.68	2.59
47	0.00	9.18	124	0.00	2.25	201	0.64	4.36
48	0.07	0.59	125	0.00	1.11	202	0.00	0.21
49	0.00	0.96	126	0.00	1.29	203	0.00	1.84
50	0.00	1.25	127	0.00	1.29	204	0.37	1.92
51	0.03	1.79	128	0.00	1.61	205	0.78	9.72
52	0.00	2.38	129	0.00	0.00	206	0.03	3.17
53	0.01	1.34	130	1.85	5.55	207	0.00	0.00
54	0.00	1.52	131	0.00	0.00	208	0.00	0.00
55	0.13	0.34	132	0.00	0.00	209	0.82	5.79
56	0.08	0.34	133	0.00	4.20	210	0.00	0.18
57	0.00	0.00	134	0.00	0.00	211	0.00	1.13
58	0.00	0.41	135	0.39	0.80	212	0.00	1.21
59	0.00	0.41	136	0.00	1.15	213	0.00	0.37
60	1.01	0.78	137	0.01	0.63	215	0.42	4.52
61	0.00	1.65	138	0.57	2.85	216	0.41	3.31
62	0.00	1.80	139	0.00	2.85	217	0.00	0.00
63	1.08	1.77	140	0.08	0.72	218	0.00	0.00
64	0.03	1.22	141	0.00	2.29	219	0.00	0.26
65	0.06	0.48	142	0.00	2.40	220	0.00	0.00
66	0.47	0.89	143	0.05	1.73	221	0.00	0.00
67	0.42	10.13	144	0.00	1.56	222	1.64	7.26
68	0.12	0.52	145	0.00	1.03	223	1.79	10.69
69	0.08	0.00	146	0.00	2.27	224	0.05	6.17
70	0.61	3.45	147	0.00	2.25	225	0.00	0.00
71	0.00	4.60	148	0.02	5.17	226	0.39	12.70
72	0.00	0.18	149	0.46	0.10	227	0.00	0.00
73	0.00	0.22	150	1.89	2.84	228	0.00	0.00
74	0.00	0.22	151	0.00	2.54	232	0.00	2.99
75	0.00	0.41	152	0.00	0.39	238	0.00	0.00

Table 5–3. Drainage and Diversion Flows for DWRDSM Nodes, *page 2 of 2*

NODE	DRN	DIV	NODE	DRN	DIV	NODE	DRN	DIV
239	0.00	0.00	316	2.04	32.13	438	0.00	0.00
240	0.03	5.77	317	0.98	8.72	440	0.00	0.00
241	0.64	7.53	318	9.96	22.69	441	0.00	0.00
242	0.19	8.88	319	2.58	14.35	443	0.00	0.00
243	0.08	3.59	320	3.70	29.22	445	0.00	0.00
244	0.00	0.00	321	1.18	7.90	446	0.00	0.00
245	0.18	3.65	322	0.00	0.00	447	0.00	0.00
246	0.45	9.98	323	0.00	0.00	448	0.00	0.00
247	0.03	5.01	324	0.00	0.00	449	0.00	0.00
248	0.00	0.00	325	0.00	0.00	451	0.00	0.00
249	0.00	0.00	326	0.85	3.29	452	0.00	0.00
250	0.09	3.69	327	0.00	0.00	453	0.00	0.00
251	1.08	3.02	328	0.00	0.00	454	0.00	0.00
252	0.00	0.00	329	0.00	0.00	455	0.00	0.00
253	1.46	18.62	330	0.13	8.89	456	0.00	0.00
254	0.00	0.00	331	0.13	8.89	457	0.00	0.00
255	0.00	0.07	332	0.41	8.95			
256	0.00	0.75	333	1.50	4.01			
257	0.13	10.52	334	0.99	14.12			
258	0.00	0.00	335	11.06	5.50			
259	0.00	0.00	336	0.37	44.16			
260	0.00	6.34	337	2.86	3.12			
261	0.00	0.00	338	0.00	5.85			
262	0.02	7.08	339	0.00	7.28			
263	0.00	0.00	340	0.00	7.75			
264	0.03	4.01	341	0.00	7.78			
265	0.00	0.00	342	0.08	3.71			
266	0.17	8.05	343	0.00	2.13			
267	0.00	0.00	344	0.03	6.18			
268	0.09	6.56	345	0.00	0.00			
269	0.48	1.19	346	0.00	1.68			
270	0.00	0.00	347	0.00	3.58			
271	0.01	6.99	348	0.01	4.24			
272	0.00	0.00	349	0.00	0.00			
273	0.00	0.00	350	0.97	11.86			
274	0.19	2.08	351	0.48	5.59			
275	0.00	0.00	352	1.40	8.25			
276	1.89	2.56	353	0.04	3.90			
277	0.00	0.00	354	0.48	10.38			
278	0.26	10.43	355	0.48	9.15			
279	0.00	0.00	356	0.00	0.00			
280	0.66	1.01	357	0.00	0.00			
281	0.00	0.00	358	0.00	0.00			
282	0.00	2.65	359	0.00	0.00			
283	0.00	0.00	360	0.00	0.00			
284	0.00	3.68	361	0.00	0.00			
285	0.00	0.00	362	0.00	0.00			
286	0.01	4.10	363	0.00	0.00			
287	0.00	0.00	364	0.00	0.00			
288	0.00	2.69	365	0.00	0.00			
289	0.00	0.00	366	0.00	0.00			
290	0.01	3.00	367	0.00	0.00			
291	0.00	0.00	368	0.00	0.00			
292	0.01	3.77	371	0.00	0.00			
293	0.00	0.00	372	0.00	0.00			
294	0.03	4.84	373	0.00	0.00			
295	0.00	0.00	374	0.00	0.00			
296	0.00	2.36	375	0.00	0.00			
297	0.00	4.86	376	0.00	0.00			
298	2.66	5.05	377	0.00	0.00			
299	0.09	2.45	378	0.00	0.00			
300	0.00	0.00	379	0.00	0.00			
301	0.14	2.56	380	0.00	0.00			
302	0.13	4.78	381	0.00	0.00			
303	0.01	3.84	382	0.00	0.00			
304	0.13	7.15	383	0.00	0.00			
305	0.14	7.32	384	0.00	0.00			
306	0.19	8.05	385	0.00	0.00			
307	0.36	3.70	386	0.00	0.00			
308	0.39	1.55	387	0.00	0.00			
309	0.00	0.00	388	0.00	0.00			
310	2.01	0.00	389	0.00	0.00			
311	0.36	2.06	390	0.00	0.00			
312	0.14	0.61	391	0.00	0.00			
313	0.00	0.00	392	0.00	0.00			
314	4.41	15.88	393	0.00	0.00			
315	0.14	0.13	394	0.00	0.00			

Table 5–4. Monthly Total Delta–wide Net Channel Depletions

Water years 1922-1992
Derived from DWR Delta Island Consumptive Use study 10/14/92
1991 April to September adjusted due to water banking (318 TAF)

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
22	1378.	752.	424.	-1250.	-2878.	353.	1244.	2809.	3698.	3800.	2657.	1647.
23	1147.	701.	-1559.	-1602.	239.	924.	691.	2293.	3420.	4249.	2828.	1438.
24	1300.	979.	936.	51.	369.	1554.	2313.	3111.	4950.	4757.	2754.	1769.
25	1159.	758.	286.	-461.	-2420.	333.	463.	1882.	3420.	3798.	2655.	1661.
26	1302.	859.	896.	-330.	-1651.	1066.	105.	2467.	3810.	4473.	2896.	1816.
27	981.	342.	760.	-1083.	-3117.	388.	633.	2242.	3040.	4249.	2897.	1813.
28	1078.	671.	529.	-455.	-11.	-851.	1178.	2931.	3771.	3800.	2657.	1667.
29	1389.	706.	598.	-141.	333.	1180.	2032.	3065.	3959.	4758.	2754.	1774.
30	1329.	952.	831.	-696.	-667.	-217.	1412.	2255.	3495.	4249.	2800.	1564.
31	1153.	870.	1018.	-288.	79.	1392.	2251.	2510.	4514.	4758.	2752.	1773.
32	1280.	787.	-1221.	-830.	-1767.	644.	1614.	2265.	3500.	4245.	2828.	1629.
33	1413.	1040.	867.	-653.	447.	899.	2204.	2667.	4646.	4758.	2754.	1763.
34	1141.	1037.	613.	-94.	-902.	1429.	2272.	2889.	4622.	4758.	2754.	1648.
35	1446.	662.	619.	-1881.	172.	-865.	-358.	2628.	3795.	3798.	2657.	1659.
36	1305.	821.	833.	-1002.	-4279.	461.	1082.	2713.	3439.	3788.	2656.	1581.
37	1200.	949.	745.	-544.	-2739.	-3072.	1408.	2309.	3499.	4246.	2828.	1629.
38	1118.	725.	65.	-1172.	-5476.	-2054.	890.	2242.	3253.	4249.	2897.	1739.
39	1110.	945.	940.	-1.	390.	1173.	2199.	2804.	4699.	4757.	2754.	1712.
40	1092.	891.	899.	-2646.	-4639.	-1233.	991.	2207.	3230.	4249.	2897.	1765.
41	1100.	849.	-1476.	-3466.	-2994.	-518.	-217.	1858.	3116.	4249.	2897.	1816.
42	1040.	789.	84.	-3083.	-938.	216.	-550.	1791.	3093.	4249.	2897.	1794.
43	1108.	653.	622.	-2733.	-425.	-866.	819.	2232.	3234.	4249.	2897.	1816.
44	1267.	891.	893.	-229.	-1462.	839.	1229.	2373.	3575.	4473.	2897.	1813.
45	1125.	694.	596.	-207.	-1282.	-469.	1709.	2172.	3550.	4248.	2828.	1629.
46	1086.	771.	-479.	-255.	134.	455.	1469.	2844.	3793.	3794.	2657.	1654.
47	1282.	711.	772.	-103.	195.	507.	1752.	2885.	3713.	4461.	2897.	1810.
48	1097.	811.	939.	32.	489.	472.	722.	2168.	3413.	3800.	2657.	1650.
49	1161.	922.	689.	-220.	218.	-429.	1717.	2775.	3923.	4449.	2877.	1785.
50	1329.	882.	897.	-538.	-313.	495.	1620.	2395.	3491.	4247.	2828.	1492.
51	877.	238.	-1695.	-2097.	-662.	345.	1104.	2135.	3151.	4249.	2892.	1798.
52	1024.	693.	-913.	-4730.	-130.	-975.	699.	2201.	3222.	4243.	2897.	1808.
53	1248.	729.	-554.	-1253.	423.	760.	870.	2307.	2985.	4249.	2866.	1816.
54	1511.	796.	926.	-147.	74.	406.	1008.	2985.	3691.	3800.	2636.	1667.
55	1333.	773.	496.	-1484.	266.	801.	1009.	2363.	3723.	4473.	2897.	1722.
56	1308.	837.	-2427.	-4758.	207.	1192.	915.	2102.	3178.	4204.	2863.	1449.
57	1051.	972.	971.	-69.	-143.	461.	1326.	1049.	3332.	4562.	2965.	1449.
58	782.	951.	706.	-2307.	-5537.	-2527.	-883.	1618.	2759.	3932.	3111.	1882.
59	1440.	958.	961.	-279.	-643.	1397.	2221.	3252.	4082.	4562.	2826.	1158.
60	1603.	979.	971.	-166.	94.	938.	1615.	2801.	4028.	4644.	2794.	1677.
61	1490.	588.	883.	-1201.	341.	375.	1353.	2231.	3325.	4383.	2766.	1512.
62	1405.	777.	884.	-59.	-3380.	272.	1543.	2334.	3337.	3884.	2653.	1388.
63	185.	822.	258.	-2061.	-1175.	-788.	-1423.	1435.	3265.	4024.	2452.	1274.
64	870.	487.	747.	-1379.	621.	1210.	2223.	3057.	2820.	4239.	2899.	1802.
65	913.	668.	-1000.	-2089.	437.	575.	313.	2305.	3022.	4080.	2321.	1647.
66	1222.	559.	-15.	-1008.	-148.	863.	1835.	2629.	3403.	3764.	2895.	1636.
67	1302.	370.	-659.	-5104.	165.	-1382.	-1523.	1711.	2270.	4104.	2828.	1658.
68	1297.	814.	936.	-575.	-429.	65.	1839.	2304.	3894.	4473.	2234.	1962.
69	1101.	711.	298.	-4851.	-3932.	477.	1139.	2679.	3054.	4293.	2931.	1535.
70	1130.	831.	285.	-4119.	-224.	921.	1660.	3195.	3023.	4338.	2760.	1927.
71	1137.	58.	-1691.	-490.	407.	489.	1310.	1677.	2788.	4337.	2965.	1875.
72	1259.	914.	650.	-97.	255.	1461.	1830.	2815.	3372.	4293.	2931.	1365.
73	744.	-483.	-202.	-5302.	-3505.	-346.	1769.	2875.	3548.	4114.	2897.	1787.
74	870.	366.	-942.	-1359.	367.	-959.	742.	2278.	3989.	4079.	3171.	2039.
75	1333.	846.	800.	-29.	-1257.	-1095.	1032.	2978.	3764.	3728.	2465.	1666.
76	849.	1019.	1011.	380.	966.	2235.	2020.	4238.	5723.	5061.	2177.	1437.
77	1256.	853.	946.	7.	588.	1559.	2476.	1345.	3993.	4499.	2939.	1610.
78	1267.	815.	540.	-4488.	-2197.	-2460.	46.	2208.	3405.	4204.	3068.	1693.
79	1386.	820.	1006.	-1092.	-2097.	-199.	959.	2480.	4210.	4414.	2931.	1946.
80	872.	775.	105.	-2629.	-3888.	507.	1125.	2069.	3087.	4119.	2828.	1629.
81	1229.	946.	866.	-737.	363.	-164.	1520.	2922.	4874.	4786.	3000.	1778.
82	919.	260.	-473.	-4230.	-386.	-3306.	75.	2655.	3163.	4110.	2863.	1290.
83	964.	-662.	-591.	-4754.	-3980.	-5521.	-195.	1940.	3524.	4518.	3098.	1736.
84	1154.	156.	-1990.	-96.	-161.	1040.	1838.	3427.	4105.	4742.	3150.	2424.
85	986.	169.	365.	-470.	107.	-184.	1573.	2769.	3767.	4473.	2896.	1694.
86	1118.	545.	388.	-1524.	-6194.	-1827.	928.	2211.	3239.	4241.	2897.	1588.
87	1383.	1065.	937.	55.	-65.	501.	2040.	3007.	4748.	4758.	2754.	1774.
88	1096.	749.	339.	-1446.	483.	1660.	1299.	2337.	3549.	5262.	3529.	2048.
89	1260.	746.	766.	-64.	167.	-322.	1539.	2628.	3726.	5161.	3104.	902.
90	892.	722.	889.	-472.	-527.	1050.	1754.	1215.	4243.	5212.	3381.	2101.
91	1506.	1101.	915.	- 228.	521.	-873.	1109.	1740.	2135.	3512.	2211.	1328.
92	942.	971.	891.	-58.	-1995.	-732.	1068.	2241.	3154.	4185.	2901.	1489.

Table 5–5. Bulletin 123 Average Seasonal Quantities of Delta Agricultural Drainage, 1964 (source: Delta 1967)

	QUANTITIES IN 1,000 POUNDS PER DAY											
DELTA AREA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NORTHERN												
Flow (cfs)	330	190	160	180	230	340	460	380	190	140	220	340
TDS	1530	930	680	600	520	330	490	500	340	460	710	1520
Cl	490	300	220	200	150	70	170	140	70	130	200	500
BOD	9.0	5.9	4.5	4.1	4.7	5.7	6.2	4.6	2.7	3.0	4.9	8.8
N	7.8	4.9	3.5	3.0	2.5	1.5	3.0	2.3	2.2	2.1	4.5	7.9
WESTERN												
Flow (cfs)	260	120	120	160	120	160	180	160	110	100	130	240
TDS	1250	680	680	830	420	390	540	580	320	310	340	1030
Cl	480	240	230	280	150	150	260	250	130	120	100	370
BOD	7.2	3.7	3.6	3.6	2.5	3.6	2.4	1.9	1.6	2.1	3.3	6.2
N	6.8	3.5	3.6	3.8	2.2	2.0	2.3	2.5	1.5	1.7	2.7	4.9
SOUTHEASTERN												
Flow (cfs)	1000	380	260	280	470	660	700	660	410	270	420	840
TDS	4640	1960	1410	1540	2180	2420	2540	3050	2220	1760	3200	3780
Cl	1560	660	0	520	740	810	950	990	690	560	980	1270
BOD	41.8	16.8	10.8	10.7	15.3	18.1	15.6	13.2	10.6	11.4	9.9	26.3
N	23.8	10.2	7.3	7.9	11.4	11.7	13.3	7.8	7.6	5.8	7.4	19.6
TOTALS												
Flow (cfs)	1590	690	540	620	820	1160	1340	1200	710	510	770	1420
TDS	7420	3570	2770	2970	3120	3140	3570	4130	2880	2530	4250	6330
Cl	2530	1200	930	1000	1040	1030	1380	1380	890	810	1280	2140
BOD	58.0	26.4	18.9	18.4	22.5	27.4	24.2	19.7	14.9	16.5	18.1	41.3
N	38.4	18.6	14.4	14.7	16.1	15.2	18.6	12.6	11.3	9.6	14.6	32.4

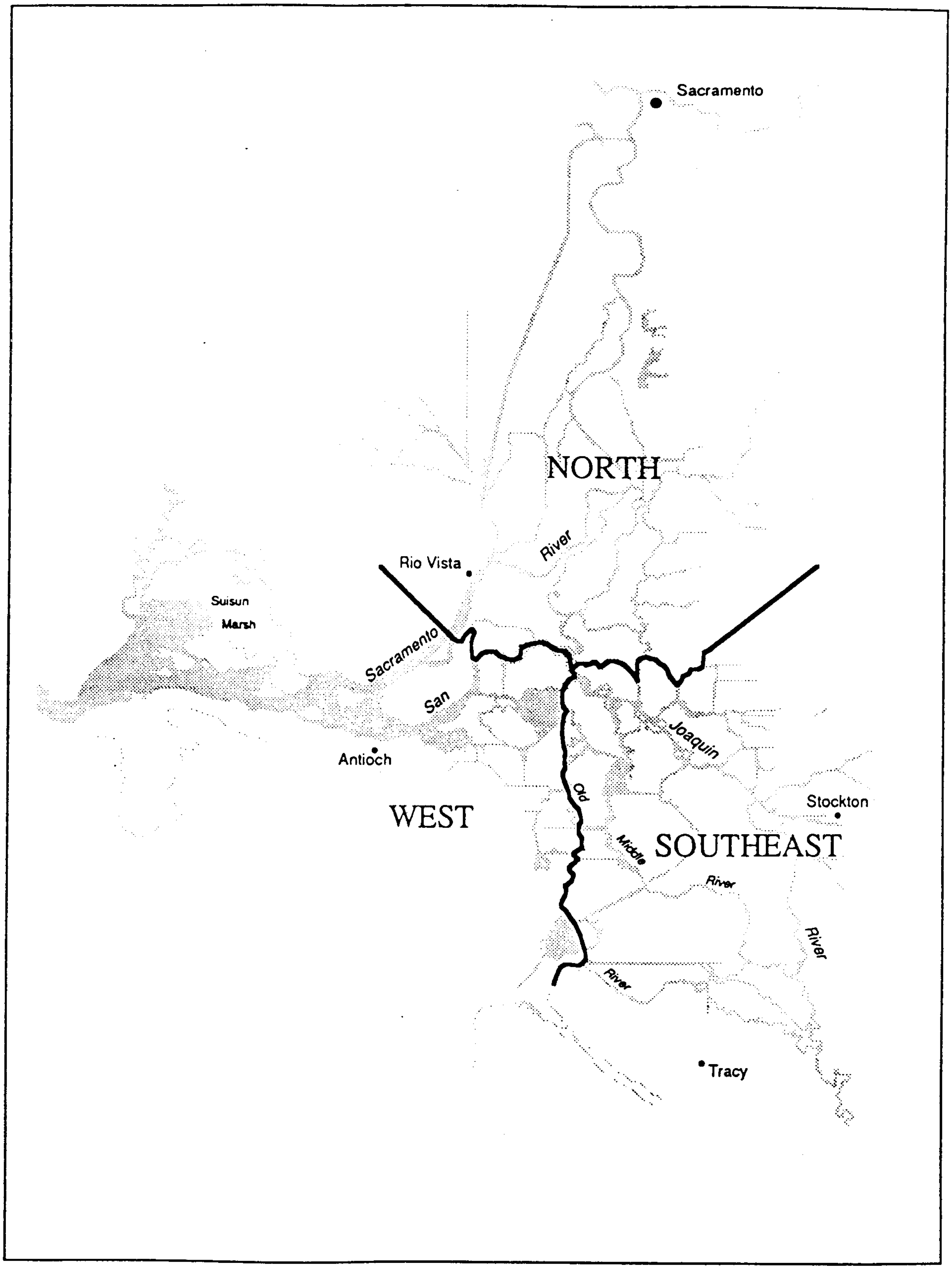

Figure 5–6. Bulletin 123 Regions

Table 5–6. DWRDSM Nodal Drainage TDS Concentration and Return Flow, *page 1 of 2*

OCT - WATER YEAR 1992

NODE	MG/L	CFS	NODE	MG/L	CFS	NODE	MG/L	CFS
1	1209.	1.94	77	0.	0.00	153	0.	0.00
2	0.	0.00	78	1209.	0.15	154	0.	0.00
3	1209.	0.53	79	575.	0.46	155	1209.	0.06
4	0.	0.00	80	1209.	0.40	156	0.	0.00
5	1209.	0.49	81	0.	0.00	157	0.	0.00
6	1209.	0.24	82	0.	0.00	158	0.	0.00
7	0.	0.00	84	0.	0.00	159	0.	0.00
8	1209.	0.61	85	575.	0.06	160	0.	0.00
9	1209.	0.38	86	575.	0.08	162	1209.	0.75
10	1209.	0.35	87	0.	0.00	163	1209.	0.67
11	1209.	0.49	88	0.	0.00	164	0.	0.00
12	1209.	0.27	89	0.	0.00	165	1209.	0.92
13	1209.	0.51	90	0.	0.00	166	0.	0.00
14	1209.	0.25	91	0.	0.00	167	1209.	0.08
15	1209.	0.47	92	0.	0.00	168	1209.	0.30
16	0.	0.00	93	737.	2.05	169	1209.	0.42
17	0.	0.00	94	0.	0.00	170	1209.	0.14
18	1209.	0.62	95	0.	0.00	171	1209.	0.04
19	1209.	0.57	96	0.	0.00	172	1209.	0.09
20	1209.	0.01	97	0.	0.00	173	1209.	0.08
21	1209.	4.59	98	647.	0.86	174	1209.	0.12
22	0.	0.00	99	0.	0.00	175	1209.	0.08
23	1209.	0.01	100	1209.	0.68	176	1209.	0.31
24	1209.	0.01	101	0.	0.00	177	1209.	0.14
25	1209.	0.01	102	0.	0.00	178	1209.	0.15
26	1209.	0.86	103	0.	0.00	179	0.	0.00
27	0.	0.00	104	1209.	0.01	181	0.	0.00
28	0.	0.00	105	1209.	0.01	182	0.	0.00
29	1209.	0.86	106	1209.	0.06	183	0.	0.00
30	1209.	0.44	107	1209.	0.04	184	0.	0.00
31	0.	0.00	108	1209.	0.01	185	0.	0.00
32	1209.	0.46	109	0.	0.00	186	0.	0.00
33	0.	0.00	110	0.	0.00	187	0.	0.00
34	0.	0.00	111	1209.	0.10	188	0.	0.00
35	1209.	1.31	112	1209.	0.15	189	1209.	0.06
36	0.	0.00	113	1209.	0.33	190	1209.	0.25
37	0.	0.00	114	1209.	0.00	191	1209.	0.21
38	575.	0.05	115	1209.	0.04	192	1209.	0.26
39	1209.	0.76	116	0.	0.00	193	575.	2.67
40	609.	0.65	117	0.	0.00	194	0.	0.00
41	609.	0.22	118	0.	0.00	195	1209.	0.33
42	587.	0.51	119	0.	0.00	196	0.	0.00
43	575.	0.09	120	0.	0.00	197	575.	0.58
44	575.	1.20	121	1209.	0.28	198	575.	0.68
45	575.	2.09	122	0.	0.00	199	575.	0.48
46	575.	0.02	123	0.	0.00	200	575.	0.68
47	0.	0.00	124	0.	0.00	201	575.	0.64
48	1209.	0.07	125	0.	0.00	202	0.	0.00
49	0.	0.00	126	0.	0.00	203	0.	0.00
50	0.	0.00	127	0.	0.00	204	575.	0.37
51	1209.	0.03	128	0.	0.00	205	575.	0.78
52	0.	0.00	129	0.	0.00	206	575.	0.03
53	1209.	0.01	130	1209.	1.85	207	0.	0.00
54	1209.	0.00	131	0.	0.00	208	0.	0.00
55	1209.	0.13	132	0.	0.00	209	575.	0.82
56	1209.	0.08	133	0.	0.00	210	0.	0.00
57	0.	0.00	134	0.	0.00	211	0.	0.00
58	1209.	0.00	135	1209.	0.39	212	0.	0.00
59	1209.	0.00	136	0.	0.00	213	0.	0.00
60	1209.	1.01	137	1209.	0.01	215	575.	0.42
61	0.	0.00	138	1209.	0.57	216	575.	0.41
62	0.	0.00	139	0.	0.00	217	0.	0.00
63	1209.	1.08	140	1209.	0.08	218	0.	0.00
64	1209.	0.03	141	0.	0.00	219	0.	0.00
65	1209.	0.06	142	0.	0.00	220	0.	0.00
66	1209.	0.47	143	1209.	0.05	221	0.	0.00
67	1209.	0.42	144	0.	0.00	222	575.	1.64
68	1209.	0.12	145	0.	0.00	223	575.	1.79
69	1209.	0.08	146	0.	0.00	224	575.	0.05
70	661.	0.61	147	0.	0.00	225	0.	0.00
71	0.	0.00	148	1209.	0.02	226	575.	0.39
72	0.	0.00	149	1209.	0.46	227	0.	0.00
73	0.	0.00	150	1209.	1.89	228	0.	0.00
74	0.	0.00	151	0.	0.00	232	0.	0.00
75	0.	0.00	152	0.	0.00	238	0.	0.00

Table 5–6. DWRDSM Nodal Drainage TDS Concentration and Return Flow, *page 2 of 2*

NODE	MG/L	CFS	NODE	MG/L	CFS	NODE	MG/L	CFS
239	0.	0.00	316	609.	2.04	395	0.	0.00
240	602.	0.03	317	609.	0.98	397	0.	0.00
241	1209.	0.64	318	609.	9.96	398	0.	0.00
242	1209.	0.19	319	609.	2.58	399	0.	0.00
243	1209.	0.08	320	609.	3.70	401	0.	0.00
244	0.	0.00	321	609.	1.18	402	0.	0.00
245	1209.	0.18	322	0.	0.00	403	0.	0.00
246	1209.	0.45	323	0.	0.00	406	0.	0.00
247	1209.	0.03	324	0.	0.00	408	0.	0.00
248	0.	0.00	325	0.	0.00	409	0.	0.00
249	0.	0.00	326	609.	0.85	410	0.	0.00
250	609.	0.09	327	0.	0.00	412	0.	0.00
251	1034.	1.08	328	0.	0.00	413	0.	0.00
252	0.	0.00	329	0.	0.00	418	0.	0.00
253	609.	1.46	330	609.	0.13	420	0.	0.00
254	0.	0.00	331	609.	0.13	421	0.	0.00
255	0.	0.00	332	609.	0.41	422	0.	0.00
256	0.	0.00	333	609.	1.50	425	0.	0.00
257	609.	0.13	334	609.	0.99	428	0.	0.00
258	0.	0.00	335	609.	11.06	433	0.	0.00
259	0.	0.00	336	609.	0.37	434	0.	0.00
260	609.	0.00	337	609.	2.86	436	0.	0.00
261	0.	0.00	338	0.	0.00	438	0.	0.00
262	609.	0.02	339	0.	0.00	440	0.	0.00
263	0.	0.00	340	0.	0.00	441	0.	0.00
264	609.	0.03	341	0.	0.00	443	0.	0.00
265	0.	0.00	342	609.	0.08	445	0.	0.00
266	609.	0.17	343	0.	0.00	446	0.	0.00
267	0.	0.00	344	609.	0.03	447	0.	0.00
268	609.	0.09	345	0.	0.00	448	0.	0.00
269	609.	0.48	346	0.	0.00	449	0.	0.00
270	0.	0.00	347	0.	0.00	451	0.	0.00
271	609.	0.01	348	609.	0.01	452	0.	0.00
272	0.	0.00	349	0.	0.00	453	0.	0.00
273	0.	0.00	350	609.	0.97	454	0.	0.00
274	609.	0.19	351	609.	0.48	455	0.	0.00
275	0.	0.00	352	609.	1.40	456	0.	0.00
276	609.	1.89	353	575.	0.04	457	0.	0.00
277	0.	0.00	354	575.	0.48			
278	609.	0.26	355	575.	0.48			
279	0.	0.00	356	0.	0.00			
280	609.	0.66	357	0.	0.00			
281	0.	0.00	358	0.	0.00			
282	609.	0.00	359	0.	0.00			
283	0.	0.00	360	0.	0.00			
284	0.	0.00	361	0.	0.00			
285	0.	0.00	362	0.	0.00			
286	609.	0.01	363	0.	0.00			
287	0.	0.00	364	0.	0.00			
288	0.	0.00	365	0.	0.00			
289	0.	0.00	366	0.	0.00			
290	609.	0.01	367	0.	0.00			
291	0.	0.00	368	0.	0.00			
292	609.	0.01	371	0.	0.00			
293	0.	0.00	372	0.	0.00			
294	609.	0.03	373	0.	0.00			
295	0.	0.00	374	0.	0.00			
296	0.	0.00	375	0.	0.00			
297	0.	0.00	376	0.	0.00			
298	609.	2.66	377	0.	0.00			
299	609.	0.09	378	0.	0.00			
300	0.	0.00	379	0.	0.00			
301	609.	0.14	380	0.	0.00			
302	609.	0.13	381	0.	0.00			
303	609.	0.01	382	0.	0.00			
304	609.	0.13	383	0.	0.00			
305	609.	0.14	384	0.	0.00			
306	609.	0.19	385	0.	0.00			
307	609.	0.36	386	0.	0.00			
308	609.	0.39	387	0.	0.00			
309	0.	0.00	388	0.	0.00			
310	609.	2.01	389	0.	0.00			
311	609.	0.36	390	0.	0.00			
312	609.	0.14	391	0.	0.00			
313	0.	0.00	392	0.	0.00			
314	609.	4.41	393	0.	0.00			
315	609.	0.14	394	0.	0.00			

Table 5–7. DWRDSM Nodal Drainage CL Concentration and Return Flow, *page 1 of 2*

OCT - WATER YEAR 1992

NODE	MG/L	CFS	NODE	MG/L	CFS	NODE	MG/L	CFS
1	385.	1.94	77	0.	0.00	153	0.	0.00
2	0.	0.00	78	385.	0.15	154	0.	0.00
3	385.	0.53	79	222.	0.46	155	385.	0.06
4	0.	0.00	80	385.	0.40	156	0.	0.00
5	385.	0.49	81	0.	0.00	157	0.	0.00
6	385.	0.24	82	0.	0.00	158	0.	0.00
7	0.	0.00	84	0.	0.00	159	0.	0.00
8	385.	0.61	85	222.	0.06	160	0.	0.00
9	385.	0.38	86	222.	0.08	162	385.	0.75
10	385.	0.35	87	0.	0.00	163	385.	0.67
11	385.	0.49	88	0.	0.00	164	0.	0.00
12	385.	0.27	89	0.	0.00	165	385.	0.92
13	385.	0.51	90	0.	0.00	166	0.	0.00
14	385.	0.25	91	0.	0.00	167	385.	0.08
15	385.	0.47	92	0.	0.00	168	385.	0.30
16	0.	0.00	93	264.	2.05	169	385.	0.42
17	0.	0.00	94	0.	0.00	170	385.	0.14
18	385.	0.62	95	0.	0.00	171	385.	0.04
19	385.	0.57	96	0.	0.00	172	385.	0.09
20	385.	0.01	97	0.	0.00	173	385.	0.08
21	385.	4.59	98	240.	0.86	174	385.	0.12
22	0.	0.00	99	0.	0.00	175	385.	0.08
23	385.	0.01	100	385.	0.68	176	385.	0.31
24	385.	0.01	101	0.	0.00	177	385.	0.14
25	385.	0.01	102	0.	0.00	178	385.	0.15
26	385.	0.86	103	0.	0.00	179	0.	0.00
27	0.	0.00	104	385.	0.01	181	0.	0.00
28	0.	0.00	105	385.	0.01	182	0.	0.00
29	385.	0.86	106	385.	0.06	183	0.	0.00
30	385.	0.44	107	385.	0.04	184	0.	0.00
31	0.	0.00	108	385.	0.01	185	0.	0.00
32	385.	0.46	109	0.	0.00	186	0.	0.00
33	0.	0.00	110	0.	0.00	187	0.	0.00
34	0.	0.00	111	385.	0.10	188	0.	0.00
35	385.	1.31	112	385.	0.15	189	385.	0.06
36	0.	0.00	113	385.	0.33	190	385.	0.25
37	0.	0.00	114	385.	0.00	191	385.	0.21
38	222.	0.05	115	385.	0.04	192	385.	0.26
39	385.	0.76	116	0.	0.00	193	222.	2.67
40	172.	0.65	117	0.	0.00	194	0.	0.00
41	172.	0.22	118	0.	0.00	195	385.	0.33
42	205.	0.51	119	0.	0.00	196	0.	0.00
43	222.	0.09	120	0.	0.00	197	222.	0.58
44	222.	1.20	121	385.	0.28	198	222.	0.68
45	222.	2.09	122	0.	0.00	199	222.	0.48
46	222.	0.02	123	0.	0.00	200	222.	0.68
47	0.	0.00	124	0.	0.00	201	222.	0.64
48	385.	0.07	125	0.	0.00	202	0.	0.00
49	0.	0.00	126	0.	0.00	203	0.	0.00
50	0.	0.00	127	0.	0.00	204	222.	0.37
51	385.	0.03	128	0.	0.00	205	222.	0.78
52	0.	0.00	129	0.	0.00	206	222.	0.03
53	385.	0.01	130	385.	1.85	207	0.	0.00
54	385.	0.00	131	0.	0.00	208	0.	0.00
55	385.	0.13	132	0.	0.00	209	222.	0.82
56	385.	0.08	133	0.	0.00	210	0.	0.00
57	0.	0.00	134	0.	0.00	211	0.	0.00
58	385.	0.00	135	385.	0.39	212	0.	0.00
59	385.	0.00	136	0.	0.00	213	0.	0.00
60	385.	1.01	137	385.	0.01	215	222.	0.42
61	0.	0.00	138	385.	0.57	216	222.	0.41
62	0.	0.00	139	0.	0.00	217	0.	0.00
63	385.	1.08	140	385.	0.08	218	0.	0.00
64	385.	0.03	141	0.	0.00	219	0.	0.00
65	385.	0.06	142	0.	0.00	220	0.	0.00
66	385.	0.47	143	385.	0.05	221	0.	0.00
67	385.	0.42	144	0.	0.00	222	222.	1.64
68	385.	0.12	145	0.	0.00	223	222.	1.79
69	385.	0.08	146	0.	0.00	224	222.	0.05
70	244.	0.61	147	0.	0.00	225	0.	0.00
71	0.	0.00	148	385.	0.02	226	222.	0.39
72	0.	0.00	149	385.	0.46	227	0.	0.00
73	0.	0.00	150	385.	1.89	228	0.	0.00
74	0.	0.00	151	0.	0.00	232	0.	0.00
75	0.	0.00	152	0.	0.00	238	0.	0.00

Table 5–7. DWRDSM Nodal Drainage CL Concentration and Return Flow, *page 2 of 2*

NODE	MG/L	CFS	NODE	MG/L	CFS	NODE	MG/L	CFS
239	0.	0.00	316	172.	2.04	438	0.	0.00
240	183.	0.03	317	172.	0.98	440	0.	0.00
241	385.	0.64	318	172.	9.96	441	0.	0.00
242	385.	0.19	319	172.	2.58	443	0.	0.00
243	385.	0.08	320	172.	3.70	445	0.	0.00
244	0.	0.00	321	172.	1.18	446	0.	0.00
245	385.	0.18	322	0.	0.00	447	0.	0.00
246	385.	0.45	323	0.	0.00	448	0.	0.00
247	385.	0.03	324	0.	0.00	449	0.	0.00
248	0.	0.00	325	0.	0.00	451	0.	0.00
249	0.	0.00	326	172.	0.85	452	0.	0.00
250	172.	0.09	327	0.	0.00	453	0.	0.00
251	323.	1.08	328	0.	0.00	454	0.	0.00
252	0.	0.00	329	0.	0.00	455	0.	0.00
253	172.	1.46	330	172.	0.13	456	0.	0.00
254	0.	0.00	331	172.	0.13	457	0.	0.00
255	0.	0.00	332	172.	0.41			
256	0.	0.00	333	172.	1.50			
257	172.	0.13	334	172.	0.99			
258	0.	0.00	335	172.	11.06			
259	0.	0.00	336	172.	0.37			
260	172.	0.00	337	172.	2.86			
261	0.	0.00	338	0.	0.00			
262	172.	0.02	339	0.	0.00			
263	0.	0.00	340	0.	0.00			
264	172.	0.03	341	0.	0.00			
265	0.	0.00	342	172.	0.08			
266	172.	0.17	343	0.	0.00			
267	0.	0.00	344	172.	0.03			
268	172.	0.09	345	0.	0.00			
269	172.	0.48	346	0.	0.00			
270	0.	0.00	347	0.	0.00			
271	172.	0.01	348	172.	0.01			
272	0.	0.00	349	0.	0.00			
273	0.	0.00	350	172.	0.97			
274	172.	0.19	351	172.	0.48			
275	0.	0.00	352	172.	1.40			
276	172.	1.89	353	222.	0.04			
277	0.	0.00	354	222.	0.48			
278	172.	0.26	355	222.	0.48			
279	0.	0.00	356	0.	0.00			
280	172.	0.66	357	0.	0.00			
281	0.	0.00	358	0.	0.00			
282	172.	0.00	359	0.	0.00			
283	0.	0.00	360	0.	0.00			
284	0.	0.00	361	0.	0.00			
285	0.	0.00	362	0.	0.00			
286	172.	0.01	363	0.	0.00			
287	0.	0.00	364	0.	0.00			
288	0.	0.00	365	0.	0.00			
289	0.	0.00	366	0.	0.00			
290	172.	0.01	367	0.	0.00			
291	0.	0.00	368	0.	0.00			
292	172.	0.01	371	0.	0.00			
293	0.	0.00	372	0.	0.00			
294	172.	0.03	373	0.	0.00			
295	0.	0.00	374	0.	0.00			
296	0.	0.00	375	0.	0.00			
297	0.	0.00	376	0.	0.00			
298	172.	2.66	377	0.	0.00			
299	172.	0.09	378	0.	0.00			
300	0.	0.00	379	0.	0.00			
301	172.	0.14	380	0.	0.00			
302	172.	0.13	381	0.	0.00			
303	172.	0.01	382	0.	0.00			
304	172.	0.13	383	0.	0.00			
305	172.	0.14	384	0.	0.00			
306	172.	0.19	385	0.	0.00			
307	172.	0.36	386	0.	0.00			
308	172.	0.39	387	0.	0.00			
309	0.	0.00	388	0.	0.00			
310	172.	2.01	389	0.	0.00			
311	172.	0.36	390	0.	0.00			
312	172.	0.14	391	0.	0.00			
313	0.	0.00	392	0.	0.00			
314	172.	4.41	393	0.	0.00			
315	172.	0.14	394	0.	0.00			

Chapter 6
Consumptive Use Adjustment Program

Reservoir operations studies are conducted by the Division of Planning using the DWR Planning Simulation Model (DWRSIM). The DWRSIM model takes into account projected water demands based on future levels of development. DWRSIM outputs Delta inflows, exports, and consumptive use among other values. DWRSIM accounts for only two regions in the Delta (Uplands and Lowlands) with the CU Model (see Chapter 3).

The monthly Delta NCD values output by DWRSIM need to be spatially allocated to DWRDSM nodes in order to model Delta hydrodynamics and water quality for scenarios involving future levels of development. Therefore, a consumptive use adjustment FORTRAN program (FDMCUA) was developed to adjust estimates of historic monthly DWRDSM nodal NCD allocations derived from the DICU model to yield the same Delta–wide NCD used in DWRSIM simulations (*FDMCUA* 1989).

As documented in the program, the adjustment is used to achieve a user–specified Delta–wide net channel depletion while approximately retaining the historic nodal allocation scheme and proportions. The consumptive use adjustment program is mainly used for planning studies. However the program is also used for historic simulations when a NCD value different from that derived by the DICU model is desired. Table C–5 in Appendix C shows an output file from the consumptive use adjustment program. The format of the file is the same as the diversion and return files output from the node allocation program. In the header, it is apparent that the values have been adjusted to match values in a DWRSIM study. A database for each level of development has been created. Each time NCD values used by the DWRSIM model are created, a database of files with matching NCD values is created for the same period the DWRSIM hydrology covers (currently 1922 through 1992).

The program adjusts the monthly diversions and returns based on the following steps:

1. Calculate the change in monthly NCD

$$\Delta NCD = \text{DWRSIM target value} - \text{DICU historic estimate} \quad (6\text{–}1)$$

2. Calculate the change in the monthly diversion using the result from Step 1.

$$\Delta diversion = \Delta NCD / 0.7 \quad (6\text{–}2)$$

Diversions are increased above NCD values based on a 70 percent farm irrigation efficiency.

3. Calculate the change in monthly return flow based on the result from Step 2.

$$\Delta return = 0.3 \times \Delta diversion \quad (6\text{–}3)$$

Returns are calculated as 30 percent of diversions based on an assumed farm irrigation efficiency of 70 percent.

The values calculated in step 2 and step 3 are used to calculate new monthly diversions and returns for each DWRDSM node. However there are two special cases as follows:

A. If the monthly diversion is much less than the return (return is at least 8 times larger) or the NCD has to be reduced so much that diversions will be reduced to zero (possible in the winter months), only the return flows are adjusted.

B. If the monthly return is much less than the diversion (diversion is at least 8 times larger) or the NCD has to be increased so much that drainage will be reduced to zero (possible in the summer months), only the diversions are adjusted.

Chapter 7
Model Validation

Most models are validated by making comparisons of model results to field data. The DICU model is difficult to validate because limited suitable field data is available. However, some hydrologic data collected on Twitchell Island in 1960 does provide enough information to validate the DICU model for at least that island (*Owen and Nance* 1962).

The Twitchell Island hydrology study was undertaken from December 1959 through March 1961. The purpose of the study was to evaluate the inflow–outflow relationships on Twitchell Island and the relationship of consumptive use to actual depletion of water from the surrounding channels. Twitchell Island was used for the study as a representative Delta island because it has highly organic surface soils. Field observations performed during the study include (1) recording siphons diversions, (2) recording pump drainage, (3) measuring precipitation, (4) measuring soil moisture content, (5) recording weather data and (6) conducting crop surveys. The field observations were used to estimate monthly values of precipitation, ET, the change in soil moisture, siphon inflow, pump outflow, and seepage (*Owen and Nance* 1962). The estimates will hereon be referred to as the Owen & Nance estimates.

In this chapter, the Owen & Nance estimates are compared to DICU model estimates for Twitchell Island for the same time period as an attempt to validate the model. The only modification made to the DICU historic input data set was to use actual 1960 land use for Twitchell Island instead of the critical water year land use typically used by the DICU model for dry water years.

Precipitation

Owen & Nance precipitation estimates were calculated utilizing the Theissen polygon method on precipitation data from five locations on Twitchell Island (*Owen and Nance* 1962). The DICU model also utilizes the Theissen polygon method using seven Delta precipitation stations. Precipitation recorded at a Rio Vista rain gauge is assigned to Twitchell Island (see Chapter 4). Figure 7–1 shows the two precipitation estimates. The difference between monthly estimates ranges from approximately 10 acre–feet (AF) to 220 AF in the period November through May. However, on an annual basis, the percent difference is less than 1 percent which indicates that the Theissen Polygon method used by DICU is adequate.

Evapotranspiration

Owen & Nance estimated ET using four separate methods of which the Blaney Criddle method (which uses temperature and atmospheric pressure data) was selected (*Owen and Nance* 1962). The DICU model ET estimates are crop dependent but not subarea dependent (see Chapter 4). Figure 7–2 shows the two ET estimates. DICU model monthly ET estimates are very close to those estimated by Owen & Nance in the months of April

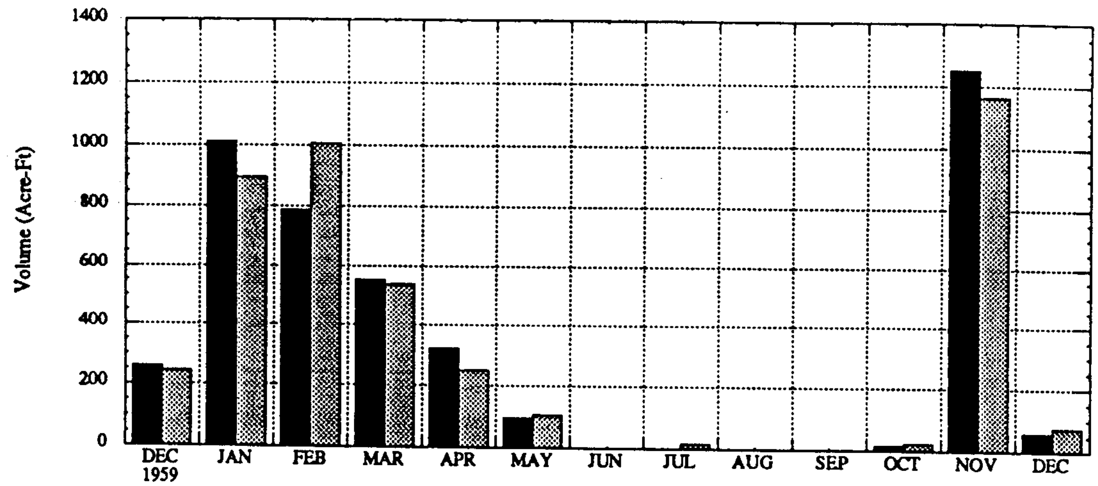

Figure 7–1. Twitchell Island Precipitation

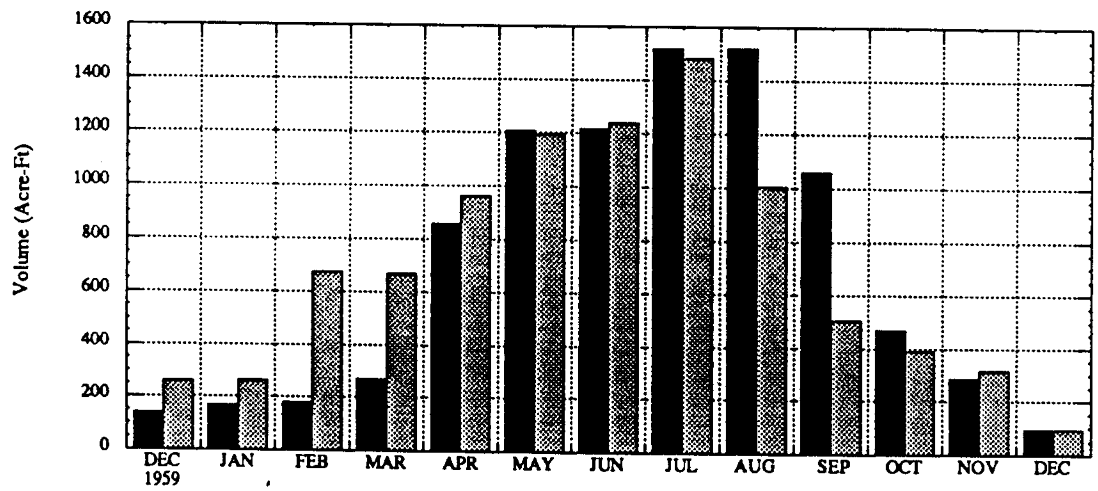

Figure 7–2. Twitchell Island Evapotranspiration

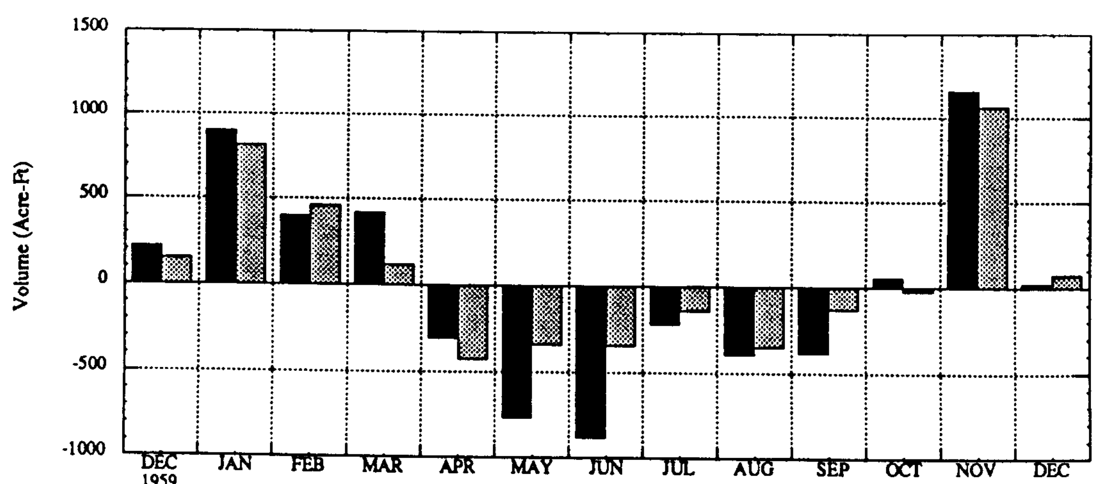

Figure 7–3. Twitchell Island Soil Moisture Change

Owen & Nance DICU

through July. In the period August through September, ET estimates are less than Owen & Nance estimates. In the remaining months (December through March), the DICU model ET estimates are higher.

The DICU model assumes that the ET of grain on Twitchell island is the same as the ET of grain anywhere else in the Delta, although humidity, wind, pressure, etc. are all factors that change within the Delta and affect ET. Owen & Nance estimates take those factors into consideration but the DICU model doesn't. The difference between the two estimates ranges from approximately 15 AF to 550 AF from April through September. However, on an annual basis, the percent difference between the two estimates is less than 1 percent.

Soil Moisture Budget

During the Twitchell Island study, neutron probe measurements were used to estimate monthly variation of soil moisture. Measurements were taken at up to 60 locations each month (*Owen and Nance* 1962). DICU soil moisture limits are also based on neutron probe measurements for a different sample period (see Chapter 4). Figure 7–3 displays estimates of Owen & Nance's soil moisture changes versus those estimated by the DICU model. The differences between the two estimates range from approximately 45 AF to 535 AF.

Applied Water

During the study period, surface irrigation water was supplied to Twitchell Island through 25 siphons. Using gauges installed at those siphons and tidal stage data recorded in the surrounding channels, siphon inflow was computed (*Owen and Nance*, 1962). In Figure 7–4, those values are compared to diversions calculated by the DICU model (irrigation efficiency and leach water requirements are taken into account). The large differences between the two estimates could be caused by seepage, irrigation efficiency, leach water, precipitation, ET, or the change in soil moisture in any month.

Owen & Nance measured some applied water (siphoned) in the winter months. The fact that the DICU model did not simulate applied water in the same time period could be because the model does not take into account the daily distribution of precipitation. The DICU model runs on a monthly time step, which means that precipitation that falls at the end of the month is available to the plant at the beginning of the month. In general, the Owen & Nance applied water estimates are higher in months when there was some precipitation. Differences between the monthly estimates range from 20 AF to 715 AF. However, on an annual basis, the difference between the estimates is approximately 10 percent.

Drainage

All discharged water from Twitchell Island is pumped through one pumping plant located along the San Joaquin River. During the 1960 study, the monthly drainage from the pumping plant was estimated by using data collected on the pump head, energy used by the pump, and pump efficiency (*Owen and Nance*, 1962). DICU model drainage is composed mainly of runoff from precipitation and leach water, and excess irrigation water (see Chapter 4). Figure 7–5 shows the two drainage estimates. DICU estimates are consistently

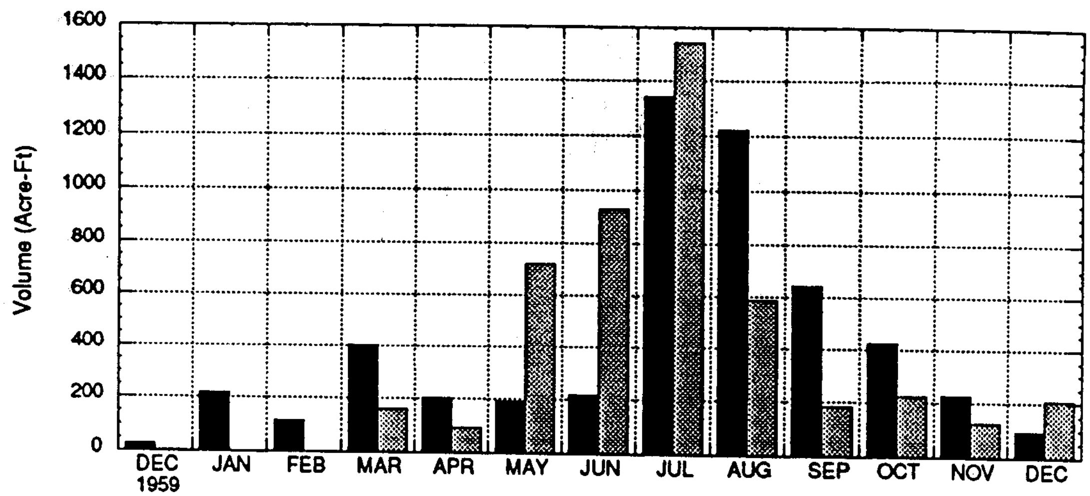

Figure 7–4. Twitchell Island Applied Water

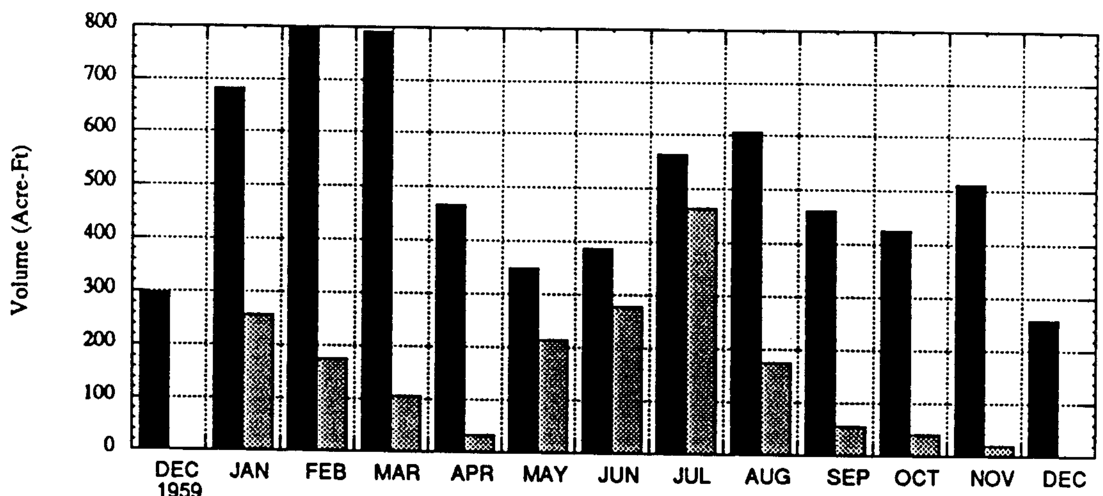

Figure 7–5. Twitchell Island Drainage

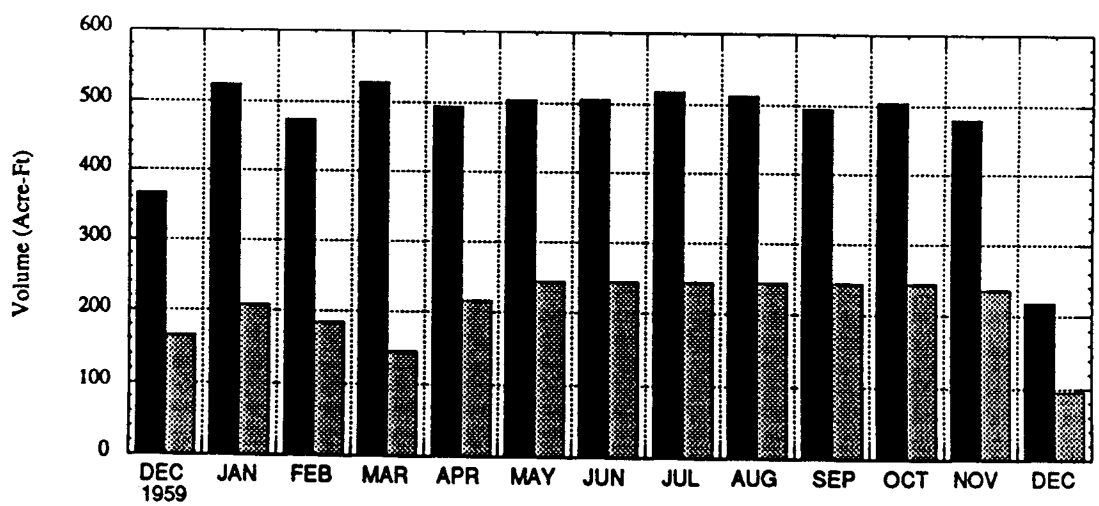

Figure 7–6. Twitchell Island Seepage

Owen & Nance DICU

lower. The difference between the two estimates ranges from 100 AF to 690 AF. On an annual basis, Owen & Nance estimates are more than three times larger than DICU estimates.

Seepage

The annual seepage was calculated by Owen & Nance from the water balance equation. All factors were measured and seepage was solved for. After the annual seepage was determined, it was subdivided into months based on flow nets (*Owen and Nance*, 1962). The distribution of the annual seepage to monthly values resulting from the flownets is very similar to a distribution which prorates the seepage based on the number of days in each month. The DICU model estimates seepage available to plants as a function of the crop root depth. The seepage estimates using both methods are displayed in Figure 7–6. In general, Owen & Nance's seepage estimates are approximately double those of the DICU model. The difference in the seepage estimates could be due to one or more of the following reasons:

1. Twitchell Island has a history of high seepage. The land surface is up to 17 ft below MSL (NGVD) at some points on the island. However, the seepage estimate used by the DICU model is based on an average seepage rate for the Delta lowlands. Therefore, it is possible that the model is under predicting seepage on Twitchell Island.
2. DICU seepage includes only that available to plants but Owen & Nance's estimates represent total seepage to Twitchell island.
3. Seepage was not directly measured in the Owen & Nance study. Inherent in the annual seepage estimate are errors that may have been made in any of the measurements used to estimate the other components of the water balance.

Discussion

A summary of observations for each factor follows:

Precipitation: Though the differences between DICU model and Owen & Nance monthly estimates range from 10 to 220 AF, on an annual basis, the percent difference is less than 1 percent. DICU precipitation estimates seem to be reasonable.

ET: The differences between DICU and Owen & Nance monthly estimates range from 15 AF to 550 AF. On an annual basis, the estimates are similar, with a percent difference of less than 1 percent. It is likely that in the near future, a different method of estimating ET for DICU subareas will be used. The new method is discussed in Chapter 9.

Soil moisture budget: The differences between DICU model monthly soil moisture estimates and Owen & Nance estimates ranges from 45 AF to 535 AF. One problem with DICU is that leach water is not taken into account in the soil moisture budget. It is incorporated into the channel diversion in the NODCU program as if it is independent of soil moisture budgeting.

Seepage: DICU seepage is about half of that estimated by Owen & Nance. This may be due to the fact that the DICU model only accounts for seepage that is available to the plants whereas Owen & Nance's seepage estimate is total seepage from the channel to the island. Any additional seepage not taken into account by the DICU model would have an effect on drainage, since excess seepage would end up in the drainage ditches.

Applied water: On an annual basis, the model performs reasonably well in predicting Twitchell Island applied water requirements with a percent difference between the two estimates of approximately 10 percent. On a monthly basis, the difference ranges from 20 AF to 715 AF. The model seems to over predict applied water early in the irrigation season and under predict late in the irrigation season.

Drainage: The difference between monthly DICU model data and Owen & Nance data ranges from 100 AF to 690 AF. On an annual basis, Owen & Nance estimates are more than three times larger than DICU estimates which also indicates poor correspondence. All the factors discussed above, including irrigation efficiency, could be held responsible for the difference.

Unfortunately, the 1960 Twitchell Island study was the last one of its kind. Since then, such thorough studies involving detailed measurements for studying Delta island inflow–outflow relationships have not been completed. However, the comparisons in this chapter show that even though the model was evaluated for a specific region, it is capturing the overall trend of some of the hydrologic factors. On an annual basis, estimates of precipitation, ET, change in soil moisture, and applied water match well. The annual seepage estimates, on the other hand, are very different and that difference influences the mismatch in drainage estimates. In the next chapter, the variability in the hydrologic factors are addressed by the discussion of some sensitivity tests.

Chapter 8
Sensitivity Analysis

The comparisons in the previous chapter show some consistent differences between model results and field estimates. To take into account the differences, sensitivity tests were made to evaluate the effect of model assumptions on Delta diversions and returns. A sensitivity analysis was conducted with the DICU model and the NODCU program.

For each test, DICU analyses was performed for water years 1922 through 1990. Delta diversions and returns were totalled for all 142 subareas and the sensitivity of those values are analyzed in this chapter. Average Delta diversion and return results over the simulation period (1922 – 1990) were compared for most tests discussed in the following sections.

Sensitivity Tests

The sensitivity of Delta diversions and returns to each of the following variables are evaluated:

- Land use: Actual land use data for 10 years was compared to DICU default land use.
- Irrigation efficiency : decreased from 70 to 50 percent.
- Seepage: increased and decreased by 50 percent.
- Precipitation: increased and decreased by 10 percent.
- Leach water: increased from about 8 percent to 33 percent of the Lowlands.
- ET: increased and decreased by 20 percent.
- Soil moisture limits: Decreased the upper soil moisture limits by 0.5 inches per root depth.

Land Use. The DICU model, by default, assigns land use to each subarea based on whether it is a critical or noncritical water year type (Chapter 4). To investigate the impact of land use on Delta diversions and returns, DICU results based on default land use patterns were compared to results based on actual Twitchell island land use for 1924 through 1931, 1938, 1948, 1955 and 1960. Results of two of the tests (water years 1930 and 1955) are discussed in this section. Results from other tests are displayed in Appendix F. The two years were chosen because they cover both water year types used by the DICU model to determine land use. Water year 1930, a dry year, is classified as a critical year by the DICU model. Water year 1955, a below normal year, is classified by the model as a non–critical water year.

Figure 8–1 shows land use for Twitchell island observed in 1930 and Figure 8–2 shows the Twitchell island land use assigned by the DICU model. Comparisons of the observed 1930 land use results versus DICU land use results for the same water year for

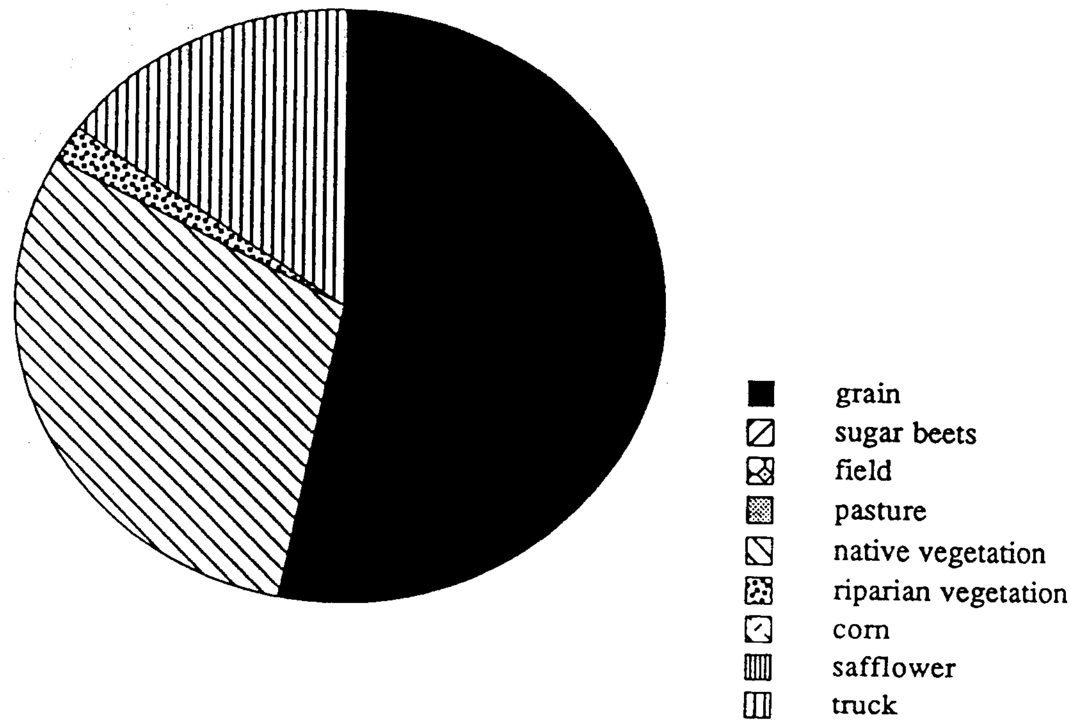

Figure 8–1. Twitchell Island 1930 Land Use

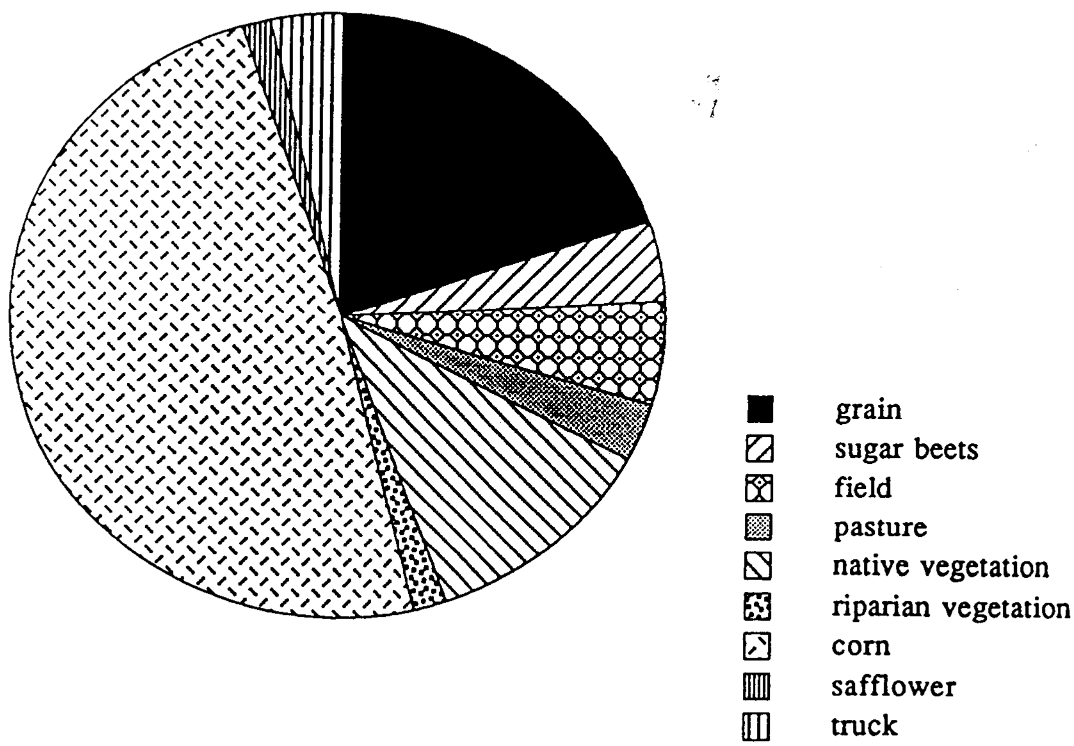

Figure 8–2. DICU Twitchell Island Land Use for Critical Water Years

Twitchell Island are shown in Figure 8–3. In the summer irrigation months, Twitchell island diversions based on DICU land use are higher than those based on observed data because the ET of the crops is very different. In critical water years, the DICU model assumes that about half of Twitchell Island is covered in corn. However 1930 land use surveys on Twitchell island claim that about half the island was covered in grain. The difference in land use is reflected in summer diversions because during that time the ET of corn is higher than the ET of grain and therefore diversions based on DICU land use is higher than those based on 1930 surveys. Figure 8–3 also shows that returns also increased in summer under the actual 1930 land use. Since diversions increased, returns also increased. Higher diversions result in more excess irrigation water due to the effect of the irrigation efficiency factor in equation 2–3.

Figure 8–4 shows land use for Twitchell island observed in 1955 and Figure 8–5 shows the Twitchell island land use assigned by the DICU model. Comparisons of the observed 1955 land use results versus DICU results for the same water year for Twitchell Island are shown in Figure 8–6. The DICU model default land use assumes that in noncritical water years about half of Twitchell island is covered in corn. The 1955 land use surveys on Twitchell island show that most of the island was covered in field crops. At first glance, it may seem that the ET rates of the two crop categories are causing the difference in diversion and returns shown in Figure 8–6. However, a closer look at the ET values reveals that the DICU model assigns the same ET rates for both crop categories. The cause of the difference is due to the upper soil moisture limits. The maximum soil moisture limit assigned to field crops in the Lowlands is lower than that assigned to corn. Therefore the model allows less water to be stored in the soil for the area covered by field crops and therefore more water needs to be diverted for ET demands in summer. Return results shown in Figure 8–6 also show the effect of the maximum soil moisture limit. In January, there is more drainage using the 1955 land use data because the soil moisture upper limit for field crops is lower than that for corn (the excess moisture is drained instead of stored in the soil).

Farm irrigation efficiency. Land and water use analysts at DWR Central District estimate Delta farm irrigation practices to be 70 percent efficient (Sato 1985). This assumption has been used to run DICU analyses in the past. However, where water is abundant and cheap, it may be more economical to use an excess of water than to pay the expense of developing efficient farm irrigation systems (*Vegetative* 1967). Therefore, in this test, the efficiency was reduced to 50 percent. This assumption implies that irrigation volumes are twice that needed for consumptive use by crops. The excess leaves the island as returns.

Figure 8–7 shows Delta diversions for both the 50 percent and 70 percent irrigation efficiency assumptions. The plot indicates that the irrigation efficiency has a much larger effect on summer diversions than on winter diversions. The reason for this effect is that in the winter, precipitation is high and ET is low. Therefore, diversions are small and are mainly composed of seepage and applied leach water which are independent of irrigation efficiency (see equation 2–2).

Figure 8–7 also shows Delta returns for both the 50 percent and 70 percent irrigation efficiency assumptions. Returns are noticeably larger during summer due to the increase in diversions. By definition, excess applied irrigation water contributes to returns.

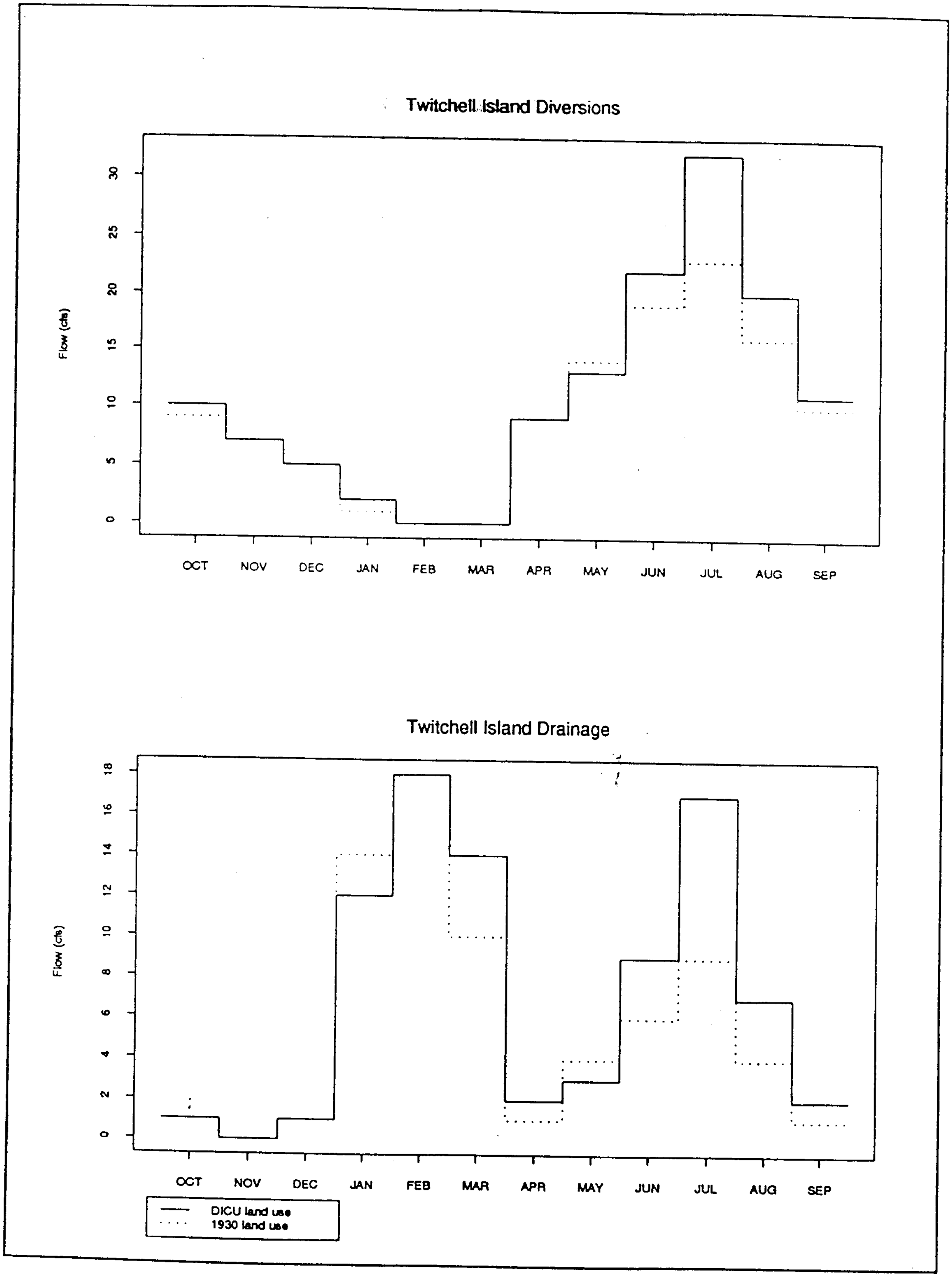

Figure 8–3. DICU Model Results: 1930

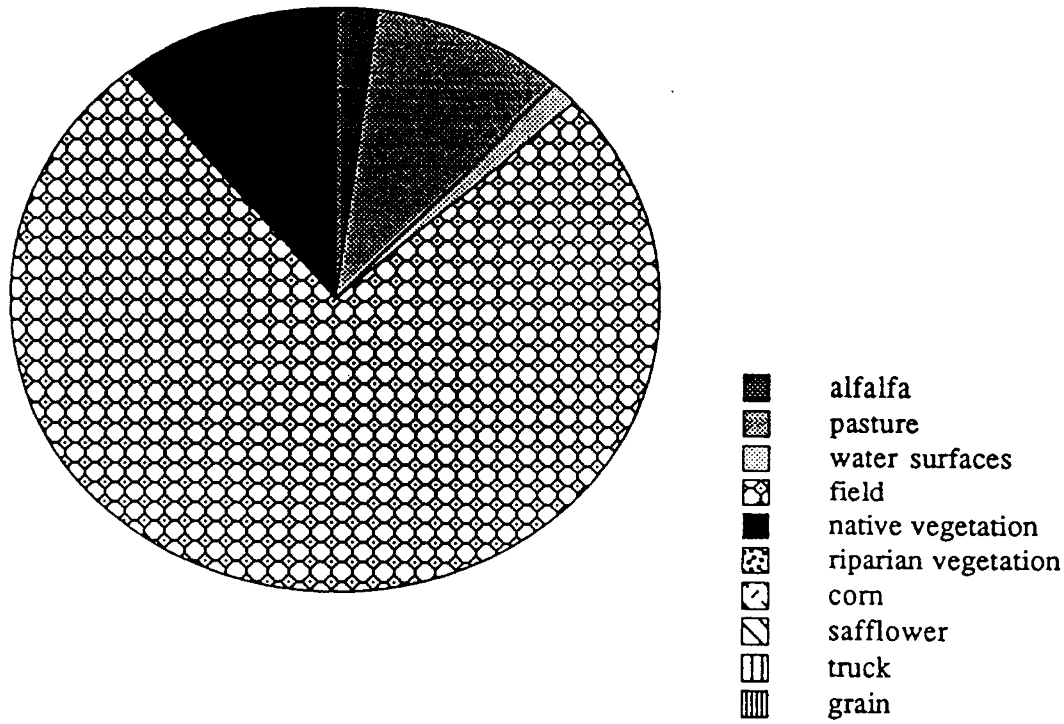

Figure 8–4. Twitchell Island 1955 Land Use

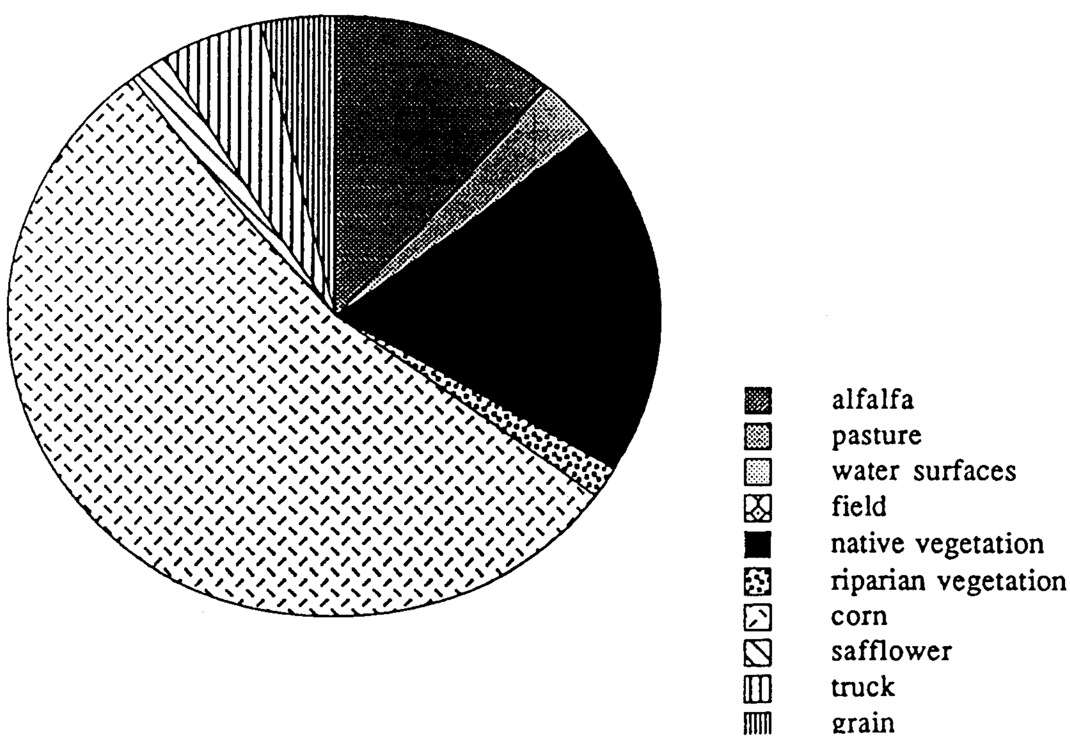

Figure 8–5. DICU Twitchell Island Land Use for Non–critical Water Years

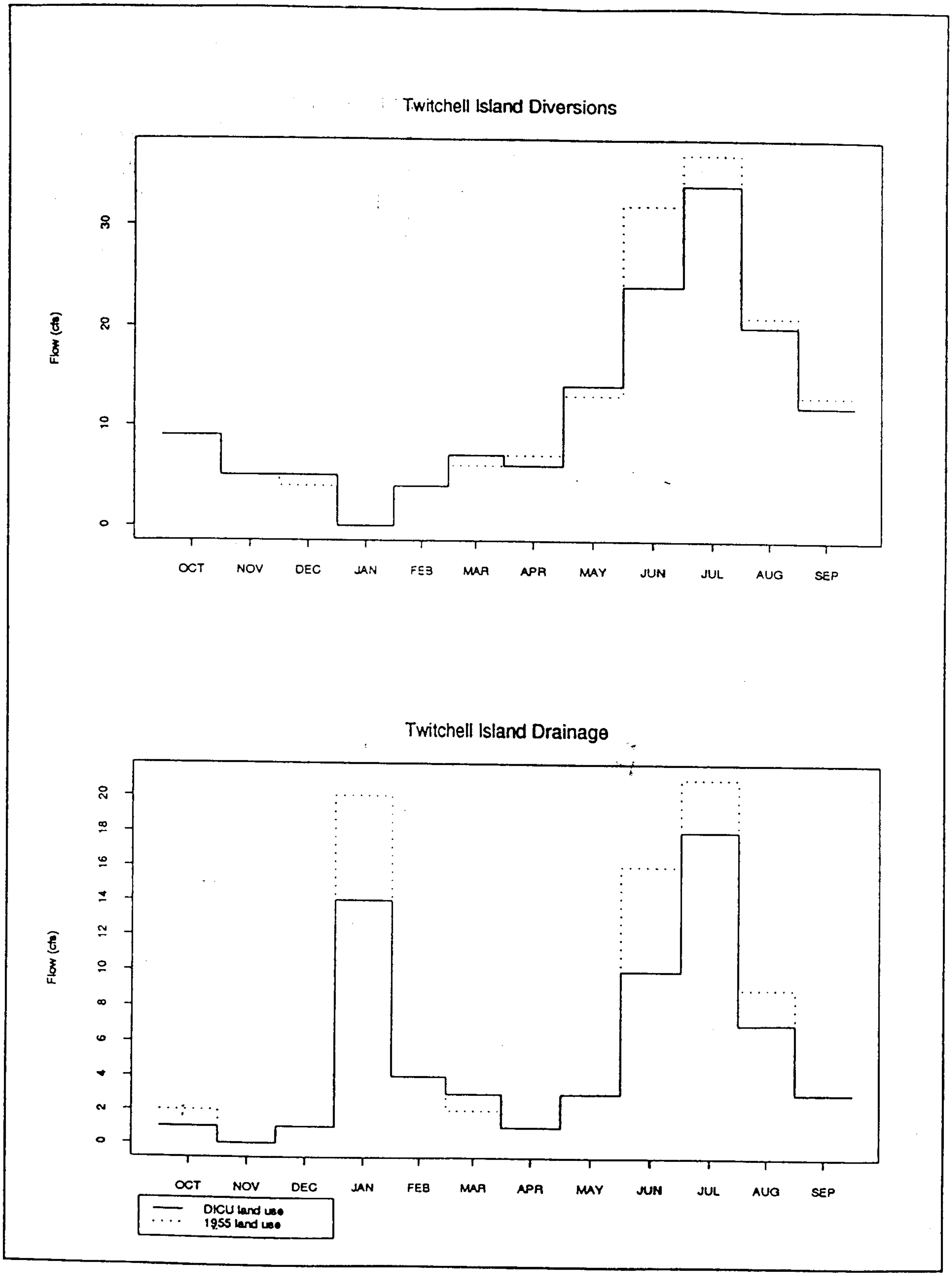

Figure 8-6. DICU Model Results: 1955

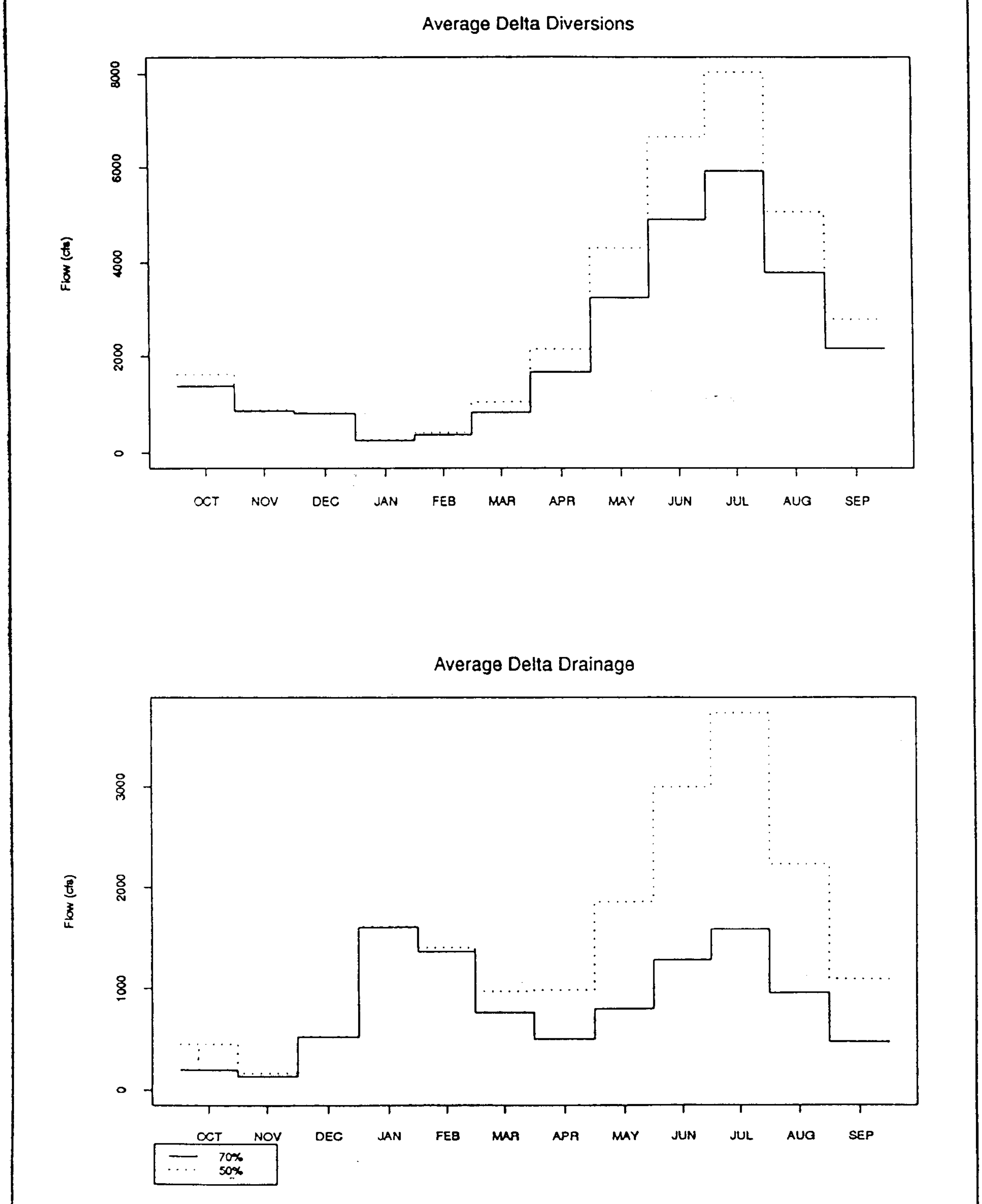

Figure 8–7. Sensitivity of Farm Irrigation Efficiency Factor

During the wet months, there is little difference in return flows because they are composed primarily of runoff, which is independent of irrigation efficiency (see equation 2–3).

Seepage. Seepage is assumed to be 0.3 inches per foot of crop rooting depth per month, per unit area in the Lowlands. Alfalfa, for example, is assigned a root depth of 4 feet in the Lowlands. Therefore about 1.2 inches of seepage per month, per unit area, is available to the roots. To test the impact of seepage on diversions and return flows, seepage was increased and decreased by 50 percent. The Twitchell Island validation showed that Owen & Nance's seepage estimates are approximately double DICU seepage estimates. However, since Owen & Nance's estimates were not directly measured and because Twitchell Island has a history of high seepage, the DICU seepage estimate was both increased and decreased by just 50 percent for the sensitivity tests.

Figure 8–8 shows Delta diversions as a result of the increase in seepage. In wet months, an increase in seepage causes an increase in Delta diversions, by definition. In dry months, an increase in seepage is counteracted by a decrease in applied irrigation water. Since seepage is not affected by irrigation efficiency, the total diversion is slightly less.

Figure 8–8 also shows Delta returns as a result of an increase in seepage. In wet months, when the soil is saturated, an increase in seepage causes an increase in Delta returns as runoff. In dry months, when the soil is not saturated, increased seepage results in reduced irrigation requirements. Since applied irrigation water is in excess of plant requirements (irrigation efficiency), return flows are lower.

Figure 8–9 shows Delta diversions as a result of a decrease in seepage. The results from this test show the same trends as the preceding test except increases show up as decreases and vice versa. In wet months, a decrease in seepage causes a decrease in Delta diversions. In dry months, a decrease in seepage is counteracted by an increase in applied irrigation water. Although applied water makes up for the decrease in seepage, the total diversion is more because applied water is increased by an irrigation efficiency factor (see equation 2–2).

Figure 8–9 also shows Delta returns as a result of a decrease in seepage. In wet months, a decrease in seepage causes a decrease in Delta returns because less seepage is drained under saturated soil conditions. In dry months, returns increase because diversions increase.

Precipitation. Precipitation used as input to the DICU model is based on data from 7 stations. The precipitation estimates probably have the least amount of error compared to the rest of the input data used in DICU analysis. To test the impact of precipitation data, the data were increased and decreased by just 10 percent based on the percent differences observed between DICU and Owen & Nance precipitation estimates on Twitchell Island (3 to 30 percent).

Figure 8–10 shows Delta diversions as a result of the increase in precipitation. The increase in precipitation causes a decrease in diversions. This means that since more precipitation is available to the plants, less applied water is needed and therefore the diversion is less.

Figure 8–10 also shows Delta returns as a result of the increase in precipitation. In wet months, when the soil is saturated, the increase in precipitation causes an increase in Delta returns as runoff. In May and June, returns decrease slightly because the extra

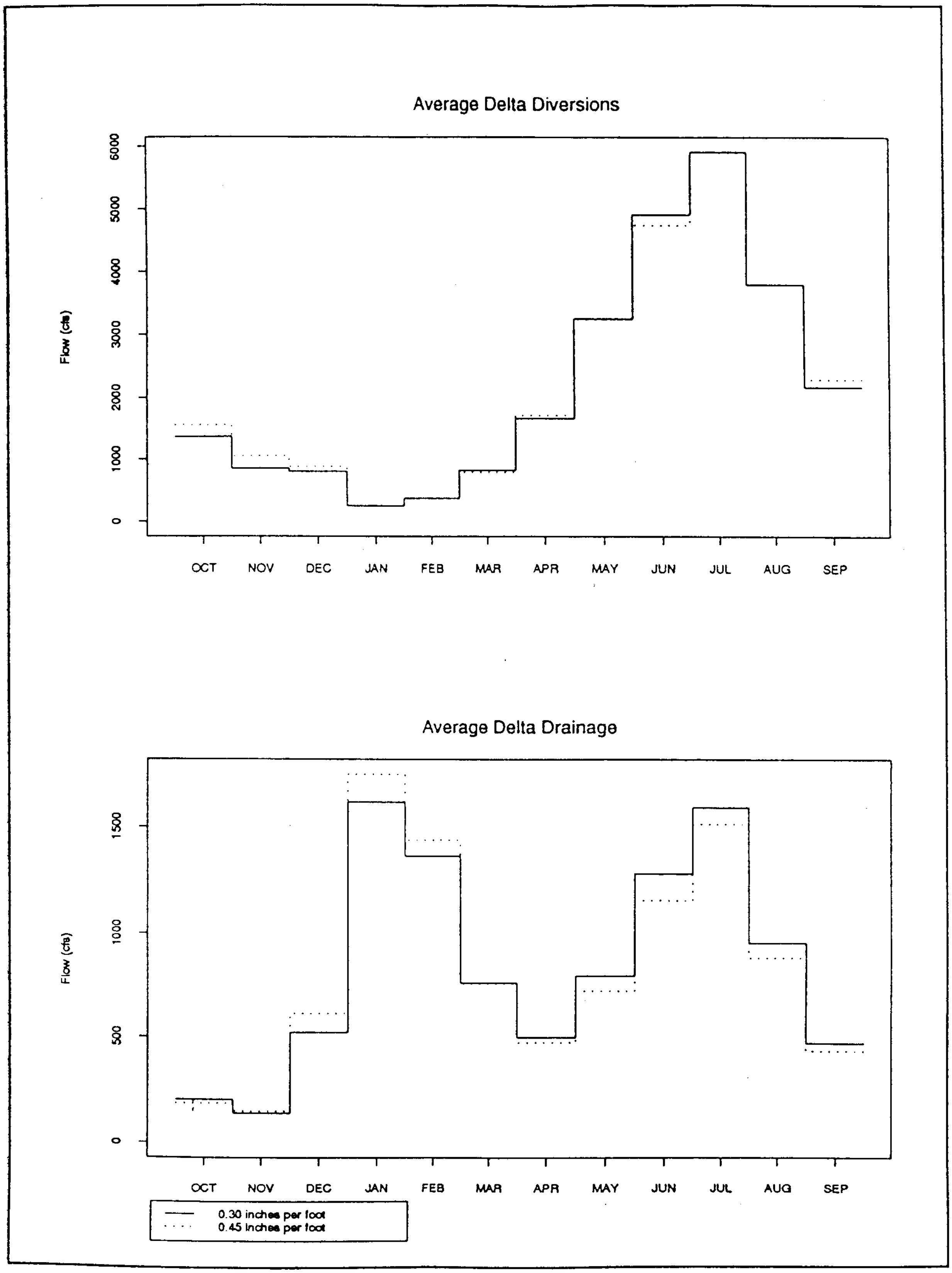

Figure 8–8. Sensitivity of Seepage Increase

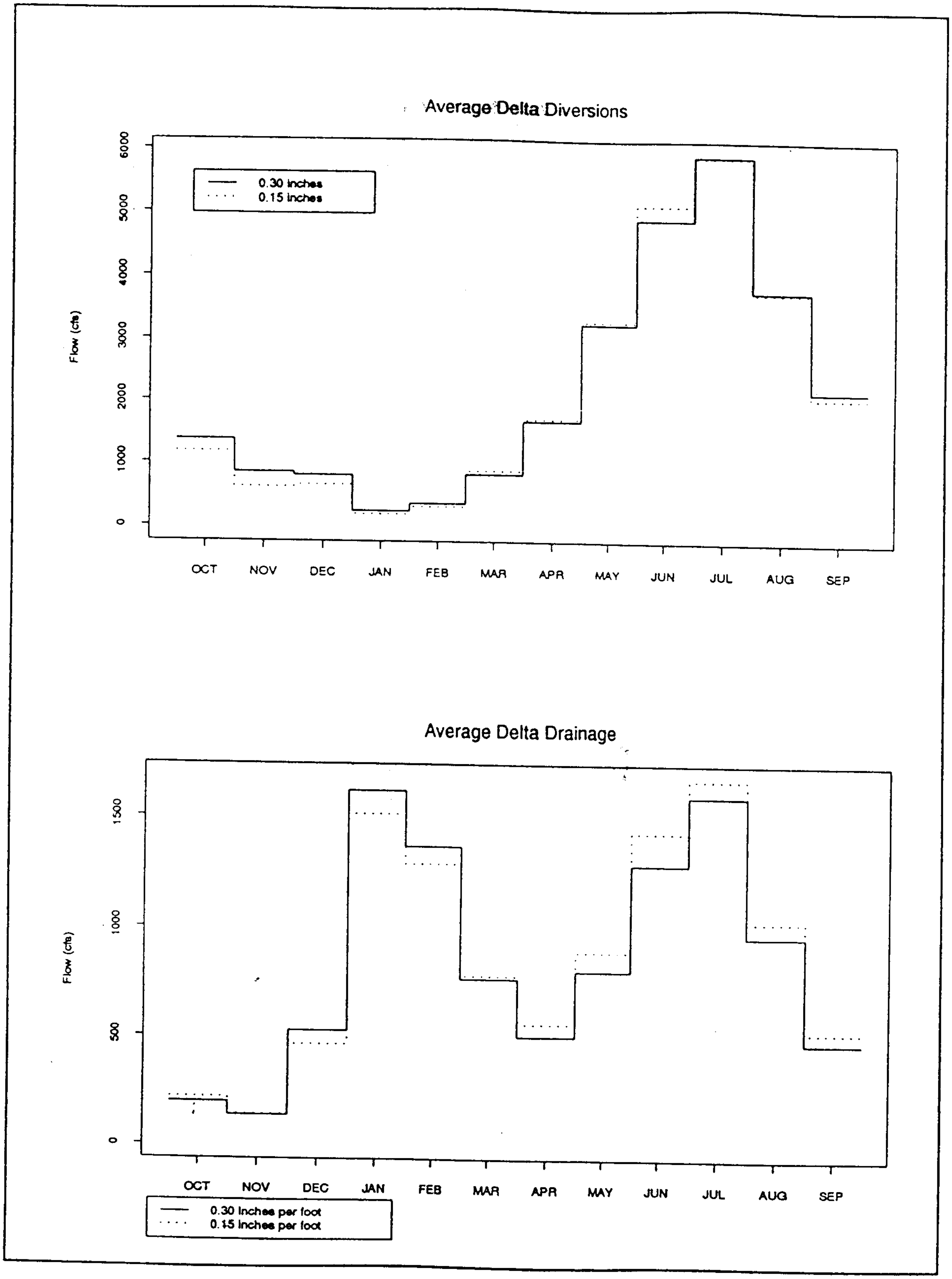

Figure 8–9. Sensitivity of Seepage Decrease

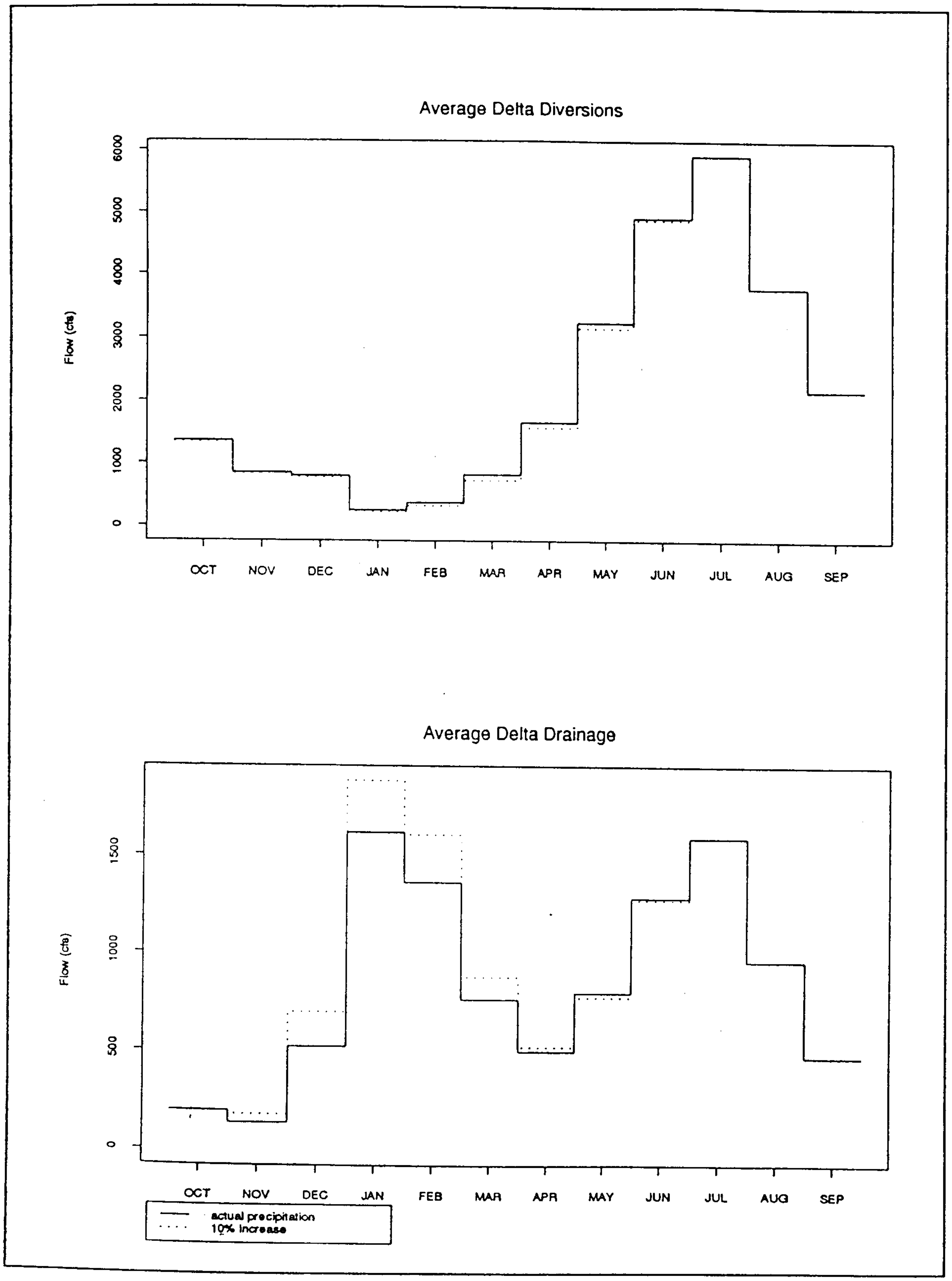

Figure 8–10. Sensitivity of Precipitation Increase

precipitation is used instead of applied water. Since precipitation is not a function of irrigation efficiency, when it is used in place of applied water, less precipitation than applied water is needed to supply the same ET demand.

Figure 8–11 shows Delta diversions and returns as a result of a decrease in precipitation. The results from this test show the same trends as the test above except increases show up as decreases and vice versa.

Leach Water. Land and water use analysts at Central District estimated leach water applied and drained monthly, based on areal surveys in the late 1970s (*Joint* 1981). According to those areal surveys, less than 8 percent of the Delta Lowlands was flooded annually to leach salts. However, some references estimate that these applications are made on the average of every 3 years (*Documentation* 1966). To test the impact of leach water practices on Delta diversions and returns, the total Lowlands area leached annually was increased to 33 percent of the Delta Lowlands. This means that the total area flooded annually increased from 26,800 acres to 115,700 acres (the total leached area was more than quadrupled). For modeling purposes, the monthly leach water volumes are distributed over the entire Delta so that each subarea is leached annually. The application and timing patterns were kept the same in the sensitivity test. Figure 8–12 shows Delta diversions as a result of an increase in leach water.

Delta diversions increase with an increase in applied leach water since diversions are a function of leach water (See equation 2–2). Figure 8–12 also shows Delta returns for both leach water volumes. Delta returns increase with an increase in leach water drained since returns are a function of leach water (see equation 2–3). Leach water affects Delta diversions and returns in DICU analysis only from October through April because those are the months when leach water practices are simulated (*Joint* 1981).

Evapotranspiration. The Delta evapotranspiration (ET) values used by the DICU model are from a variety of sources (see Chapter 4). To test the sensitivity of Delta diversions and returns to changes in ET, the ET estimates were increased and decreased by 20 percent. In the Twitchell Island validation, the average percent difference between model estimates and Owen & Nance estimates was 20%.

Figure 8–13 shows Delta diversions as a result of the increase in ET. An increase in ET means that the plant demand is greater. Applied water is increased, which causes an increase in Delta diversions.

Figure 8–13 also shows Delta returns as a result of the increase in ET. In wet months, the increase in ET results in a decrease in return flows. Since the ET demand is higher, more precipitation is used to satisfy the ET demand, which results in less runoff. In dry months, since more irrigation water is applied, there is more excess irrigation water that drains.

Figure 8–14 shows Delta diversions as a result of the decrease in ET. The results from this test are similar to those from the test above. The same trends can be observed except increases show up as decreases and vice versa. The decrease in ET causes a decrease in Delta diversions. Since there is less demand for water by the plants, less applied water is needed, which decreases Delta diversions.

Figure 8–14 also shows Delta returns as a result of the decrease in ET. In wet months, the decrease in ET results in an increase in returns. Since the ET demand is lower,

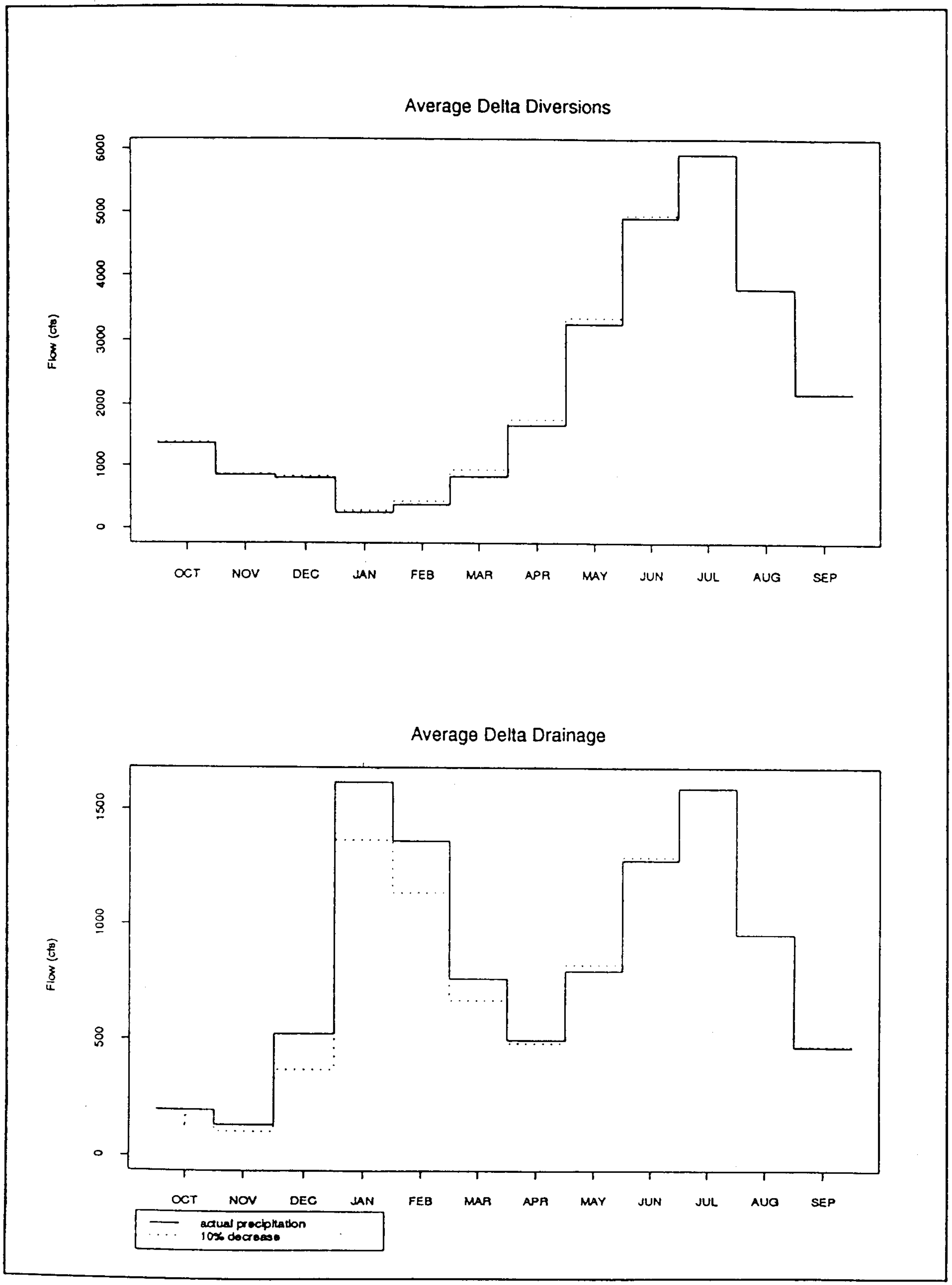

Figure 8–11. Sensitivity of Precipitation Decrease

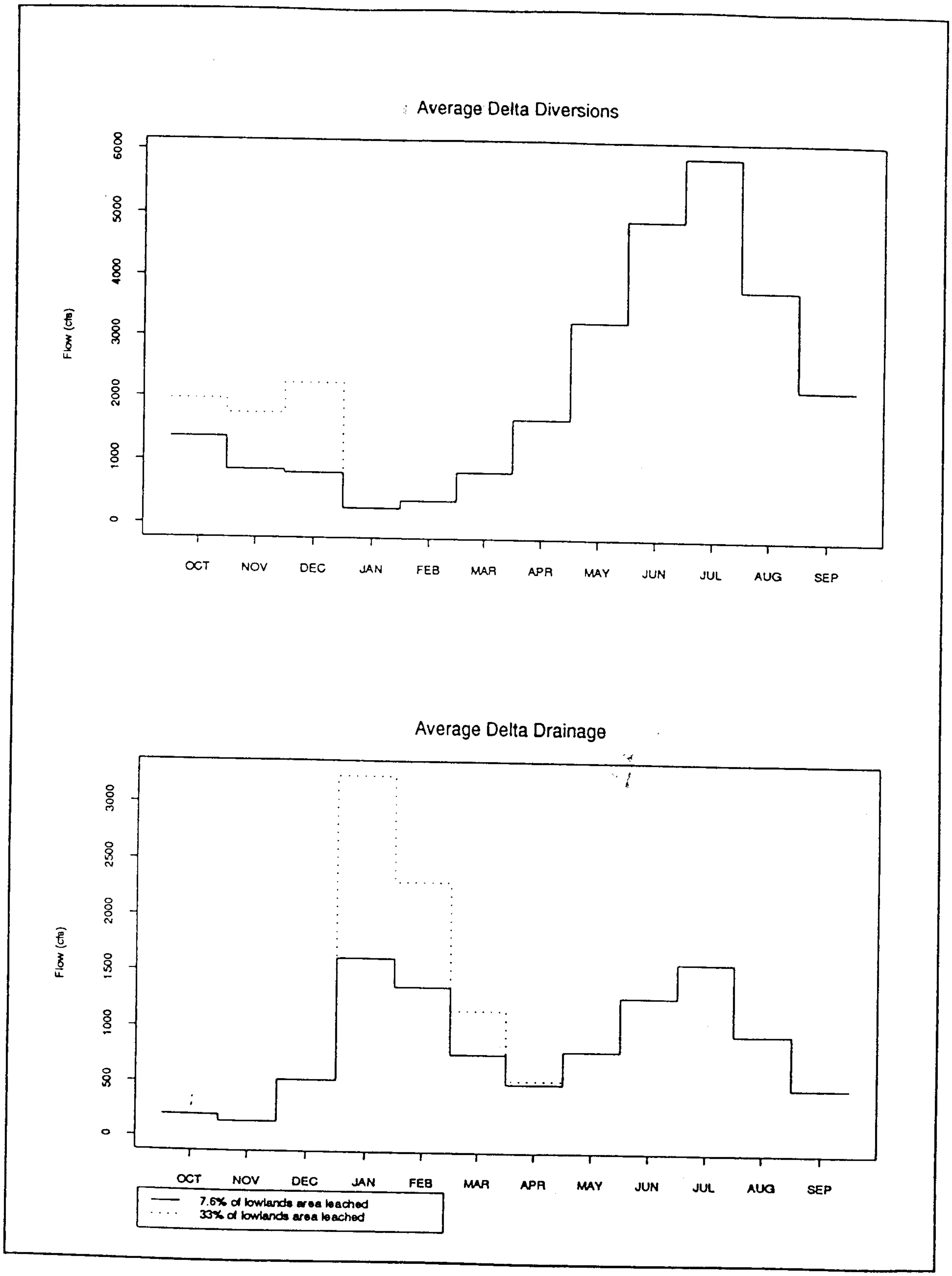

Figure 8–12. Sensitivity of Leach Water

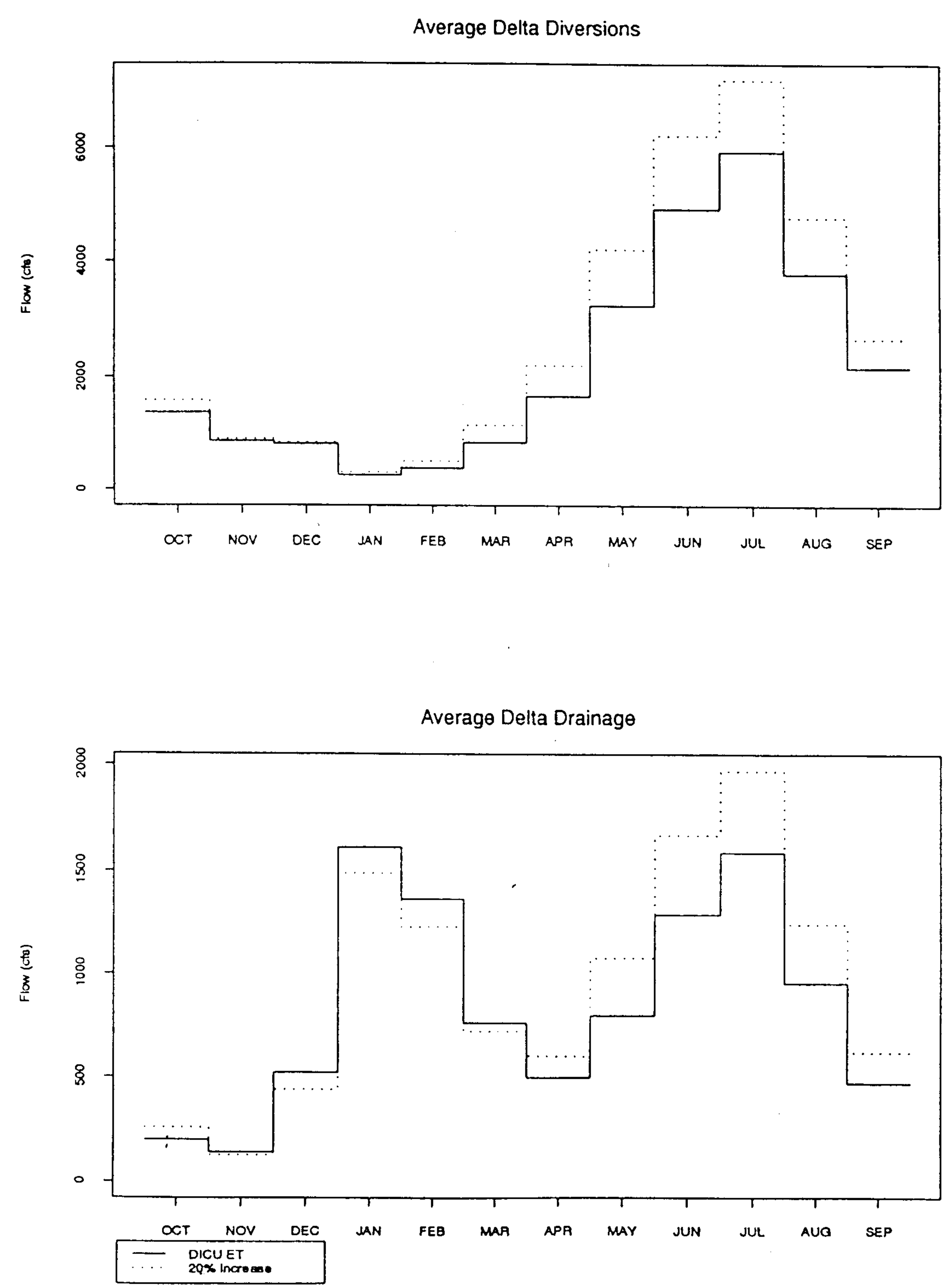

Figure 8–13. Sensitivity of Evapotranspiration Increase

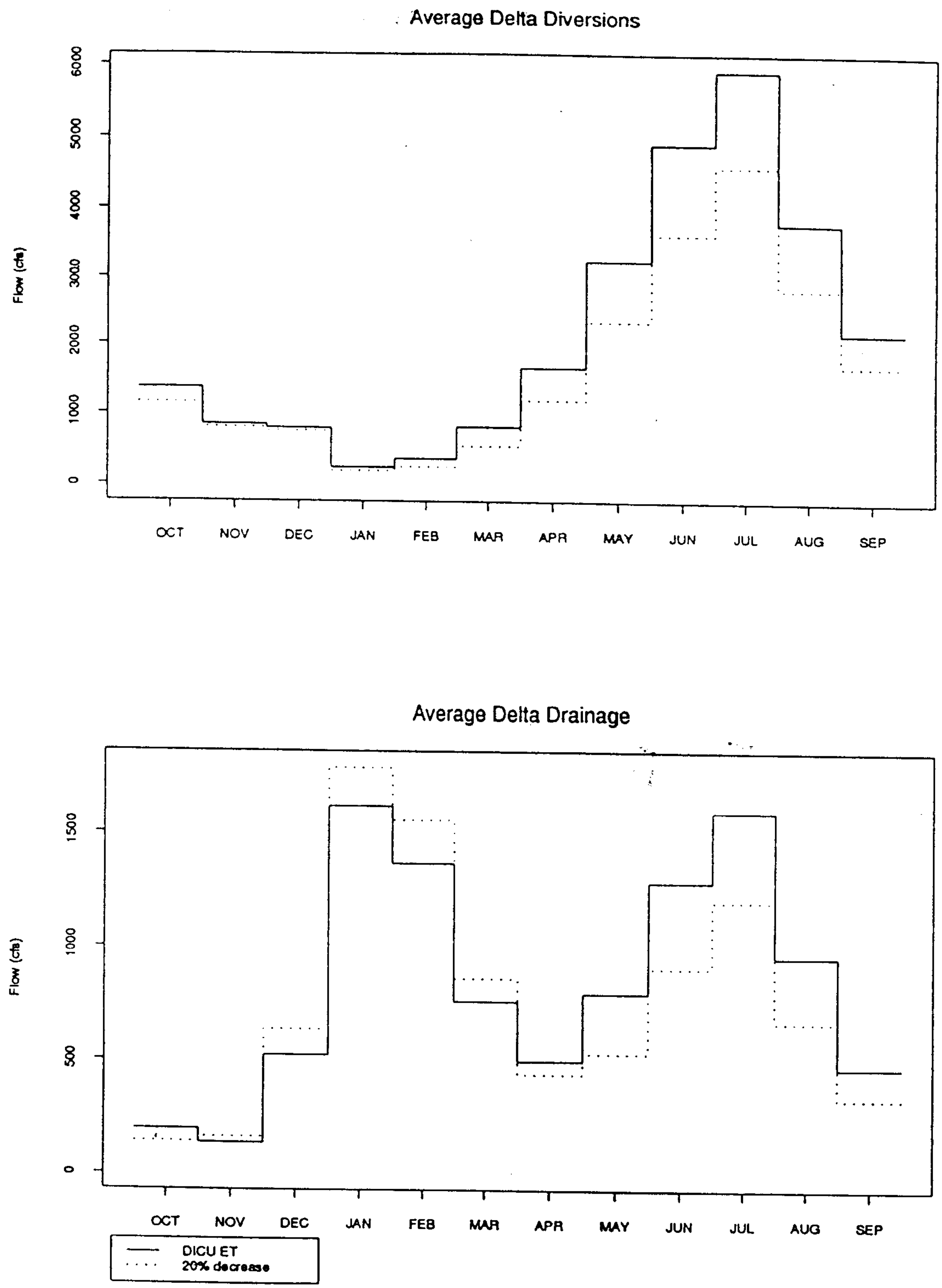

Figure 8–14. Sensitivity of Evapotranspiration Decrease

less precipitation is used to satisfy the ET demand, which results in more runoff. In dry months, since less irrigation water is applied, less drains.

Soil Moisture Limits. Soil moisture limits used by the DICU model are a function of the crop root depths. The upper soil moisture limit in the Delta Uplands is assumed to be 1.5 inches per foot root depth. In the Lowlands, it is assumed to be 3 inches per foot root depth. To test the impact of soil moisture limits on diversion and returns, the Uplands upper limit was arbitrarily decreased from 1.5 inches to 1.0 inch per root depth and the Lowlands upper limit was arbitrarily decreased from 3.0 to 2.5 inches per root depth. Lower limits were decreased accordingly.

Figure 8–15 shows Delta diversions as a result of the decrease in the limits. The diversions are slightly less in January, February, and March because during dry years, applied water is needed to bring the soil moisture for the *grain* and *safflower* crops to the lower limit. Most other crops have a lower soil moisture limit equal to zero during those months (See Figure 4–5). During summer, less soil moisture is available for plant use (maximum storage is lower) and therefore more applied irrigation water is needed, which increases diversions.

Figure 8–15 also shows Delta returns as a result of the decrease in soil moisture limits. The returns increased in winter because the upper soil moisture limit was reduced. The soil was unable to retain as much moisture and therefore there was more runoff. In summer, more irrigation water was applied and therefore more excess irrigation water was drained. Higher diversions result in more excess irrigation water (due to the irrigation efficiency factor).

Additional model runs to test the impact of soil moisture limits (such as increasing the upper limits or varying the lower limits only) were not carried out because this test showed little sensitivity.

Discussion

Tables 8–1 and 8–2 summarize the results from the sensitivity tests by showing the impact of each variable on Delta diversions and returns. Although the percent increase/decrease of each variable is different, the individual adjustments are assumed to be reasonable and therefore direct comparisons are made at the bottom of the tables. The two variables showing the greatest effect on Delta diversions and returns are listed for each month. The results show which variables tested are dominant at different times of the year. A summary of observations follows:

- The irrigation efficiency and ET are the two major variables controlling the quantity of both diversions and returns from March through September.
- Leach water generally has the largest impact on diversions during the months it is applied (October through December) and on returns during the months when it is drained (January through April).
- The effect of precipitation on Delta diversions is most obvious in wet months when it is the main source of water. If it is decreased, more water is diverted to compensate for the lack of precipitation. Precipitation has the greatest effect on returns in the winter months when returns are composed primarily of runoff.

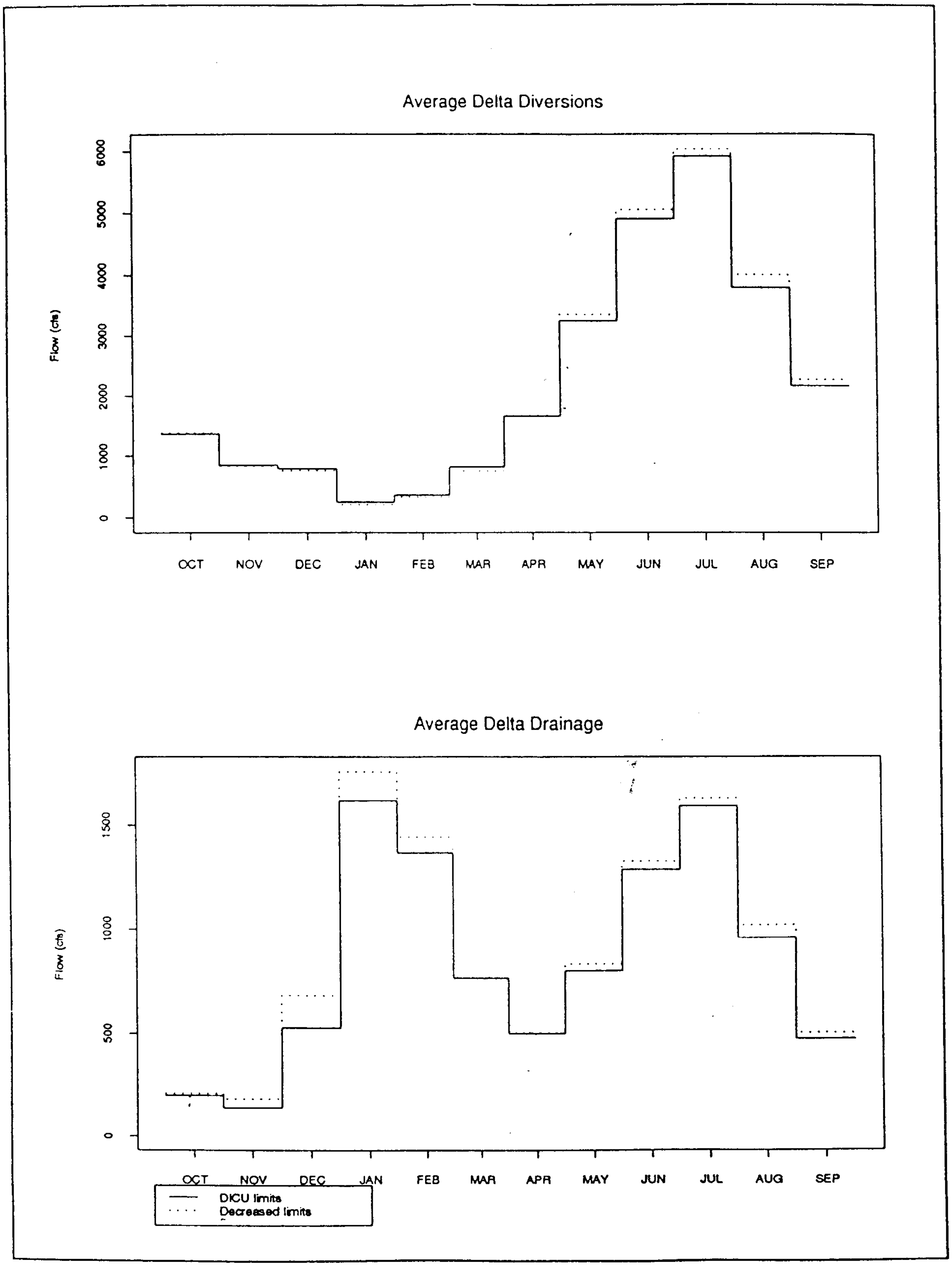

Figure 8–15. Sensitivity of Soil Moisture Limits

- Seepage is one of the dominant variables in October, November, and December when applied water is low and seepage is the main component of Delta diversions. Seepage does not significantly impact return flows. However, the DICU model only takes into account seepage available to plants. If the seepage assumption was modified to take into account total seepage to the island, returns would increase (excess seepage is pumped back into the channel).
- Soil moisture limits have the greatest effect on Delta return flows in wet months when soil moisture is stored in the soil. If the soil moisture storage capacity is decreased, runoff increases, which in turn increases return flows.

Table 8–1. Sensitivity of Delta Diversions: Percent Changes

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Decrease Efficiency	+18	+4	+1	+4	+11	+26	+30	+33	+35	+36	+34	+30
Increase Seepage	+14	+24	+10	–3	–2	–4	+3	0	–4	0	0	+6
Decrease Seepage	–13	–28	–18	–22	–12	+7	+2	+1	+4	0	0	–5
Increase Precipitation	–1	–2	–3	–14	–14	–11	–5	–3	0	0	0	0
Decrease Precipitation	+1	+2	+4	+15	+17	+14	+6	+3	+1	0	0	0
Increase Area Leached	+44	+105	+180	0	0	0	0	0	0	0	0	0
Decrease ET	–15	–5	–5	–21	–31	–34	–28	–28	–26	–22	–26	–22
Increase ET	+16	+5	+4	+19	+33	+38	+34	+29	+26	+21	+25	+24
Decrease Upper Soil Moisture Limits	+2	–2	–5	–17	–11	–8	0	+3	+3	+2	+6	+5
Primary Variable	LW	LW	LW	S	ET	ET	ET	eff	eff	eff	eff	eff
Secondary Variable	eff	S	S	ET	P	eff	eff	ET	ET	ET	ET	ET

Table 8–2. Sensitivity of Delta Drainage: Percent Changes

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Decrease Efficiency	+128	+22	+1	+1	+3	+28	+97	+133	+133	+133	+133	+133
Increase Seepage	–8	+7	+17	+8	+5	0	–5	–9	–10	–5	–8	–8
Decrease Seepage	+10	+3	–11	–6	–5	+2	+11	+11	+11	+5	+8	+11
Increase Precipitation	–1	+29	+33	+16	+17	+15	+4	–3	–1	0	0	0
Decrease Precipitation	+2	–21	–29	–15	–16	–12	–3	+3	+1	0	0	0
Increase Area Leached	0	0	0	+100	+68	+52	+6	0	0	0	0	0
Decrease ET	–27	+18	+22	+10	+14	+13	–11	–33	–29	–24	–30	–30
Increase ET	+30	–8	–16	–8	–10	–5	+20	+35	+30	+24	+30	+32
Decrease Upper Soil Moisture Limits	+5	+30	+30	+8	+6	+1	+1	+4	+3	+2	+7	+7
Primary Variable	eff	SM	P	LW	LW	LW	eff	eff	eff	eff	eff	eff
Secondary Variable	ET	P	SM	P	P	eff	ET	ET	ET	ET	ET	ET

Tables 8–1 and 8–2 show that leach water and irrigation efficiency are the most important variables. However, they are entirely dependent on the farmer's decision. Therefore models will always be limited to only very approximate estimates of these values on a drain–by–drain basis because of lack of information. Sensitive parameters need to be explored further to determine if modifications to the current assumptions need to be made.

Chapter 9
Future Directions

Delta Island Water Use Study

A joint feasibility study is being conducted by DWR Division of Local Assistance and USGS under the MWQI program to measure irrigation and drainage water quantities, quality, and power use for pumping drain water off the islands (*Five–year* 1994). The plan is to study water use in the Delta by focusing on Twitchell Island. After determining the water balance on Twitchell Island, extrapolation methods may be used to estimate the water balance on other Delta islands. Return flows will be calculated using historic power records and pump test data obtained from PG&E. The DICU model is being used by the study team to prioritize data needs. Studies such as this one might give further insight on the magnitude of Delta channel depletions.

Modified ET Formulation

ET is one of the two major variables controlling the quantity of both diversions and return flows from March through September (Chapter 8). A new method of estimating ET in the Delta was recently developed by DWR Central District (*Historic* 1994). The method is based on the Hargreaves–Samani equation, which uses temperature and solar radiation to calculate reference ET. ET estimates generated using the Hargreaves–Samani equation will be used in the future as input to the DICU model instead of using estimates based on pan evaporation data.

Disaggregating Channel Diversion Estimates

To reduce entrainment of eggs, larvae, and juvenile fish in the Delta, diversion facilities can be evaluated with models discussed in this report to (1) assess the benefits of managing diversion timing and water use, (2) decide where screens are needed, and (3) consider whether diversion points should be relocated or consolidated. Output from the DICU model will be modified to address the significance of agricultural diversions on particle fate and movement within the Delta by disaggregating channel diversion estimates into two components: siphon inflow and seepage. While disaggregation is unnecessary for simulating hydrodynamics and water quality, it is essential for simulating particle fate and movement.

Extending Land Use Database

Recall from Chapter 4 that only two sets of land use data are currently used by the DICU model. However, variation in land use on an island–by–island basis can be significant from year to year and notably affects diversions and returns (Chapter 8). Historic Delta land use information is available in the DWR Bulletin 23 series (*Report*) and on a Geographic Information System. The DWR Division of Planning currently has a contract with USGS to digitize the 142 DICU subareas. The land use data, in conjunction with the digitized regions and the GIS, can be used to develop a DICU land use database that varies annually. Interpolation may be used to estimate land use for years in which no information is available.

Assigning Drain Quality Constituents

The node allocation program assigns a monthly salinity concentration to all return flows based on three regions in the Delta (Chapter 4). Those values vary monthly but not from year to year and are used by DWRDSM. DWRDSM2, the new model currently being developed by the DWR Division of Planning, will need additional input data for several drain quality constituents including electrical conductivity (EC), minerals, organics, nutrients, dissolved oxygen, temperature, and algae. Estimates of the constituents may be assigned to regions in the Delta that differ from Bulletin 123 regions. These estimates will be used until a dynamic drainage quality module is formulated.

Model Calibration

A model calibration is planned using data from sources of information that were not discussed in detail in this report. DWR Report 4 has data from a study conducted in 1954 and 1955 in the Delta Lowlands. Monthly diversion and drainage data for 24 subregions of the Delta Lowlands resulted from that study (*Quantity* 1956). Diversion data is available in the DWR Bulletin 23 series (*Report*). Data collected from the DWR/USGS study may provide additional information useful for model calibration. Calibration parameters may include total seepage, irrigation efficiency and leach water.

Modifying Seepage Estimate

The existing DICU seepage estimate only takes into account seepage available to plants. In the future, this assumption will be revised to also include seepage that is not available to plants, but which flows directly into drainage ditches.

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Appendix A

Net Delta Channel Depletion Estimates

Table A-1. Dayflow Net Channel Depletion Estimates: 1930–1993 Monthly Averages

(in thousand acre-feet)

WYEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1930	90.	83.	3.	-167.	-65.	-39.	51.	119.	192.	230.	194.	129.	819.
1931	47.	32.	108.	-119.	-49.	4.	87.	59.	176.	226.	196.	132.	898.
1932	82.	-6.	-187.	-38.	-123.	46.	79.	99.	184.	223.	196.	132.	688.
1933	97.	84.	-14.	-147.	-17.	-15.	88.	69.	187.	225.	196.	132.	884.
1934	80.	41.	-62.	-54.	-103.	49.	91.	106.	179.	226.	196.	110.	859.
1935	76.	-29.	-8.	-87.	2.	-125.	-52.	120.	188.	225.	196.	132.	641.
1936	34.	63.	28.	-152.	-362.	43.	5.	93.	145.	226.	196.	117.	437.
1937	97.	87.	-21.	-144.	-221.	-256.	59.	116.	182.	225.	196.	132.	451.
1938	89.	-14.	-125.	-16.	-279.	-152.	56.	114.	188.	226.	197.	121.	405.
1939	44.	44.	33.	-45.	-85.	-58.	85.	102.	190.	228.	199.	111.	847.
1940	76.	76.	78.	-266.	-179.	-106.	-22.	127.	188.	231.	201.	133.	537.
1941	71.	71.	-193.	-137.	-155.	-4.	-88.	103.	194.	233.	203.	136.	434.
1942	44.	33.	-107.	-215.	-59.	-44.	-93.	38.	196.	235.	205.	135.	368.
1943	85.	-109.	-8.	-184.	-109.	-127.	17.	106.	196.	238.	207.	139.	450.
1944	91.	64.	35.	-75.	-198.	-42.	10.	107.	192.	240.	209.	139.	772.
1945	90.	-106.	-49.	45.	-185.	-136.	97.	126.	206.	247.	214.	144.	692.
1946	-2.	1.	-110.	17.	-23.	-26.	62.	80.	209.	248.	219.	147.	823.
1947	108.	-46.	32.	32.	-38.	-35.	95.	133.	188.	256.	223.	150.	1097.
1948	30.	34.	74.	57.	6.	-108.	-4.	73.	171.	260.	227.	152.	972.
1949	64.	75.	-18.	13.	-36.	-181.	110.	139.	219.	262.	226.	144.	1016.
1950	98.	55.	42.	-143.	-58.	-6.	82.	141.	220.	265.	231.	125.	1052.
1951	44.	-152.	-80.	-70.	-24.	-28.	86.	81.	221.	265.	231.	155.	728.
1952	54.	-5.	-145.	-240.	-41.	-98.	17.	142.	218.	264.	228.	153.	548.
1953	114.	15.	-124.	-49.	47.	30.	29.	90.	197.	265.	230.	154.	998.
1954	102.	63.	63.	-11.	-47.	-85.	25.	104.	198.	265.	230.	155.	1062.
1955	113.	-25.	-46.	-133.	-4.	31.	-17.	81.	220.	265.	230.	154.	871.
1956	107.	21.	-374.	-247.	1.	67.	7.	87.	223.	268.	233.	132.	524.
1957	85.	73.	108.	-81.	-88.	-56.	-23.	58.	208.	268.	233.	153.	938.
1958	11.	75.	-31.	-151.	-327.	-212.	-196.	104.	217.	268.	233.	149.	140.
1959	107.	101.	80.	-147.	-205.	64.	48.	150.	223.	268.	232.	-4.	916.
1960	115.	103.	76.	-110.	-126.	34.	56.	122.	223.	268.	233.	157.	1149.
1961	115.	-74.	68.	-81.	-47.	-51.	66.	139.	218.	268.	228.	135.	983.
1962	112.	-2.	23.	-6.	-336.	8.	96.	128.	223.	268.	232.	155.	900.
1963	4.	89.	11.	37.	-394.	-80.	-132.	92.	212.	268.	233.	137.	477.
1964	4.	-113.	118.	-65.	42.	26.	93.	129.	175.	264.	230.	144.	1047.
1965	54.	-78.	-131.	-112.	23.	-12.	10.	147.	223.	268.	213.	156.	760.
1966	110.	-128.	-5.	-2.	-110.	55.	90.	131.	222.	268.	233.	154.	1018.
1967	115.	-127.	-115.	-228.	-16.	-108.	-127.	141.	207.	268.	233.	153.	395.
1968	104.	70.	-5.	-31.	-131.	-60.	87.	141.	223.	268.	233.	157.	1054.
1969	91.	-44.	-146.	-297.	-230.	6.	57.	146.	222.	268.	233.	139.	444.
1970	48.	57.	-56.	-329.	-29.	-5.	83.	148.	215.	268.	233.	157.	790.
1971	75.	-163.	-197.	17.	25.	-41.	57.	97.	221.	268.	233.	156.	746.
1972	95.	62.	-77.	55.	9.	78.	59.	144.	212.	268.	233.	118.	1256.
1973	29.	-173.	18.	-258.	-135.	-136.	94.	148.	223.	268.	233.	144.	453.
1974	-15.	-93.	-45.	-86.	7.	-45.	-17.	150.	208.	240.	233.	157.	693.
1975	78.	52.	-7.	36.	-211.	-95.	39.	150.	222.	262.	199.	156.	879.
1976	11.	67.	117.	62.	-12.	25.	20.	150.	221.	268.	193.	115.	1237.
1977	72.	70.	109.	-28.	-24.	16.	108.	64.	223.	268.	233.	136.	1247.
1978	112.	23.	-120.	-317.	-154.	-177.	-48.	142.	223.	268.	233.	142.	328.
1979	115.	-5.	92.	-238.	-209.	-46.	79.	152.	225.	215.	231.	154.	765.
1980	30.	9.	-42.	-221.	-114.	-14.	38.	126.	223.	233.	233.	157.	656.
1981	112.	95.	41.	-203.	-13.	-127.	29.	149.	223.	268.	233.	157.	962.
1982	18.	-80.	7.	-293.	-93.	-256.	-146.	150.	214.	254.	233.	33.	39.
1983	34.	-146.	-112.	-183.	-164.	-334.	-8.	63.	223.	268.	233.	109.	-18.
1984	84.	-251.	-125.	50.	-25.	19.	81.	150.	223.	268.	232.	132.	837.
1985	33.	-127.	12.	26.	-29.	-64.	94.	150.	211.	268.	233.	144.	951.
1986	57.	-92.	-12.	-59.	-412.	-190.	14.	139.	223.	265.	233.	104.	271.
1987	115.	101.	71.	-67.	-197.	-135.	110.	143.	223.	268.	233.	157.	1021.
1988	82.	4.	-76.	-75.	39.	55.	-42.	122.	205.	268.	233.	157.	970.
1989	102.	-1.	-34.	25.	-61.	-118.	98.	147.	207.	268.	228.	40.	901.
1990	21.	37.	128.	-11.	-105.	41.	75.	47.	203.	268.	233.	154.	1092.
1991	112.	39.	12.	60.	-164.	-291.	78.	136.	221.	263.	230.	157.	852.
1992	66.	76.	-27.	-74.	-245.	-54.	112.	150.	219.	268.	233.	157.	881.
1993	88.	59.	-115.	-337.	-180.	-141.	75.	111.	181.	268.	233.	157.	399.
AVERAGE	72.	0.	-24.	-98.	-107.	-60.	34.	117.	207.	255.	222.	136.	755.

Table A-2. DOI Net Channel Depletion Estimates: Monthly Averages for All Water Years

(in thousand acre-feet)

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
118.	55.	2.	-12.	-36.	-10.	63.	121.	191.	268.	252.	174.	1186.

Table A-3. CU Net Channel Depletion Estimatcs: (Constant ET) 1922–1992 Monthly Averages

(in thousand acre–feet)

WYEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1922	68.	46.	19.	-99.	-143.	22.	67.	117.	210.	233.	160.	94.	794.
1923	63.	38.	-127.	-99.	16.	49.	19.	124.	204.	229.	158.	84.	758.
1924	71.	52.	56.	-10.	3.	35.	89.	136.	200.	222.	155.	95.	1104.
1925	53.	46.	1.	-38.	-125.	23.	21.	75.	183.	217.	153.	93.	702.
1926	72.	48.	53.	-33.	-110.	46.	-5.	119.	204.	225.	155.	93.	867.
1927	58.	18.	41.	-62.	-162.	21.	33.	120.	192.	225.	156.	94.	734.
1928	51.	40.	11.	-43.	-2.	-53.	65.	123.	210.	233.	160.	95.	890.
1929	75.	39.	16.	-23.	5.	23.	79.	137.	181.	235.	162.	96.	1025.
1930	76.	55.	49.	-82.	-46.	-19.	61.	129.	225.	249.	167.	96.	960.
1931	65.	49.	60.	-51.	-8.	32.	92.	111.	215.	249.	170.	102.	1086.
1932	75.	45.	-120.	-64.	-91.	38.	74.	129.	223.	247.	170.	102.	828.
1933	80.	53.	50.	-81.	14.	6.	92.	120.	220.	245.	170.	102.	1071.
1934	66.	55.	29.	-25.	-77.	50.	90.	137.	210.	243.	169.	97.	1044.
1935	73.	40.	15.	-133.	11.	-51.	-16.	130.	218.	241.	169.	102.	799.
1936	63.	51.	48.	-93.	-228.	25.	60.	116.	196.	239.	169.	97.	743.
1937	71.	55.	37.	-74.	-147.	-178.	68.	139.	212.	238.	168.	103.	692.
1938	71.	43.	-9.	-75.	-293.	-115.	57.	133.	212.	236.	168.	100.	528.
1939	65.	52.	56.	-18.	-1.	8.	92.	132.	214.	237.	169.	101.	1107.
1940	71.	54.	56.	-180.	-248.	-69.	63.	132.	214.	238.	170.	103.	604.
1941	71.	51.	-92.	-217.	-164.	-25.	-3.	117.	211.	239.	172.	106.	466.
1942	66.	48.	-11.	-187.	-42.	11.	-15.	113.	213.	240.	173.	106.	715.
1943	74.	39.	22.	-165.	-21.	-41.	53.	140.	215.	241.	174.	108.	839.
1944	79.	51.	52.	-27.	-107.	41.	62.	125.	206.	242.	176.	108.	1008.
1945	67.	37.	-1.	-23.	-81.	-37.	90.	139.	221.	247.	179.	110.	948.
1946	52.	48.	-55.	-24.	9.	23.	97.	135.	225.	249.	181.	110.	1050.
1947	82.	40.	35.	-11.	-9.	2.	104.	154.	215.	251.	183.	112.	1158.
1948	54.	50.	58.	-5.	21.	2.	40.	105.	216.	255.	185.	112.	1093.
1949	73.	53.	36.	-30.	-4.	-48.	103.	158.	235.	259.	187.	112.	1134.
1950	86.	50.	52.	-84.	-23.	20.	87.	158.	239.	267.	191.	107.	1150.
1951	57.	9.	-118.	-122.	-26.	21.	79.	139.	240.	269.	192.	114.	854.
1952	68.	41.	-89.	-291.	-4.	-54.	50.	155.	241.	272.	194.	115.	698.
1953	88.	45.	-64.	-82.	24.	43.	57.	149.	231.	275.	193.	116.	1075.
1954	85.	49.	57.	-17.	-7.	-3.	69.	157.	242.	278.	194.	116.	1220.
1955	89.	44.	8.	-119.	0.	44.	49.	140.	251.	283.	198.	111.	1098.
1956	85.	48.	-192.	-271.	2.	55.	54.	136.	250.	284.	199.	100.	750.
1957	70.	55.	60.	-13.	-31.	21.	67.	92.	239.	285.	199.	111.	1155.
1958	60.	54.	38.	-170.	-270.	-121.	-49.	126.	246.	286.	196.	115.	511.
1959	86.	54.	57.	-34.	-87.	52.	98.	173.	258.	287.	199.	66.	1209.
1960	87.	55.	55.	-48.	-61.	31.	84.	152.	258.	287.	200.	117.	1217.
1961	87.	33.	48.	-100.	10.	5.	82.	156.	260.	290.	198.	112.	1181.
1962	86.	40.	51.	-19.	-234.	24.	96.	164.	258.	288.	199.	116.	1069.
1963	29.	49.	15.	-126.	-65.	-42.	-38.	131.	253.	288.	198.	110.	802.
1964	63.	35.	52.	-74.	23.	49.	102.	171.	227.	286.	193.	115.	1242.
1965	58.	41.	-76.	-118.	16.	35.	35.	151.	255.	283.	182.	116.	978.
1966	85.	31.	-22.	-74.	-15.	49.	94.	161.	252.	278.	195.	114.	1148.
1967	85.	22.	-50.	-329.	17.	-46.	-14.	142.	228.	282.	194.	114.	645.
1968	82.	43.	52.	-68.	-19.	0.	86.	151.	250.	280.	155.	114.	1131.
1969	76.	40.	17.	-300.	-198.	28.	70.	148.	247.	278.	191.	110.	707.
1970	62.	43.	2.	-284.	-9.	27.	89.	157.	239.	276.	189.	112.	908.
1971	73.	-7.	-116.	-37.	19.	24.	78.	121.	239.	275.	189.	112.	970.
1972	81.	48.	24.	-16.	9.	63.	89.	163.	237.	274.	188.	94.	1254.
1973	45.	-33.	-19.	-330.	-169.	-17.	84.	152.	243.	273.	187.	109.	520.
1974	52.	4.	-66.	-95.	15.	-30.	43.	138.	233.	256.	187.	113.	850.
1975	64.	49.	43.	-10.	-83.	-76.	63.	137.	243.	269.	174.	112.	985.
1976	47.	50.	56.	0.	23.	72.	85.	178.	241.	276.	158.	93.	1279.
1977	71.	48.	52.	-7.	28.	52.	96.	121.	238.	271.	184.	92.	1246.
1978	76.	40.	8.	-313.	-100.	-114.	27.	126.	243.	273.	181.	101.	548.
1979	78.	38.	54.	-137.	-135.	6.	67.	130.	242.	268.	180.	106.	897.
1980	52.	43.	-4.	-168.	-199.	13.	65.	123.	235.	254.	180.	107.	701.
1981	78.	51.	48.	-50.	8.	-22.	77.	139.	240.	269.	180.	99.	1117.
1982	53.	7.	-32.	-269.	-39.	-176.	2.	123.	237.	272.	179.	67.	424.
1983	49.	-38.	-35.	-277.	-192.	-277.	7.	111.	212.	242.	165.	84.	51.
1984	71.	6.	-123.	-14.	-8.	32.	79.	145.	239.	270.	179.	107.	983.
1985	54.	-17.	5.	-27.	-8.	-32.	79.	140.	226.	261.	178.	99.	958.
1986	69.	30.	12.	-85.	-327.	-99.	62.	125.	216.	243.	170.	90.	506.
1987	80.	52.	52.	-11.	-29.	-13.	90.	145.	215.	242.	171.	106.	1100.
1988	69.	41.	19.	-86.	16.	50.	71.	120.	197.	243.	172.	107.	1019.
1989	77.	42.	40.	-11.	4.	-6.	93.	147.	215.	246.	168.	57.	1072.
1990	59.	43.	55.	-31.	-15.	47.	91.	71.	211.	251.	174.	105.	1061.
1991	75.	51.	51.	1.	24.	-48.	83.	122.	178.	250.	169.	106.	1062.
1992	51.	50.	51.	-13.	-121.	-16.	70.	137.	215.	251.	173.	104.	952.
AVERAGE	69.	39.	7.	-94.	-60.	-7.	62.	135.	226.	258.	178.	103.	916.

Table A–4. CU Net Channel Depletion Estimates (Hargreaves–Samani ET): Preliminary 1922–1992 Monthly Averages

(in thousand acre–feet)

WYEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1922	66.	47.	21.	-106.	-154.	15.	63.	117.	199.	223.	135.	96.	722.
1923	57.	34.	-148.	-108.	18.	56.	14.	117.	168.	209.	135.	74.	626.
1924	67.	53.	56.	-10.	13.	39.	97.	147.	199.	189.	138.	86.	1074.
1925	47.	45.	-16.	-39.	-136.	26.	13.	64.	180.	194.	122.	67.	567.
1926	68.	48.	54.	-36.	-94.	60.	16.	130.	240.	252.	157.	87.	982.
1927	60.	23.	44.	-60.	-162.	22.	33.	119.	186.	225.	145.	83.	718.
1928	54.	38.	16.	-41.	10.	-39.	71.	136.	213.	227.	165.	97.	947.
1929	76.	39.	15.	-27.	11.	31.	78.	143.	169.	222.	162.	90.	1009.
1930	82.	57.	49.	-77.	-31.	-12.	61.	109.	214.	215.	137.	66.	870.
1931	68.	51.	62.	-43.	-1.	47.	121.	138.	205.	289.	189.	96.	1222.
1932	77.	45.	-125.	-66.	-89.	45.	75.	129.	233.	245.	178.	116.	863.
1933	86.	56.	50.	-74.	16.	12.	98.	105.	218.	277.	182.	98.	1124.
1934	77.	57.	31.	-24.	-74.	63.	127.	150.	203.	246.	177.	105.	1138.
1935	77.	40.	21.	-131.	11.	-53.	-25.	133.	243.	242.	184.	105.	847.
1936	64.	51.	52.	-83.	-227.	32.	65.	126.	198.	257.	191.	109.	835.
1937	78.	56.	43.	-78.	-152.	-174.	73.	150.	208.	246.	188.	106.	744.
1938	78.	44.	-1.	-75.	-294.	-125.	54.	142.	224.	240.	179.	106.	572.
1939	65.	53.	57.	-14.	6.	17.	116.	147.	233.	245.	182.	108.	1215.
1940	79.	57.	58.	-159.	-240.	-52.	66.	147.	240.	239.	181.	97.	713.
1941	78.	52.	-72.	-209.	-165.	-10.	-4.	120.	210.	248.	152.	106.	506.
1942	68.	49.	-4.	-184.	-33.	22.	-17.	112.	228.	248.	184.	107.	780.
1943	81.	40.	27.	-154.	-8.	-31.	59.	157.	208.	242.	174.	118.	913.
1944	82.	53.	54.	-13.	-89.	55.	63.	141.	200.	238.	194.	126.	1104.
1945	74.	35.	4.	-22.	-67.	-36.	108.	137.	242.	274.	189.	121.	1059.
1946	54.	47.	-50.	-20.	12.	33.	112.	144.	227.	249.	197.	117.	1122.
1947	84.	40.	32.	-12.	-7.	11.	123.	184.	226.	249.	180.	132.	1242.
1948	52.	50.	58.	6.	30.	9.	28.	91.	206.	254.	193.	107.	1084.
1949	74.	54.	36.	-31.	-5.	-51.	111.	160.	247.	256.	174.	110.	1135.
1950	88.	51.	52.	-84.	-14.	23.	99.	172.	235.	278.	203.	101.	1204.
1951	57.	6.	-125.	-126.	-24.	28.	80.	142.	240.	268.	188.	117.	851.
1952	70.	41.	-91.	-299.	-6.	-63.	46.	171.	213.	271.	206.	121.	680.
1953	96.	45.	-67.	-82.	26.	55.	61.	133.	212.	303.	173.	116.	1071.
1954	89.	48.	58.	-14.	-10.	-10.	77.	170.	238.	289.	174.	114.	1223.
1955	94.	42.	-4.	-137.	4.	53.	42.	139.	247.	264.	216.	117.	1077.
1956	89.	48.	-198.	-278.	1.	61.	54.	136.	265.	273.	193.	101.	745.
1957	69.	56.	61.	-9.	-29.	24.	71.	80.	265.	287.	197.	107.	1179.
1958	55.	54.	35.	-174.	-270.	-133.	-51.	134.	227.	265.	202.	120.	464.
1959	93.	56.	59.	-25.	-78.	65.	126.	179.	280.	308.	199.	53.	1315.
1960	92.	57.	57.	-37.	-50.	38.	87.	151.	293.	302.	214.	124.	1328.
1961	90.	32.	48.	-111.	13.	7.	87.	142.	284.	306.	194.	107.	1199.
1962	91.	40.	49.	-21.	-258.	21.	110.	163.	274.	293.	200.	114.	1076.
1963	24.	50.	11.	-130.	-51.	-43.	-70.	116.	249.	269.	196.	103.	724.
1964	60.	27.	43.	-96.	26.	59.	116.	168.	213.	280.	192.	109.	1197.
1965	63.	39.	-83.	-126.	20.	39.	29.	162.	230.	270.	169.	100.	912.
1966	94.	30.	-29.	-69.	-11.	56.	117.	178.	254.	246.	200.	109.	1175.
1967	88.	20.	-60.	-332.	15.	-52.	-56.	146.	213.	288.	208.	111.	589.
1968	87.	48.	53.	-63.	-13.	10.	101.	162.	270.	290.	135.	117.	1197.
1969	78.	39.	11.	-316.	-213.	34.	74.	167.	225.	287.	221.	123.	730.
1970	60.	49.	11.	-273.	0.	38.	96.	183.	244.	290.	199.	125.	1022.
1971	75.	-7.	-123.	-37.	20.	28.	79.	111.	237.	273.	192.	117.	965.
1972	82.	48.	25.	-20.	13.	86.	99.	188.	255.	270.	190.	87.	1323.
1973	42.	-57.	-30.	-339.	-165.	-21.	97.	180.	271.	270.	190.	109.	547.
1974	53.	0.	-69.	-93.	20.	-19.	45.	156.	245.	246.	198.	130.	912.
1975	73.	48.	43.	-9.	-78.	-76.	54.	154.	260.	251.	170.	123.	1013.
1976	47.	50.	58.	3.	34.	88.	90.	216.	255.	268.	124.	91.	1324.
1977	81.	48.	55.	-6.	42.	65.	126.	110.	248.	271.	176.	82.	1298.
1978	81.	41.	12.	-311.	-79.	-100.	19.	141.	250.	268.	189.	98.	609.
1979	87.	37.	54.	-140.	-136.	5.	66.	140.	262.	256.	168.	119.	918.
1980	55.	42.	1.	-167.	-190.	16.	66.	119.	214.	230.	167.	102.	655.
1981	86.	53.	49.	-42.	14.	-18.	88.	152.	269.	274.	186.	100.	1211.
1982	53.	6.	-30.	-273.	-21.	-183.	-2.	139.	212.	252.	171.	57.	381.
1983	49.	-52.	-34.	-295.	-191.	-283.	-1.	113.	215.	226.	165.	90.	2.
1984	78.	6.	-121.	-10.	-2.	42.	83.	169.	243.	271.	180.	126.	1065.
1985	50.	-22.	3.	-34.	9.	-26.	96.	169.	250.	252.	167.	83.	997.
1986	72.	26.	6.	-88.	-318.	-77.	67.	137.	220.	234.	181.	76.	536.
1987	86.	54.	53.	-8.	-16.	-3.	116.	171.	219.	216.	173.	114.	1175.
1988	77.	41.	25.	-80.	21.	64.	84.	134.	205.	271.	180.	120.	1142.
1989	87.	41.	43.	-10.	7.	1.	114.	162.	213.	263.	173.	57.	1151.
1990	63.	46.	56.	-23.	-8.	64.	112.	79.	234.	261.	180.	114.	1178.
1991	80.	53.	52.	3.	37.	-29.	86.	126.	179.	256.	174.	107.	1124.
1992	53.	51.	51.	-9.	-84.	-20.	74.	140.	216.	257.	178.	106.	1013.
AVERAGE	72.	39.	7.	-94.	-55.	-1.	67.	142.	230.	258.	179.	104.	947.

Table A-5. DICU Net Channel Depletion Estimates: 1922–1992 Monthly Averages

(in thousand acre-feet)

WYEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1922	85.	45.	26.	-77.	-160.	22.	74.	173.	220.	234.	163.	98.	902.
1923	71.	42.	-96.	-99.	13.	57.	41.	141.	203.	261.	174.	86.	894.
1924	80.	58.	58.	3.	20.	96.	138.	191.	294.	293.	169.	105.	1506.
1925	71.	45.	18.	-28.	-134.	20.	28.	116.	203.	234.	163.	99.	834.
1926	80.	51.	55.	-20.	-92.	66.	6.	152.	227.	275.	178.	108.	1086.
1927	60.	20.	47.	-67.	-173.	24.	38.	138.	181.	261.	178.	108.	815.
1928	66.	40.	33.	-28.	-1.	-52.	70.	180.	224.	234.	163.	99.	1029.
1929	85.	42.	37.	-9.	18.	73.	121.	188.	236.	293.	169.	106.	1359.
1930	82.	57.	51.	-43.	-37.	-13.	84.	139.	208.	261.	172.	93.	1053.
1931	71.	52.	63.	-18.	4.	86.	134.	154.	269.	293.	169.	105.	1382.
1932	79.	47.	-75.	-51.	-98.	40.	96.	139.	208.	261.	174.	97.	916.
1933	87.	62.	53.	-40.	25.	55.	131.	164.	276.	293.	169.	105.	1380.
1934	70.	62.	38.	-6.	-50.	88.	135.	178.	275.	293.	169.	98.	1349.
1935	89.	39.	38.	-116.	10.	-53.	-21.	162.	226.	234.	163.	99.	869.
1936	80.	49.	51.	-62.	-238.	28.	64.	167.	205.	233.	163.	94.	835.
1937	74.	56.	46.	-33.	-152.	-189.	84.	142.	208.	261.	174.	97.	767.
1938	69.	43.	4.	-72.	-304.	-126.	53.	138.	194.	261.	178.	103.	541.
1939	68.	56.	58.	0.	22.	72.	131.	172.	280.	293.	169.	102.	1423.
1940	67.	53.	55.	-163.	-258.	-76.	59.	136.	192.	261.	178.	105.	610.
1941	68.	51.	-91.	-213.	-166.	-32.	-13.	114.	185.	261.	178.	108.	450.
1942	64.	47.	5.	-190.	-52.	13.	-33.	110.	184.	261.	178.	107.	695.
1943	68.	39.	38.	-168.	-24.	-53.	49.	137.	192.	261.	178.	108.	826.
1944	78.	53.	55.	-14.	-81.	52.	73.	146.	213.	275.	178.	108.	1135.
1945	69.	41.	37.	-13.	-71.	-29.	102.	134.	211.	261.	174.	97.	1013.
1946	67.	46.	-29.	-16.	7.	28.	87.	175.	226.	233.	163.	98.	1086.
1947	79.	42.	47.	-6.	11.	31.	104.	177.	221.	274.	178.	108.	1267.
1948	67.	48.	58.	2.	27.	29.	43.	133.	203.	234.	163.	98.	1106.
1949	71.	55.	42.	-14.	12.	-26.	102.	171.	233.	274.	177.	106.	1204.
1950	82.	52.	55.	-33.	-17.	30.	96.	147.	208.	261.	174.	89.	1145.
1951	54.	14.	-104.	-129.	-37.	21.	66.	131.	187.	261.	178.	107.	750.
1952	63.	41.	-56.	-291.	-7.	-60.	42.	135.	192.	261.	178.	108.	605.
1953	77.	43.	-34.	-77.	24.	47.	52.	142.	178.	261.	176.	108.	996.
1954	93.	47.	57.	-9.	4.	25.	60.	184.	220.	234.	162.	99.	1175.
1955	82.	46.	31.	-91.	15.	49.	60.	145.	221.	275.	178.	102.	1114.
1956	80.	50.	-149.	-293.	12.	73.	54.	129.	189.	259.	176.	86.	667.
1957	65.	58.	60.	-4.	-8.	28.	79.	65.	198.	281.	182.	86.	1089.
1958	48.	57.	43.	-142.	-308.	-155.	-53.	100.	164.	242.	191.	112.	299.
1959	89.	57.	59.	-17.	-36.	86.	132.	200.	243.	281.	174.	69.	1336.
1960	99.	58.	60.	-10.	5.	58.	96.	172.	240.	286.	172.	100.	1334.
1961	92.	35.	54.	-74.	19.	23.	80.	137.	198.	270.	170.	90.	1094.
1962	86.	46.	54.	-4.	-188.	17.	92.	144.	199.	239.	163.	83.	931.
1963	11.	49.	16.	-127.	-65.	-48.	-85.	88.	194.	247.	151.	76.	508.
1964	54.	29.	46.	-85.	34.	74.	132.	188.	168.	261.	178.	107.	1187.
1965	56.	40.	-62.	-128.	24.	35.	19.	142.	180.	251.	143.	98.	797.
1966	75.	33.	-1.	-62.	-8.	53.	109.	162.	202.	231.	178.	97.	1070.
1967	80.	22.	-41.	-314.	9.	-85.	-91.	105.	135.	252.	174.	99.	346.
1968	80.	48.	58.	-35.	-24.	4.	109.	142.	232.	275.	137.	117.	1143.
1969	68.	42.	18.	-298.	-218.	29.	68.	165.	182.	264.	180.	91.	591.
1970	69.	49.	18.	-253.	-12.	57.	99.	196.	180.	267.	170.	115.	954.
1971	70.	3.	-104.	-30.	23.	30.	78.	103.	166.	267.	182.	112.	899.
1972	77.	54.	40.	-6.	14.	90.	109.	173.	201.	264.	180.	81.	1278.
1973	46.	-29.	-12.	-326.	-195.	-21.	105.	177.	211.	253.	178.	106.	493.
1974	54.	22.	-58.	-84.	20.	-59.	44.	140.	237.	251.	195.	121.	884.
1975	82.	50.	49.	-2.	-70.	-67.	61.	183.	224.	229.	152.	99.	991.
1976	52.	61.	62.	23.	54.	137.	120.	261.	340.	311.	134.	85.	1641.
1977	77.	51.	58.	0.	33.	96.	147.	83.	238.	277.	181.	96.	1336.
1978	78.	48.	33.	-276.	-122.	-151.	3.	136.	203.	259.	189.	101.	499.
1979	85.	49.	62.	-67.	-116.	-12.	57.	153.	250.	271.	180.	116.	1027.
1980	54.	46.	6.	-162.	-216.	31.	67.	127.	184.	253.	174.	97.	662.
1981	76.	56.	53.	-45.	20.	-10.	90.	180.	290.	294.	185.	106.	1295.
1982	57.	15.	-29.	-260.	-21.	-203.	4.	163.	188.	253.	176.	77.	419.
1983	59.	-39.	-36.	-292.	-221.	-340.	-12.	119.	210.	278.	191.	103.	20.
1984	71.	9.	-122.	-6.	-9.	64.	109.	211.	244.	292.	194.	144.	1201.
1985	61.	10.	22.	-29.	6.	-11.	94.	170.	224.	275.	178.	101.	1101.
1986	69.	32.	24.	-94.	-344.	-112.	55.	136.	193.	261.	178.	94.	492.
1987	85.	63.	58.	3.	-4.	31.	121.	185.	282.	293.	169.	106.	1393.
1988	67.	45.	21.	-89.	27.	102.	77.	144.	211.	324.	217.	122.	1267.
1989	77.	44.	47.	-4.	9.	-20.	92.	162.	222.	317.	191.	54.	1191.
1990	55.	43.	55.	-29.	-29.	65.	104.	75.	252.	321.	208.	125.	1244.
1991	93.	65.	56.	14.	29.	-54.	66.	107.	127.	216.	136.	79.	935.
1992	58.	58.	55.	-4.	-111.	-45.	64.	138.	188.	257.	178.	89.	924.
AVERAGE	71.	42.	17.	-82.	-55.	2.	68.	149.	214.	265.	174.	100.	967.

Appendix B

Accounting Procedure Used by the DICU Model

Output from a sample DICU model simulation is shown in Table B–1. The simulation generates monthly historic CU estimates on 142 subareas for water years 1922 through 1992. The table reports crop depletion for water year 1922 for each of the 20 land–use categories on subarea 1 (Union Island, east). The computer program maintains a soil moisture budget and calculates the contribution of rainfall, seepage, stored soil moisture, and irrigation toward consumptive use. The program is designed to compute monthly values. A detailed description of the column headings listed in Table B–1 follows (*Consumptive Use Program* 1979):

Column Explanations for DICU Model Output Table

The following definitions describe the column headings in Table B–1. The explanations pertain to the present use of the program in the Delta.

Month – represents the months of October through September in the water year under consideration.

Precipitation – represents the monthly precipitation plus seepage allocated to each subarea in inches.

Consumptive Use – estimates of monthly consumptive use of crops grown under good farm management practices.

Consumptive Use of Precipitation – the portion of precipitation plus seepage in a given month that is used directly by the plants. It does not include precipitation and seepage stored as soil moisture. The value is the smaller of precipitation plus seepage and CU.

Change in Soil Moisture – soil moisture changes in the crop rooting zone. A positive value indicates a gain in soil moisture storage and a negative value indicates a loss in storage.

Soil Moisture Accumulation – the amount of water available to plants (stored in the rooting zone) at the end of the month. Available soil moisture storage capacity is computed as 1.5 inches of water per foot of rooting depth in the Uplands and 3 inches per foot rooting depth in the Lowlands. The rooting depths are shown in the heading of each crop listing.

Consumptive Use of Applied Water – amount of applied water. When consumptive use exceeds the water available from rainfall, seepage, and soil moisture storage, additional water must be applied. During the irrigation season, the CU of applied water is computed as the algebraic sum of consumptive use and change in soil moisture less precipitation and seepage. If the result is negative, no applied water is needed and zero is shown in this column. In the model, water is also applied when the soil moisture dips below the lower limit. During the non–irrigation season, water supply to the crops is limited to the use of available rainfall and soil moisture storage only.

Total Monthly Consumptive Use – the unit area monthly effect on the water supply of a subarea caused by a particular land use. It is computed as the algebraic sum of consumptive use and change in soil moisture. The value in inches is then converted to feet to continue the computation.

Historic Area – This is the estimated land use acreage for the subarea under examination.

Historic Consumptive Use of Precipitation – This column shows the consumptive use of precipitation plus seepage in acre–feet. It is computed by multiplying the sum of precipitation plus seepage used directly by the plants plus that stored as soil moisture, by the historic acreage.

Historic Consumptive Use of Applied Water + Losses – the consumptive use of applied water plus losses in acre–feet. The loss term takes into account losses in applied water due to transporting irrigation water from natural channels to farmland. In the Delta, these losses are assumed to be zero. Therefore the values in this column are computed by multiplying the total monthly consumptive use of applied water by the historic acreage.

Total Historic Depletion – estimated monthly depletion. It is computed by multiplying the total monthly consumptive use by the historic acreage.

Projected Area – estimated future acreage of the particular land use (this option is currently not used).

Projected Consumptive Use – estimated future level of monthly consumptive use (this option is currently not used).

Bookkeeping Procedure for Irrigated Pasture

The user must declare in the input data which months are irrigation months and which are non–irrigation months. Applied water is allowed to satisfy consumptive use only in irrigation months. If, during a non–irrigation month, precipitation, seepage, and soil moisture are not enough to meet the ET demand, then the ET demand is not satisfied. In Table B–1, November through February were declared irrigation months for irrigated pasture during non–critical water years. If the ET demand is fully met by precipitation, any excess precipitation is available to be stored in the soil and used later. The quantity of water stored as soil moisture is limited to that needed to bring the soil moisture storage to the maximum level prescribed for that month. In Table B–1, total monthly CU is reported in both inches and feet. These CU values, when multiplied by the historic acreage and the projected acreage yield values for historic depletion and projected consumptive use. The projected area is the estimated crop acreage at some future time, say 1995 or 2000. However, the projected values are not currently being used since projecting land use on each of 142 subareas is infeasible. See Chapter 6 for details on the source of projected consumptive estimates.

To aid in understanding the DICU soil moisture bookkeeping, a step–by–step explanation of the assumptions and mathematics used to generate Table B–1 is provided.

Table B–1. DICU Model Output: Bookkeeping for Subarea 1, *page 1 of 5*

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED PASTURE — EFF. ROOT DEPTH 2.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	0.66	3.67	0.66	1.00	4.00	4.01	4.67	0.39	10.	1.	3.	4.	0.	0.
NOV	1.83	1.09	1.09	0.74	4.74	0.00	1.83	0.15	10.	2.	0.	2.	0.	0.
DEC	2.84	0.68	0.68	1.26	6.00	0.00	1.94	0.16	10.	2.	0.	2.	0.	0.
JAN	3.01	0.80	0.80	0.00	6.00	0.00	0.80	0.07	10.	1.	0.	1.	0.	0.
FEB	3.43	1.38	1.38	0.00	6.00	0.00	1.38	0.12	10.	1.	0.	1.	0.	0.
MAR	1.50	2.51	1.50	0.00	6.00	1.01	2.51	0.21	10.	1.	1.	2.	0.	0.
APR	1.18	3.77	1.18	0.00	6.00	2.59	3.77	0.31	10.	1.	2.	3.	0.	0.
MAY	1.11	6.66	1.11	-1.00	5.00	4.55	5.66	0.47	10.	1.	4.	5.	0.	0.
JUN	0.61	6.78	0.61	-0.50	4.50	5.67	6.28	0.52	10.	1.	5.	5.	0.	0.
JUL	0.60	6.76	0.60	-0.50	4.00	5.66	6.26	0.52	10.	0.	5.	5.	0.	0.
AUG	0.60	6.20	0.60	-0.50	3.50	5.10	5.70	0.48	10.	0.	4.	5.	0.	0.
SEP	0.60	4.56	0.60	-0.50	3.00	3.46	4.06	0.34	10.	0.	3.	3.	0.	0.
TOTAL	17.97	44.87	10.81	3.00		32.06	44.87	3.74		11.	27.	37.		0.

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED ALFALFA — EFF. ROOT DEPTH 4.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.26	3.67	1.26	0.00	6.00	2.41	3.67	0.31	2223.	233.	446.	679.	0.	0.
NOV	2.43	1.09	1.09	1.34	7.34	0.00	2.43	0.20	2223.	450.	0.	450.	0.	0.
DEC	3.44	0.68	0.68	2.76	10.10	0.00	3.44	0.29	2223.	637.	0.	637.	0.	0.
JAN	3.61	0.80	0.80	1.90	12.00	0.00	2.70	0.22	2223.	500.	0.	500.	0.	0.
FEB	4.03	1.38	1.38	0.00	12.00	0.00	1.38	0.12	2223.	256.	0.	256.	0.	0.
MAR	2.10	2.51	2.10	0.00	12.00	0.41	2.51	0.21	2223.	389.	76.	465.	0.	0.
APR	1.78	3.77	1.78	-1.00	11.00	0.99	2.77	0.23	2223.	330.	184.	514.	0.	0.
MAY	1.71	6.66	1.71	-1.00	10.00	3.95	5.66	0.47	2223.	317.	731.	1048.	0.	0.
JUN	1.21	6.78	1.21	-1.00	9.00	4.57	5.78	0.48	2223.	224.	847.	1071.	0.	0.
JUL	1.20	6.76	1.20	-1.00	8.00	4.56	5.76	0.48	2223.	222.	845.	1068.	0.	0.
AUG	1.20	6.20	1.20	-1.00	7.00	4.00	5.20	0.43	2223.	222.	742.	964.	0.	0.
SEP	1.20	4.56	1.20	-1.00	6.00	2.36	3.56	0.30	2223.	222.	437.	659.	0.	0.
TOTAL	25.17	44.87	15.61	6.00		23.26	44.87	3.74		4003.	4309.	8311.		0.

WATER YEAR 1922

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED FIELD — EFF. ROOT DEPTH 2.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	0.66	1.44	0.66	-0.78	1.22	0.00	0.66	0.06	618.	34.	0.	34.	0.	0.
NOV	1.83	0.86	0.86	0.97	2.19	0.00	1.83	0.15	618.	94.	0.	94.	0.	0.
DEC	2.84	0.68	0.68	2.16	4.35	0.00	2.84	0.24	618.	146.	0.	146.	0.	0.
JAN	3.01	0.80	0.80	1.65	6.00	0.00	2.44	0.20	618.	126.	0.	126.	0.	0.
FEB	3.43	1.38	1.38	0.00	6.00	0.00	1.38	0.12	618.	71.	0.	71.	0.	0.
MAR	1.50	1.58	1.50	-0.08	5.92	0.00	1.50	0.12	618.	77.	0.	77.	0.	0.
APR	1.18	1.47	1.18	-0.29	5.63	0.00	1.18	0.10	618.	61.	0.	61.	0.	0.
MAY	1.11	3.15	1.11	-1.63	4.00	0.41	1.52	0.13	618.	57.	21.	78.	0.	0.
JUN	0.61	5.83	0.61	1.00	5.00	6.22	6.83	0.57	618.	31.	320.	352.	0.	0.
JUL	0.60	6.50	0.60	0.00	5.00	5.90	6.50	0.54	618.	31.	304.	335.	0.	0.
AUG	0.60	4.61	0.60	-2.00	3.00	2.01	2.61	0.22	618.	31.	103.	134.	0.	0.
SEP	0.60	2.09	0.60	-1.00	2.00	0.49	1.09	0.09	618.	31.	25.	56.	0.	0.
TOTAL	17.97	30.38	10.57	5.78		15.02	30.38	2.53		791.	774.	1564.		0.

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED SUGAR BEETS — EFF. ROOT DEPTH 4.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.26	3.01	1.26	0.00	7.00	1.75	3.01	0.25	57.	6.	8.	14.	0.	0.
NOV	2.43	0.86	0.86	1.57	8.57	0.00	2.43	0.20	57.	12.	0.	12.	0.	0.
DEC	3.44	0.68	0.68	2.76	11.33	0.00	3.44	0.29	57.	16.	0.	16.	0.	0.
JAN	3.61	0.80	0.80	0.67	12.00	0.00	1.46	0.12	57.	7.	0.	7.	0.	0.
FEB	4.03	1.38	1.38	0.00	12.00	0.00	1.38	0.12	57.	7.	0.	7.	0.	0.
MAR	2.10	1.58	1.58	0.00	12.00	0.00	1.58	0.13	57.	8.	0.	8.	0.	0.
APR	1.78	1.20	1.20	0.00	12.00	0.00	1.20	0.10	57.	6.	0.	6.	0.	0.
MAY	1.71	3.87	1.71	-0.50	11.50	1.66	3.37	0.28	57.	8.	8.	16.	0.	0.
JUN	1.21	6.36	1.21	-0.50	11.00	4.65	5.86	0.49	57.	6.	22.	28.	0.	0.
JUL	1.20	7.03	1.20	-1.00	10.00	4.83	6.03	0.50	57.	6.	23.	29.	0.	0.
AUG	1.20	6.20	1.20	-2.00	8.00	3.00	4.20	0.35	57.	6.	14.	20.	0.	0.
SEP	1.20	4.56	1.20	-1.00	7.00	2.36	3.56	0.30	57.	6.	11.	17.	0.	0.
TOTAL	25.17	37.53	14.27	5.00		18.26	37.53	3.13		92.	87.	178.		0.

WATER YEAR 1922

Table B–1. DICU Model Output: Bookkeeping for Subarea 1, *page 2 of 5*

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED GRAIN

EFF. ROOT DEPTH 2.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	0.66	1.31	0.66	-0.65	0.35	0.00	0.66	0.06	1777.	98.	0.	98.	0.	0.
NOV	1.83	0.86	0.86	0.97	1.32	0.00	1.83	0.15	1777.	271.	0.	271.	0.	0.
DEC	2.84	0.68	0.68	2.16	3.48	0.00	2.84	0.24	1777.	421.	0.	421.	0.	0.
JAN	3.01	0.80	0.80	2.21	5.70	0.00	3.01	0.25	1777.	446.	0.	446.	0.	0.
FEB	3.43	1.38	1.38	0.30	6.00	0.00	1.68	0.14	1777.	249.	0.	249.	0.	0.
MAR	1.50	2.51	1.50	-1.01	4.99	0.00	1.50	0.12	1777.	222.	0.	222.	0.	0.
APR	1.18	4.23	1.18	-3.05	1.94	0.00	1.18	0.10	1777.	175.	0.	175.	0.	0.
MAY	1.11	6.05	1.11	-1.94	0.00	3.00	4.11	0.34	1777.	164.	445.	609.	0.	0.
JUN	0.61	2.33	0.61	0.00	0.00	0.00	0.61	0.05	1777.	90.	0.	90.	0.	0.
JUL	0.60	0.89	0.60	0.00	0.00	0.00	0.60	0.05	1777.	89.	0.	89.	0.	0.
AUG	0.60	0.94	0.60	0.00	0.00	0.00	0.60	0.05	1777.	89.	0.	89.	0.	0.
SEP	0.60	0.95	0.60	0.00	0.00	0.00	0.60	0.05	1777.	89.	0.	89.	0.	0.
TOTAL	17.97	22.93	10.57	5.65		3.00	19.23	1.60		2403.	445.	2847.		0.

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED RICE

EFF. ROOT DEPTH 1.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	0.36	2.49	0.36	-2.00	1.00	0.00	0.36	0.03	0.	0.	0.	0.	0.	0.
NOV	1.53	1.09	1.09	0.44	1.44	0.00	1.53	0.13	0.	0.	0.	0.	0.	0.
DEC	2.54	0.68	0.68	1.56	3.00	0.00	2.24	0.19	0.	0.	0.	0.	0.	0.
JAN	2.71	0.80	0.80	0.00	3.00	0.00	0.80	0.07	0.	0.	0.	0.	0.	0.
FEB	3.13	1.38	1.38	0.00	3.00	0.00	1.38	0.12	0.	0.	0.	0.	0.	0.
MAR	1.20	1.95	1.20	-0.75	2.25	0.00	1.20	0.10	0.	0.	0.	0.	0.	0.
APR	0.88	1.93	0.88	6.75	9.00	7.80	8.68	0.72	0.	0.	0.	0.	0.	0.
MAY	0.81	7.74	0.81	1.50	10.50	8.43	9.24	0.77	0.	0.	0.	0.	0.	0.
JUN	0.31	8.69	0.31	1.50	12.00	9.88	10.19	0.85	0.	0.	0.	0.	0.	0.
JUL	0.30	8.63	0.30	0.00	12.00	8.33	8.63	0.72	0.	0.	0.	0.	0.	0.
AUG	0.30	7.90	0.30	-1.50	10.50	6.10	6.40	0.53	0.	0.	0.	0.	0.	0.
SEP	0.30	5.13	0.00	-7.50	3.00	0.00	0.00	0.00	0.	0.	0.	0.	0.	0.
TOTAL	14.37	48.42	8.11	11.75		40.55	50.66	4.22		0.	0.	0.		0.

SEPT. RICE DRAINAGE = 0. 0.

WATER YEAR 1922

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED TRUCK

EFF. ROOT DEPTH 4.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.26	1.31	1.26	-0.05	5.95	0.00	1.26	0.10	1321.	139.	0.	139.	0.	0.
NOV	2.43	0.86	0.86	1.57	7.52	0.00	2.43	0.20	1321.	268.	0.	268.	0.	0.
DEC	3.44	0.68	0.68	2.76	10.28	0.00	3.44	0.29	1321.	379.	0.	379.	0.	0.
JAN	3.61	0.80	0.80	1.72	12.00	0.00	2.51	0.21	1321.	277.	0.	277.	0.	0.
FEB	4.03	1.38	1.38	0.00	12.00	0.00	1.38	0.12	1321.	152.	0.	152.	0.	0.
MAR	2.10	1.49	1.49	0.00	12.00	0.00	1.49	0.12	1321.	164.	0.	164.	0.	0.
APR	1.78	1.20	1.20	0.00	12.00	0.00	1.20	0.10	1321.	132.	0.	132.	0.	0.
MAY	1.71	3.87	1.71	0.00	12.00	2.16	3.87	0.32	1321.	188.	238.	426.	0.	0.
JUN	1.21	6.78	1.21	0.00	12.00	5.57	6.78	0.57	1321.	133.	614.	747.	0.	0.
JUL	1.20	7.39	1.20	-2.00	10.00	4.19	5.39	0.45	1321.	132.	461.	593.	0.	0.
AUG	1.20	5.17	1.20	-2.00	8.00	1.97	3.17	0.26	1321.	132.	217.	349.	0.	0.
SEP	1.20	1.62	1.20	-0.41	7.59	0.00	1.20	0.10	1321.	132.	0.	132.	0.	0.
TOTAL	25.17	32.54	14.18	6.05		13.89	34.12	2.84		2227.	1529.	3756.		0.

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED TOMATOES

EFF. ROOT DEPTH 4.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.26	1.31	1.26	-0.05	5.95	0.00	1.26	0.10	2974.	312.	0.	312.	0.	0.
NOV	2.43	0.86	0.86	1.57	7.52	0.00	2.43	0.20	2974.	602.	0.	602.	0.	0.
DEC	3.44	0.68	0.68	2.76	10.28	0.00	3.44	0.29	2974.	853.	0.	853.	0.	0.
JAN	3.61	0.80	0.80	1.72	12.00	0.00	2.51	0.21	2974.	623.	0.	623.	0.	0.
FEB	4.03	1.38	1.38	0.00	12.00	0.00	1.38	0.12	2974.	342.	0.	342.	0.	0.
MAR	2.10	1.49	1.49	0.00	12.00	0.00	1.49	0.12	2974.	369.	0.	369.	0.	0.
APR	1.78	1.20	1.20	0.00	12.00	0.00	1.20	0.10	2974.	296.	0.	296.	0.	0.
MAY	1.71	3.87	1.71	0.00	12.00	2.16	3.87	0.32	2974.	424.	536.	960.	0.	0.
JUN	1.21	6.78	1.21	0.00	12.00	5.57	6.78	0.57	2974.	300.	1381.	1681.	0.	0.
JUL	1.20	7.39	1.20	-2.00	10.00	4.19	5.39	0.45	2974.	297.	1038.	1335.	0.	0.
AUG	1.20	5.17	1.20	-2.00	8.00	1.97	3.17	0.26	2974.	297.	488.	786.	0.	0.
SEP	1.20	1.62	1.20	-0.41	7.59	0.00	1.20	0.10	2974.	297.	0.	297.	0.	0.
TOTAL	25.17	32.54	14.18	6.05		13.89	34.12	2.84		5013.	3443.	8456.		0.

WATER YEAR 1922

Table B–1. DICU Model Output: Bookkeeping for Subarea 1, *page 3 of 5*

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED ORCHARD — EFF. ROOT DEPTH 5.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.56	3.27	1.56	0.00	9.00	1.71	3.27	0.27	447.	58.	64.	122.	0.	0.
NOV	2.73	0.94	0.94	1.79	10.79	0.00	2.73	0.23	447.	102.	0.	102.	0.	0.
DEC	3.74	0.68	0.68	3.06	13.86	0.00	3.74	0.31	447.	139.	0.	139.	0.	0.
JAN	3.91	0.80	0.80	1.14	15.00	0.00	1.94	0.16	447.	72.	0.	72.	0.	0.
FEB	4.33	1.38	1.38	0.00	15.00	0.00	1.38	0.12	447.	51.	0.	51.	0.	0.
MAR	2.40	1.58	1.58	0.00	15.00	0.00	1.58	0.13	447.	59.	0.	59.	0.	0.
APR	2.08	2.48	2.08	-0.40	14.60	0.00	2.08	0.17	447.	77.	0.	77.	0.	0.
MAY	2.01	5.93	2.01	-1.10	13.50	2.82	4.83	0.40	447.	75.	105.	180.	0.	0.
JUN	1.51	6.25	1.51	-0.50	13.00	4.24	5.75	0.48	447.	56.	158.	214.	0.	0.
JUL	1.50	6.23	1.50	-1.00	12.00	3.73	5.23	0.44	447.	56.	139.	195.	0.	0.
AUG	1.50	5.73	1.50	-2.00	10.00	2.23	3.73	0.31	447.	56.	83.	139.	0.	0.
SEP	1.50	4.18	1.50	-1.00	9.00	1.68	3.18	0.26	447.	56.	63.	118.	0.	0.
TOTAL	28.77	39.46	17.03	6.00		16.43	39.46	3.29		858.	612.	1470.		0.

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED VINEYARD — EFF. ROOT DEPTH 4.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.26	1.44	1.26	-0.18	7.82	0.00	1.26	0.10	0.	0.	0.	0.	0.	0.
NOV	2.43	0.86	0.86	1.57	9.39	0.00	2.43	0.20	0.	0.	0.	0.	0.	0.
DEC	3.44	0.68	0.68	2.61	12.00	0.00	3.29	0.27	0.	0.	0.	0.	0.	0.
JAN	3.61	0.80	0.80	0.00	12.00	0.00	0.80	0.07	0.	0.	0.	0.	0.	0.
FEB	4.03	1.38	1.38	0.00	12.00	0.00	1.38	0.12	0.	0.	0.	0.	0.	0.
MAR	2.10	1.58	1.58	0.00	12.00	0.00	1.58	0.13	0.	0.	0.	0.	0.	0.
APR	1.78	1.38	1.38	0.00	12.00	0.00	1.38	0.12	0.	0.	0.	0.	0.	0.
MAY	1.71	4.36	1.71	0.00	12.00	2.65	4.36	0.36	0.	0.	0.	0.	0.	0.
JUN	1.21	5.19	1.21	-1.00	11.00	2.98	4.19	0.35	0.	0.	0.	0.	0.	0.
JUL	1.20	5.70	1.20	-1.00	10.00	3.50	4.70	0.39	0.	0.	0.	0.	0.	0.
AUG	1.20	4.98	1.20	-1.00	9.00	2.78	3.98	0.33	0.	0.	0.	0.	0.	0.
SEP	1.20	3.42	1.20	-1.00	8.00	1.22	2.42	0.20	0.	0.	0.	0.	0.	0.
TOTAL	25.17	31.76	14.45	4.18		13.13	31.76	2.65		0.	0.	0.		0.

WATER YEAR 1922

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED SAFFLOWER — EFF. ROOT DEPTH 4.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.26	2.49	1.26	0.00	0.00	0.00	1.26	0.10	580.	61.	0.	61.	0.	0.
NOV	2.43	1.17	1.17	1.26	1.26	0.00	2.43	0.20	580.	117.	0.	117.	0.	0.
DEC	3.44	1.13	1.13	2.31	3.57	0.00	3.44	0.29	580.	166.	0.	166.	0.	0.
JAN	3.61	0.80	0.80	2.81	6.38	0.00	3.61	0.30	580.	174.	0.	174.	0.	0.
FEB	4.03	1.38	1.38	2.65	9.03	0.00	4.03	0.34	580.	195.	0.	195.	0.	0.
MAR	2.10	1.77	1.77	2.97	12.00	2.64	4.74	0.39	580.	101.	127.	229.	0.	0.
APR	1.78	2.30	1.78	-0.52	11.48	0.00	1.78	0.15	580.	86.	0.	86.	0.	0.
MAY	1.71	5.81	1.71	-1.48	10.00	0.00	1.71	0.14	580.	83.	0.	83.	0.	0.
JUN	1.21	9.22	1.21	-4.00	6.00	0.00	1.21	0.10	580.	58.	0.	58.	0.	0.
JUL	1.20	6.85	1.20	-3.00	3.00	0.00	1.20	0.10	580.	58.	0.	58.	0.	0.
AUG	1.20	4.14	1.20	-2.94	0.06	0.00	1.20	0.10	580.	58.	0.	58.	0.	0.
SEP	1.20	2.38	1.20	-0.06	0.00	0.00	1.20	0.10	580.	58.	0.	58.	0.	0.
TOTAL	25.17	39.43	15.80	12.00		2.64	27.81	2.32		1217.	127.	1344.		0.

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7

IRRIGATED CORN — EFF. ROOT DEPTH 3.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	TOTAL MONTHLY C. U. FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	0.96	1.44	0.96	-0.48	1.52	0.00	0.96	0.08	827.	66.	0.	66.	0.	0.
NOV	2.13	0.86	0.86	1.27	2.79	0.00	2.13	0.18	827.	147.	0.	147.	0.	0.
DEC	3.14	0.68	0.68	2.46	5.25	0.00	3.14	0.26	827.	216.	0.	216.	0.	0.
JAN	3.31	0.80	0.80	2.51	7.77	0.00	3.31	0.28	827.	228.	0.	228.	0.	0.
FEB	3.73	1.38	1.38	1.23	9.00	0.00	2.61	0.22	827.	180.	0.	180.	0.	0.
MAR	1.80	1.58	1.58	0.00	9.00	0.00	1.58	0.13	827.	109.	0.	109.	0.	0.
APR	1.48	1.47	1.47	0.00	9.00	0.00	1.47	0.12	827.	101.	0.	101.	0.	0.
MAY	1.41	3.15	1.41	-1.74	7.26	0.00	1.41	0.12	827.	97.	0.	97.	0.	0.
JUN	0.91	5.83	0.91	-2.26	5.00	2.66	3.57	0.30	827.	63.	183.	246.	0.	0.
JUL	0.90	6.50	0.90	0.00	5.00	5.60	6.50	0.54	827.	62.	386.	448.	0.	0.
AUG	0.90	4.61	0.90	-2.00	3.00	1.71	2.61	0.22	827.	62.	118.	180.	0.	0.
SEP	0.90	2.09	0.90	-1.00	2.00	0.19	1.09	0.09	827.	62.	13.	75.	0.	0.
TOTAL	21.57	30.38	12.75	7.48		10.15	30.38	2.53		1394.	699.	2093.		0.

WATER YEAR 1922

Table B-1. DICU Model Output: Bookkeeping for Subarea 1, *page 4 of 5*

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7
IRRIGATED NI PASTURE
EFF. ROOT DEPTH 2.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	0.66	3.67	0.66	0.00	0.00	0.00	0.66	0.06	0.	0.	0.	0.	0.	0.
NOV	1.83	1.09	1.09	0.74	0.74	0.00	1.83	0.15	0.	0.	0.	0.	0.	0.
DEC	2.84	0.68	0.68	2.16	2.90	0.00	2.84	0.24	0.	0.	0.	0.	0.	0.
JAN	3.01	0.80	0.80	2.21	5.11	0.00	3.01	0.25	0.	0.	0.	0.	0.	0.
FEB	3.43	1.38	1.38	0.89	6.00	0.00	2.27	0.19	0.	0.	0.	0.	0.	0.
MAR	1.50	2.51	1.50	-1.01	4.99	0.00	1.50	0:12	0.	0.	0.	0.	0.	0.
APR	1.18	3.77	1.18	-2.59	2.40	0.00	1.18	0.10	0.	0.	0.	0.	0.	0.
MAY	1.11	6.66	1.11	-2.40	0.00	0.00	1.11	0.09	0.	0.	0.	0.	0.	0.
JUN	0.61	6.78	0.61	0.00	0.00	0.00	0.61	0.05	0.	0.	0.	0.	0.	0.
JUL	0.60	6.76	0.60	0.00	0.00	0.00	0.60	0.05	0.	0.	0.	0.	0.	0.
AUG	0.60	6.20	0.60	0.00	0.00	0.00	0.60	0.05	0.	0.	0.	0.	0.	0.
SEP	0.60	4.56	0.60	0.00	0.00	0.00	0.60	0.05	0.	0.	0.	0.	0.	0.
TOTAL	17.97	44.87	10.81	6.00		0.00	16.81	1.40		0.	0.	0.		0.

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) · 1 1 7
IRRIGATED NI VINEYARD
EFF. ROOT DEPTH 4.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.26	1.44	1.26	0.00	0.00	0.00	1.26	0.10	0.	0.	0.	0.	0.	0.
NOV	2.43	0.86	0.86	1.57	1.57	0.00	2.43	0.20	0.	0.	0.	0.	0.	0.
DEC	3.44	0.68	0.68	2.76	4.33	0.00	3.44	0.29	0.	0.	0.	0.	0.	0.
JAN	3.61	0.80	0.80	2.81	7.15	0.00	3.61	0.30	0.	0.	0.	0.	0.	0.
FEB	4.03	1.38	1.38	2.65	9.80	0.00	4.03	0.34	0.	0.	0.	0.	0.	0.
MAR	2.10	1.58	1.58	0.52	10.31	0.00	2.10	0.17	0.	0.	0.	0.	0.	0.
APR	1.78	1.38	1.38	0.40	10.71	0.00	1.78	0.15	0.	0.	0.	0.	0.	0.
MAY	1.71	4.36	1.71	-2.65	8.07	0.00	1.71	0.14	0.	0.	0.	0.	0.	0.
JUN	1.21	5.19	1.21	-3.98	4.08	0.00	1.21	0.10	0.	0.	0.	0.	0.	0.
JUL	1.20	5.70	1.20	-4.08	0.00	0.00	1.20	0.10	0.	0.	0.	0.	0.	0.
AUG	1.20	4.98	1.20	0.00	0.00	0.00	1.20	0.10	0.	0.	0.	0.	0.	0.
SEP	1.20	3.42	1.20	0.00	0.00	0.00	1.20	0.10	0.	0.	0.	0.	0.	0.
TOTAL	25.17	31.76	14.45	10.71		0.00	25.17	2.10		0.	0.	0.		0.

WATER YEAR 1922

AREA 1 CROP DEPLETION ANALYSIS
UNION ISLAND (EAST) 1 1 7
IRRIGATED NI ORCHARD
EFF. ROOT DEPTH 5.0 FT.

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	CONSUMP. USE OF APPLIED WATER INCHES	TOTAL MONTHLY C. U. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HIST. CUA + LOSSES AF	TOTAL HISTORIC DEPLET. AF	2000 LEVEL AREA ACRES	2000 LEVEL CONSUMP. USE AF
OCT	1.56	3.27	1.56	0.00	0.00	0.00	1.56	0.13	0.	0.	0.	0.	0.	0.
NOV	2.73	0.94	0.94	1.79	1.79	0.00	2.73	0.23	0.	0.	0.	0.	0.	0.
DEC	3.74	0.68	0.68	3.06	4.86	0.00	3.74	0.31	0.	0.	0.	0.	0.	0.
JAN	3.91	0.80	0.80	3.11	7.97	0.00	3.91	0.33	0.	0.	0.	0.	0.	0.
FEB	4.33	1.38	1.38	2.95	10.92	0.00	4.33	0.36	0.	0.	0.	0.	0.	0.
MAR	2.40	1.58	1.58	0.82	11.74	0.00	2.40	0.20	0.	0.	0.	0.	0.	0.
APR	2.08	2.48	2.08	-0.40	11.33	0.00	2.08	0.17	0.	0.	0.	0.	0.	0.
MAY	2.01	5.93	2.01	-3.92	7.41	0.00	2.01	0.17	0.	0.	0.	0.	0.	0.
JUN	1.51	6.25	1.51	-4.74	2.67	0.00	1.51	0.13	0.	0.	0.	0.	0.	0.
JUL	1.50	6.23	1.50	-2.67	0.00	0.00	1.50	0.12	0.	0.	0.	0.	0.	0.
AUG	1.50	5.73	1.50	0.00	0.00	0.00	1.50	0.12	0.	0.	0.	0.	0.	0.
SEP	1.50	4.18	1.50	0.00	0.00	0.00	1.50	0.12	0.	0.	0.	0.	0.	0.
TOTAL	28.77	39.46	17.03	11.74		0.00	28.77	2.40		0.	0.	0.		0.

WATER YEAR 1922

AREA 1 HAY AND GRAIN DEPLETION ANALYSIS EFF. ROOT DEPTH 2.00 FT.

MONTH	PRECIP AND SEEP INCHES	TOTAL CONSUMP. USE INCHES	CU OF SEEP AND PRECIP INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	MONTHLY DEPLET. IN.	FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE AF	PROJECTD AREA ACRES	PROJECTD CONSUMP. USE AF
OCT	0.66	1.31	0.66	0.00	0.00	0.66	0.06	228.	13.	0.	0.
NOV	1.83	0.86	0.86	0.97	0.97	1.83	0.15	228.	35.	0.	0.
DEC	2.84	0.68	0.68	2.16	3.13	2.84	0.24	228.	54.	0.	0.
JAN	3.01	0.80	0.80	2.21	5.35	3.01	0.25	228.	57.	0.	0.
FEB	3.43	1.38	1.38	0.65	6.00	2.03	0.17	228.	39.	0.	0.
MAR	1.50	2.51	1.50	-1.01	4.99	1.50	0.12	228.	28.	0.	0.
APR	1.18	4.23	1.18	-3.05	1.94	1.18	0.10	228.	22.	0.	0.
MAY	1.11	6.05	1.11	-1.94	0.00	1.11	0.09	228.	21.	0.	0.
JUN	0.61	2.33	0.61	0.00	0.00	0.61	0.05	228.	12.	0.	0.
JUL	0.60	0.89	0.60	0.00	0.00	0.60	0.05	228.	11.	0.	0.
AUG	0.60	0.94	0.60	0.00	0.00	0.60	0.05	228.	11.	0.	0.
SEP	0.60	0.95	0.60	0.00	0.00	0.60	0.05	228.	11.	0.	0.
TOTAL	17.97	22.93	10.57	6.00		16.57	1.38		315.		0.

Table B–1. DICU Model Output: Bookkeeping for Subarea 1, *page 5 of 5*

NATIVE VEGETATION DEPLETION ANALYSIS
EFF. ROOT DEPTH 2.5

MONTH	PRECIP. INCHES	CONSUMP. USE INCHES	CONSUMP. USE OF PRECIP. INCHES	CHANGE IN SOIL MOISTURE INCHES	SOIL MOISTURE ACCUM. INCHES	MONTHLY DEPLETION IN.	MONTHLY DEPLETION FT.	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE AF	2000 LEVEL AREA ACRES	PROJECTD CONSUMP. USE AF
OCT	0.81	3.67	0.81	0.00	0.00	0.81	0.07	1008.	100.	12170.	800.
NOV	1.98	1.09	1.09	0.89	0.89	1.98	0.17	1008.	200.	12170.	2000.
DEC	2.99	0.68	0.68	2.31	3.20	2.99	0.25	1008.	300.	12170.	3000.
JAN	3.16	0.80	0.80	2.36	5.56	3.16	0.26	1008.	300.	12170.	3200.
FEB	3.58	1.38	1.38	1.94	7.50	3.32	0.28	1008.	300.	12170.	3400.
MAR	1.65	2.51	1.65	-0.86	6.64	1.65	0.14	1008.	100.	12170.	1700.
APR	1.33	3.77	1.33	-2.44	4.20	1.33	0.11	1008.	100.	12170.	1300.
MAY	1.26	6.66	1.26	-4.20	0.00	1.26	0.10	1008.	100.	12170.	1300.
JUN	0.76	6.78	0.76	0.00	0.00	0.76	0.06	1008.	100.	12170.	800.
JUL	0.75	6.76	0.75	0.00	0.00	0.75	0.06	1008.	100.	12170.	800.
AUG	0.75	6.20	0.75	0.00	0.00	0.75	0.06	1008.	100.	12170.	800.
SEP	0.75	4.56	0.75	0.00	0.00	0.75	0.06	1008.	100.	12170.	800.
TOTAL	19.77	44.87	12.01	7.50		19.51	1.63		1900.		19900.

AREA 1 RIPARIAN VEGETATION DEPLETION ANALYSIS

MONTH	PRECIP AND SEEP INCHES	TOTAL CONSUMP. USE INCHES	CU OF SEEP AND PRECIP INCHES	RESIDUAL CU TO BE MET FROM INFLOW INCHES	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HISTORIC RESIDUAL CONSUMP. USE AF	PROJECTED AREA ACRES	PROJ ECTD CONSUMP. USE OF PRECIP. AF	PROJECT RESIDUAL CONSUMP. USE AF
OCT	0.06	4.85	0.06	4.79	10.	0.	4.	0.	0.	0.
NOV	1.23	1.33	1.23	0.10	10.	1.	0.	0.	0.	0.
DEC	2.24	1.02	1.02	0.00	10.	1.	0.	0.	0.	0.
JAN	2.41	1.14	1.14	0.00	10.	1.	0.	0.	0.	0.
FEB	2.83	1.75	1.75	0.00	10.	1.	0.	0.	0.	0.
MAR	0.90	3.16	0.90	2.26	10.	1.	2.	0.	0.	0.
APR	0.58	4.69	0.58	4.11	10.	0.	3.	0.	0.	0.
MAY	0.51	8.35	0.51	7.84	10.	0.	7.	0.	0.	0.
JUN	0.01	8.37	0.01	8.36	10.	0.	7.	0.	0.	0.
JUL	0.00	8.01	0.00	8.01	10.	0.	7.	0.	0.	0.
AUG	0.00	7.52	0.00	7.52	10.	0.	6.	0.	0.	0.
SEP	0.00	5.61	0.00	5.61	10.	0.	5.	0.	0.	0.
TOTAL	10.77	55.79	7.20	48.60		6.	40.		0.	0.

AREA 1 WATER SURFACE DEPLETION ANALYSIS

MONTH	PRECIP AND SEEP INCHES	TOTAL CONSUMP. USE INCHES	CU OF SEEP AND PRECIP INCHES	RESIDUAL CU TO BE MET FROM INFLOW INCHES	HISTORIC AREA ACRES	HISTORIC CONSUMP. USE OF PRECIP. AF	HISTORIC RESIDUAL CONSUMP. USE AF	PROJECTED AREA ACRES	PROJ ECTD CONSUMP. USE OF PRECIP. AF	PROJECT RESIDUAL CONSUMP. USE AF
OCT	0.06	4.85	0.06	4.79	80.	0.	32.	0.	0.	0.
NOV	1.23	1.33	1.23	0.10	80.	8.	1.	0.	0.	0.
DEC	2.24	1.02	1.02	0.00	80.	7.	0.	0.	0.	0.
JAN	2.41	1.14	1.14	0.00	80.	8.	0.	0.	0.	0.
FEB	2.83	1.75	1.75	0.00	80.	12.	0.	0.	0.	0.
MAR	0.90	3.16	0.90	2.26	80.	6.	15.	0.	0.	0.
APR	0.58	4.69	0.58	4.11	80.	4.	27.	0.	0.	0.
MAY	0.51	8.35	0.51	7.84	80.	3.	52.	0.	0.	0.
JUN	0.01	8.37	0.01	8.36	80.	0.	56.	0.	0.	0.
JUL	0.00	8.01	0.00	8.01	80.	0.	53.	0.	0.	0.
AUG	0.00	7.52	0.00	7.52	80.	0.	50.	0.	0.	0.
SEP	0.00	5.61	0.00	5.61	80.	0.	37.	0.	0.	0.
TOTAL	10.77	55.79	7.20	48.60		48.	324.		0.	0.

WATER YEAR 1922

AREA 1 UNION ISLAND (EAST) 1 1 7 STUDYDICU5-1MAR92

URBAN CONSUMPTIVE USE — TOTAL BASIN CONSUMPTIVE USE SUMMARY

MONTH	HIST. URBAN AREA ACRES	HIST. CU OF PRECIP AF	HISTORIC DEPL. OF APPLIED WATER AF	HIST. TOTAL DEPL. AF	LEVEL URBAN AREA ACRES	URBAN CONSUMP. USE AF	BASIN PRECIP AF	HISTORIC AF	2000 LEVEL AF
OCT	10.	0.	1.	1.	0.	0.	100.	1636.	800.
NOV	10.	1.	0.	1.	0.	0.	1200.	2310.	2000.
DEC	10.	1.	0.	1.	0.	0.	2300.	3308.	3000.
JAN	10.	1.	0.	1.	0.	0.	2400.	2809.	3200.
FEB	10.	1.	0.	1.	0.	0.	2900.	1813.	3400.
MAR	10.	1.	0.	1.	0.	0.	900.	1824.	1700.
APR	10.	1.	1.	1.	0.	0.	600.	1635.	1300.
MAY	10.	1.	1.	2.	0.	0.	500.	3663.	1300.
JUN	10.	0.	1.	2.	0.	0.	0.	4663.	800.
JUL	10.	0.	1.	2.	0.	0.	0.	4360.	800.
AUG	10.	0.	1.	1.	0.	0.	0.	2856.	800.
SEP	10.	0.	1.	1.	0.	0.	0.	1642.	800.
TOTAL		9.	7.	15.		0.	10900.	32518.	19900.

WATER YEAR 1922

The example below covers only irrigated pasture on Union Island east, for one year. Keep in mind that the bookkeeping method is repeated for each of the 20 land use categories on each of the 142 Delta subareas for water year 1922 through the present water year.

October. After reading in all of the input data, the computer program began with average monthly demands of crop consumptive use (CU) in inches. Table B–1, "Crop Depletion Analysis – Irrigated Pasture", lists the CU demand for October as 3.67 inches in column 3 under "Consumptive Use." The program first supplied this demand with available precipitation and seepage. Even though seepage is not shown in the column heading, it is added to the precipitation and the sum is listed in column 2 as 0.66 inches. The amount of water supplied from precipitation is shown in column 4, "Consumptive Use of Precipitation" and becomes part of column 8, "Total Monthly CU." If the crop CU demand for each month cannot be fully supplied by precipitation, additional water can be supplied from previously stored soil moisture. In October, no soil moisture was available for irrigated pasture. Moreover, the storage had to be increased by 1.00 inches to an October minimum of 4.00 inches (for irrigated pasture in the Lowlands). Therefore the unmet crop CU demand and the increase in soil moisture had to be supplied by irrigation (because October is part of the irrigation season). The demand for applied water during October is then calculated as:

	3.67 inches CU Demand
minus	0.66 inches precipitation plus seepage
plus	1.00 inches for soil moisture
equals	4.01 inches applied water.

The applied water is shown in column 7 of Table B–1. The total monthly consumptive use in October became:

	0.66 inches precipitation
plus	4.01 inches applied water
equals	4.67 inches total monthly CU

November. In Table B–1, November had 1.83 inches of precipitation, which was enough to meet the CU demand for pasture of 1.09 inches. The excess precipitation, 0.74 inches is assumed to have permeated the soil, increasing the storage to 4.74 inches. The total consumptive use of irrigated pasture for November was calculated as:

	1.09 inches CU demand
plus	0.74 inches stored in the soil
equals	1.83 inches total monthly CU

December. In Table B–1, December had 2.84 inches of precipitation, which was more than enough to meet the CU demand of 0.68 inches. Part of the excess precipitation, 1.26 inches is assumed to have permeated the soil, increasing the storage to the December maximum of 6.00 inches. The excess precipitation, 0.90 inches, became runoff, which is not listed in the CU program. The total consumptive use of irrigated pasture for December was calculated as:

	0.68 inches CU demand
plus	1.26 inches stored in the soil
equals	1.94 inches total monthly CU

January and February. In January and February, the CU demand was met by ample precipitation and the soil moisture remained at the maximum allowable level. Excess precipitation became runoff.

March and April. In March and April, precipitation was insufficient to meet the CU demand. Also, soil moisture storage had to be maintained at 6.00 inches. Therefore, applied water was used to meet the CU demand unmet by precipitation and seepage.

May. In May, the CU demand of 6.66 inches for was partially met by 1.11 inches of precipitation. The remaining CU demand of 5.55 inches was taken care of by applied water and stored soil moisture. Soil moisture was available to irrigated pasture because the minimum allowable storage decreased by 1.00 inches to 5.00 inches in May. Applied water was computed as:

	6.66 inches CU demand
minus	1.11 inches precipitation
minus	1.00 inches extracted from stored soil moisture
equals	4.55 inches applied water.

The total CU in May was computed as:

	1.11 inches precipitation
plus	4.55 inches of applied water
equals	5.66 inches total monthly CU.

June through September. For the balance of the growing season, the preceding method was used to determine the other monthly values of consumptive use of applied water (CU_{AW}). Table 4–4 shows that the lower limit of soil moisture during June for irrigated pasture is 0.50 inches less than the preceding month. This pattern was incorporated into the program to simulate a field practice known as "Soil Moisture Mining," which is described in Chapter 4.

In Table B–1, the total consumptive use of applied water (CU_{AW}) for irrigated pasture for water year 1922 is reported as 32.06 inches. It can be readily shown how this value is a function of the amount and distribution of rainfall. This value might vary 20 percent from year to year. For crops such as alfalfa, that are normally planted in deep soil, the opportunity within the program for the storage and subsequent use of precipitation is much greater. In Table B–1, for irrigated alfalfa, the total monthly consumptive use is shown as 44.87 inches, the same as that for irrigated pasture. However, more rainfall was utilized during the year by alfalfa through the storage of rainfall in the soil.

Bookkeeping Procedure for Special Land Use Categories

The computer program method of allocating precipitation, seepage, stored soil moisture and applied water is similar for most of the 20 land–use categories. However, soil moisture bookkeeping for the following categories is handled differently:

1. dry grasses (hay and grain);
2. native vegetation;
3. non–irrigated crops (non–irrigated pasture, vineyards, orchards);
4. riparian vegetation;
5. water surfaces; and
6. urban areas.

Moisture accounting for these crop categories is also shown in Table B–1.

Native Vegetation, Dry Grasses and Non–irrigated Crops. In the bookkeeping for these categories, irrigation is not used to meet a deficit between the water needs of the plants and the water available from precipitation, seepage, or stored soil moisture. The consumptive use demand in months when deficits occur is not met.

In Table B–1 under, "Hay and Grain Depletion Analysis," a typical moisture budget is depicted where 16.57 inches of the total annual precipitation of 17.97 inches was utilized. Direct use of precipitation comprised 10.57 inches while an additional 6.00 inches was used indirectly from soil storage of the annual precipitation. Monthly values, when multiplied by historic area, yield estimates of historic CU for dry grasses on the region (Union Island, east). Bookkeeping for native vegetation and non–irrigated crops was handled similarly.

Riparian Vegetation and Water Surface Categories. Moisture accounting for riparian vegetation and water surfaces is also handled differently from the other crop categories. In the accounting for these two categories, soil moisture and applied water are not used to satisfy the ET demand. However, if available precipitation and seepage are insufficient to meet the ET demand, diversions are simulated i.e. the total plant demand for these two categories is met. (See the columns in Table B–1 labeled "Residual Consumptive Use to be Met by Inflow").

Urban Land Use. Moisture accounting for the urban land use category is treated differently from all other categories. First of all, urban land use is divided into three categories by area and each is assigned an ET value. Lawns and landscape are assumed to cover 25 percent of urban area and are assigned the ET of pasture. Vacant lots are assumed to cover 37 percent of urban area and are assigned the ET of native vegetation. Hardtops and roofs are assumed to cover 38 percent of urban area and no ET demand is assigned to that area (*Consumptive Use Program* 1979).

For urban lands, applied water is used to satisfy the plant demand when precipitation and seepage cannot. No soil moisture bookkeeping is performed. Unit depletion is calculated as 25 percent of that of irrigated pasture (representing lawns, shrubbery, and trees) plus 37 per cent of that of native vegetation.

The last section in Table B–1 "Total Basin Consumptive Use Summary" lists the total basin precipitation and the total historic consumptive use for subarea 1 (Union Island, east).

The bookkeeping methods described above are repeated for 142 Delta subareas.

Appendix C

Miscellaneous Tables

Table C-1. DICU Land Use Acreage for Non-critical Water Years, page 1 of 2

SUB-AREA NAME	#	UR	PA	AL	F	SB	GR	RI	TR	TO	OR	VI	SF	CR	PP	VV	OO	RV	MS	DG	MV	TOTAL
UNION ISLAND (EAST)	1	10	10	2223	618	57	1777	0	1321	2974	447	0	580	827	0	0	0	10	80	228	1008	12170
UNION ISLAND (WEST)	2	0	0	2204	228	931	1558	0	2071	3306	0	0	741	1777	0	0	0	19	380	0	1085	14300
GRAND ISLAND	3	371	29	798	114	542	2024	0	76	1587	1748	0	1245	6679	0	0	0	19	0	0	1338	16570
MOSSDALE	4	399	171	1321	456	0	1634	0	893	836	304	10	285	646	0	0	0	19	500	0	1146	8620
MERRITT ISLAND	5	0	0	190	29	285	1226	0	67	599	266	371	675	390	0	0	0	0	0	114	558	4770
LISBON DISTRICT	6	10	0	162	76	1140	1454	0	38	893	38	114	542	751	0	0	0	0	0	190	612	6020
ANDRUS ISLAND (LOWER)	7	228	0	105	48	0	960	0	0	0	0	0	0	1881	0	0	0	0	0	0	258	3480
SHERMAN ISLAND	8	38	314	665	105	57	3050	0	722	0	0	0	770	3715	0	0	0	0	20	10	1294	10760
NEW HOPE TRACT	9	485	276	228	770	513	580	190	333	941	143	266	76	4123	0	0	0	0	220	0	896	10040
SUTTER ISLAND	10	0	0	76	0	361	0	0	0	76	969	105	304	390	0	0	0	0	0	0	119	2400
ROUGH AND READY	11	1074	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	220	0	396	1690
MOSS TRACT (BOGGS)	12	1786	29	0	0	0	48	0	19	0	0	0	0	0	0	0	0	0	140	152	496	2670
ANDRUS ISLAND (MIDDLE)	13	266	0	143	0	0	67	0	0	0	114	0	48	874	0	0	0	10	0	0	118	1640
RYER ISLAND	14	38	0	741	67	561	4465	0	257	1596	304	380	684	1644	0	0	0	19	120	57	907	11840
ROBERTS ISLAND (MIDDLE)	15	798	10	1986	485	551	1625	0	1501	1577	105	0	1691	1273	0	0	0	29	60	0	809	12500
EGBERT TRACT	16	0	105	0	0	675	1178	0	0	0	0	0	257	675	0	0	0	152	90	143	2395	5670
EGBERT TRACT	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	590	590
ROBERTS ISLAND (UPPER)	18	0	86	2081	209	162	760	0	456	1083	323	67	1045	684	0	0	0	0	20	0	834	7810
TERMINOUS TRACT	19	209	29	770	1159	314	2030	0	380	0	0	19	48	4636	0	0	0	143	440	0	813	11050
PIERSON DISTRICT	20	95	0	675	0	181	884	0	0	580	1425	608	542	2293	0	0	0	29	0	0	658	8670
WALNUT GROVE	21	124	0	0	0	0	152	0	0	0	19	0	0	95	0	0	0	0	0	0	30	420
ANDRUS ISLAND (UPPER)	22	29	0	38	0	48	371	0	105	0	361	0	257	912	0	0	0	10	0	0	129	2260
TYLER ISLAND	23	38	10	67	29	0	3135	0	57	0	247	0	95	4389	0	0	0	19	0	0	814	8900
POCKET DISTRICT	24	2480	0	29	29	0	10	0	19	29	0	0	276	95	0	0	0	0	340	0	63	3370
ROBERTS ISLAND (LOWER)	25	285	19	656	418	181	2394	0	1938	304	10	0	475	3059	0	0	0	67	470	323	1071	11670
SCRIBNER	26	0	0	152	0	162	67	0	48	95	105	0	323	399	0	0	0	0	0	0	219	1570
HOOD JUNCTION	27	0	0	0	0	0	0	0	0	0	114	0	0	0	0	0	0	10	0	0	6	130
RANDALL ISLAND	28	0	0	0	0	0	19	0	0	0	352	0	0	0	0	0	0	0	0	0	29	400
BOULDIN ISLAND	29	124	0	0	257	0	988	0	228	228	0	0	114	2917	0	0	0	10	820	0	1154	6840
GLIDE DISTRICT	30	0	0	0	0	29	608	0	0	314	0	0	162	0	0	0	0	0	0	0	257	1370
EL PESCADERO	31	19	19	1539	209	0	1036	0	523	1349	95	0	352	171	0	0	0	38	180	0	1290	6820
HOTCHKISS TRACT	32	247	1596	105	48	0	162	0	0	0	0	0	0	0	0	0	0	0	20	0	1182	3360
BRYON TRACT	33	399	380	57	143	409	1691	0	722	0	0	0	200	732	0	0	0	10	250	0	1457	6450
CLIFTON COURT	34	0	19	0	0	181	295	0	0	0	0	0	0	0	0	0	0	38	2420	0	477	3430
INACTIVE	35	0	0	314	0	190	285	0	0	428	162	57	105	456	0	0	0	0	0	0	133	2130
WEBER TRACT	36	684	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	36	820
JERSEY ISLAND	37	0	1919	0	0	0	29	0	0	0	0	0	0	513	0	0	0	0	0	0	989	3450
WEST SACRAMENTO	38	3762	114	570	29	646	1416	0	266	513	133	0	314	285	0	0	0	29	340	922	1581	10920
NETHERLANDS (COUNTIES 48 & 57)	39	190	447	2850	124	2214	8208	0	257	3819	0	323	2660	2024	0	0	0	10	350	162	1742	25380
UNNAMED	40	200	1112	48	342	504	475	257	0	0	162	333	181	1701	0	0	0	19	10	0	1086	6430
PICO AND NAGLEE	41	865	200	1311	304	475	1682	0	181	637	19	0	190	1501	0	0	0	0	240	0	1185	8790
TWITCHELL ISLAND	42	0	105	399	0	0	133	0	171	0	0	0	76	1938	0	0	0	57	0	0	701	3580
SMITH RANCH	43	722	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	160	0	48	940
PRIVATELY OWNED	44	0	0	0	0	0	76	247	0	0	0	105	219	779	0	0	0	0	0	0	184	1610
SMITH TRACT	45	1815	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	0	195	2080
PROSPECT ISLAND	46	0	0	0	10	0	38	0	0	485	0	0	0	342	0	0	0	67	580	0	938	2460
MILDRED ISLAND	47	0	0	0	0	0	0	0	0	0	0	29	0	732	0	0	0	38	250	0	261	1310
VENICE ISLAND	48	0	0	0	152	0	0	0	0	0	0	0	0	1701	0	0	0	190	1240	703	544	4530
ORWOOD TRACT	49	0	0	200	0	0	1064	0	608	0	0	0	0	760	0	0	0	0	20	0	358	3010
HOLLAND TRACT	50	0	2518	19	0	0	504	0	0	0	0	0	0	114	0	0	0	0	0	0	1085	4240
WEBB TRACT	51	0	0	0	1739	0	1986	0	0	0	0	0	0	770	0	0	0	38	50	0	987	5570
MANDEVILLE ISLAND	52	29	0	0	646	0	523	0	0	0	0	513	0	2651	0	0	0	456	1690	0	1372	7880
BACON ISLAND	53	57	0	0	333	0	0	0	3183	0	0	124	0	1159	0	0	0	314	580	0	980	6730
EMPIRE TRACT	54	38	0	0	0	0	333	0	0	0	0	0	0	2470	0	0	0	171	590	323	525	4450
MCDONALD TRACT	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	0	3400	3650
BRACK TRACT	56	95	532	171	504	57	722	0	48	257	0	323	0	2461	0	0	0	0	220	0	460	5850
PALM TRACT	57	0	29	0	0	0	1397	0	0	0	0	0	0	722	0	0	0	0	40	0	362	2550
RINDGE TRACT	58	0	0	0	1387	0	143	0	741	0	0	0	0	3810	0	0	0	57	210	0	642	6990
JONES TRACT (LOWER)	59	10	0	0	656	0	266	0	656	38	0	0	599	2546	0	0	0	0	110	0	1099	5980
JONES TRACT (UPPER)	60	95	0	0	200	342	1568	0	912	0	0	0	105	2033	0	0	0	171	220	0	1164	6810
VICTORIA ISLAND	61	133	0	409	0	713	1805	0	2746	0	0	0	0	827	0	0	0	67	340	0	640	7680
MEDFORD ISLAND	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	350	0	1238	1750
BISHOP TRACT	63	10	0	0	456	181	418	0	48	228	0	0	0	656	0	0	0	19	130	0	324	2470
KING ISLAND	64	38	0	0	285	0	637	0	922	0	0	0	0	1169	0	0	0	181	380	29	429	4070
PESCADERO DISTRICT	65	86	29	1539	371	38	874	0	152	817	67	0	0	969	0	0	0	0	140	0	438	5520
PESCADERO DISTRICT	66	352	38	1121	380	0	361	0	67	276	0	0	0	998	0	0	10	0	180	0	507	4290
BRADFORD ISLAND	67	19	342	0	0	0	124	0	0	276	0	0	0	1093	0	0	0	0	0	0	316	2170
HASTINGS TRACT	68	10	1264	0	0	1207	1473	0	76	656	0	19	0	1207	0	0	0	0	60	0	1268	7240
STEWART TRACT	69	38	0	798	48	0	1235	0	200	1102	143	0	95	0	0	0	0	0	280	0	601	4540
RIVER JUNCTION	70	19	57	67	57	0	219	0	0	0	0	0	0	580	0	0	0	0	20	0	431	1450
VEALE TRACT	71	0	105	361	86	0	447	0	0	0	0	0	0	67	0	0	0	10	30	0	234	1340
BRANNON ISLAND	72	143	57	114	608	38	1520	0	209	48	162	29	1112	2822	0	0	0	10	10	0	548	7430
YOLANO (COUNTIES 48 & 57)	73	38	3962	86	494	2470	3544	0	76	285	0	0	0	1007	0	0	0	0	40	219	1799	14020
WOODWARD ISLAND	74	0	0	0	0	0	808	0	0	0	0	0	0	703	0	0	0	0	250	0	359	2120
SARGENT-BARNHART TRACT	75	19	124	0	0	0	228	0	48	0	0	0	295	437	0	0	0	0	60	0	89	1300
MCMULLIN RANCH	76	0	10	143	371	0	475	0	0	171	0	0	0	741	0	0	0	0	40	0	289	2240
INACTIVE	77	0	4199	48	580	1938	2223	19	0	0	0	0	665	3268	0	0	0	76	950	143	6491	20600
UNNAMED	78	0	0	0	0	190	722	0	0	0	0	0	200	998	0	0	0	0	0	0	760	2870
KASSON	79	276	124	219	323	475	295	0	0	380	0	0	0	190	0*	0	0	0	40	0	388	2710

Table C-1. DICU Land Use Acreage for Non–critical Water Years, page 2 of 2

SUB-AREA NAME	#	UR	PA	AL	F	SB	GR	RI	TR	TO	OR	VI	SF	CR	PP	VV	OO	RV	MS	DG	NV	TOTAL
CANAL RANCH	80	0	95	219	0	0	1967	0	0	0	0	0	0	988	0	0	0	0	110	0	501	3880
CANAL RANCH	81	0	0	0	0	0	0	0	0	0	0	0	0	162	0	0	0	0	0	0	28	190
STARK TRACT	82	0	10	247	0	0	0	0	0	276	0	38	0	0	0	0	0	0	70	38	61	740
LIBERTY ISLAND (COUNTIES 48 & 57)	83	0	0	0	884	133	285	0	0	0	0	0	0	2936	0	0	0	86	20	0	676	5020
WALTHALL TRACT	84	0	29	76	86	0	513	0	314	114	10	0	0	143	0	0	0	0	90	0	255	1630
PARADISE JUNCTION	85	380	209	922	561	209	1036	0	665	960	29	0	0	1093	0	0	0	10	120	0	896	7090
WETHERBEE LAKE	86	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	65	200
CACHE-HAAS AREA	87	38	1340	0	0	0	0	0	0	0	0	0	67	1549	0	0	0	0	50	0	406	3450
CACHE-HAAS AREA	88	0	285	0	0	0	627	0	0	0	0	0	0	0	0	0	0	0	0	0	1228	2140
PETER POCKET	89	0	703	0	0	124	447	0	0	0	0	0	0	0	0	0	0	0	40	0	216	1530
MOSSDALE 2	90	67	0	0	95	0	76	0	0	124	10	0	0	0	0	0	0	0	0	0	38	410
MOSSDALE 2	91	86	0	190	19	48	95	0	219	0	0	0	38	0	0	0	0	0	90	0	265	1050
UNDESIGNATED AREA	92	143	10	0	0	0	29	0	0	48	181	152	0	0	0	0	0	1843	11960	0	3324	17690
UNDESIGNATED AREA	93	2385	190	0	0	0	447	314	0	124	0	0	238	114	0	0	0	228	340	0	3480	7860
EHRHARDT CLUB (ARD)	94	0	0	0	67	0	0	0	0	0	0	0	0	304	0	0	0	19	0	0	200	590
COSUMNES-MOKELUMNE	95	48	637	0	418	0	276	456	0	0	38	0	19	922	0	0	0	523	10	0	1233	4580
DEAD HORSE ISLAND	96	0	0	0	0	0	0	0	0	0	0	0	0	181	0	0	0	0	0	0	19	200
HOOD AREA	97	57	0	0	0	0	57	0	0	0	0	19	38	0	0	0	0	10	0	0	29	210
IDA ISLAND	98	29	0	0	0	0	0	0	0	0	0	0	0	29	0	0	0	0	0	0	2	60
LOCKE AREA	99	38	0	0	0	0	76	0	0	0	76	0	0	19	0	0	0	333	30	0	128	700
MCCORMACK-WILLIAMSON TRACT	100	10	0	0	209	0	523	0	0	0	0	0	114	665	0	0	0	10	0	0	89	1620
STONE LAKE AREA	101	143	874	57	0	209	865	124	0	105	0	247	0	703	0	0	0	456	130	0	1297	5210
UNDESIGNATED AREA	102	1017	76	0	0	95	713	0	0	57	0	0	0	38	0	0	0	0	440	0	264	2700
UNDESIGNATED AREA	103	10517	2926	4836	8626	1682	7182	0	228	4085	6603	181	950	4560	0	0	0	105	760	865	9184	63290
ACKER ISLAND	104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	30	0	21	80
ATLAS TRACT	105	0	0	0	152	0	124	0	0	0	0	0	0	0	0	0	0	0	40	0	34	350
ATLAS TRACT	106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	30	0	11	70
DREXLER TRACT	107	0	0	0	171	0	599	0	1501	0	0	0	143	409	0	0	0	133	120	0	344	3420
ELMWOOD TRACT	108	10	0	0	0	0	114	0	190	0	0	0	0	428	0	0	0	0	40	0	108	890
FERN ISLAND	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	40	0	14	130
HEADREACH ISLAND	110	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	70	0	34	200
HEMMING TRACT	111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	160	0	2742	2940
HOG ISLAND	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	70	0	86	270
HONKER LAKE TRACT	113	0	0	808	0	0	190	0	352	67	0	0	228	295	0	0	0	114	20	0	236	2310
MORRISON ISLAND	114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	30	0	21	80
RIO BLANCO TRACT	115	0	0	0	0	0	152	0	0	209	0	0	190	0	0	0	0	0	40	0	109	700
SHIMA TRACT	116	0	76	0	0	0	912	0	0	0	200	0	0	323	0	0	0	0	110	0	359	1980
SHIN KEE TRACT	117	0	0	105	0	276	152	0	0	67	0	0	181	209	0	0	0	0	30	0	120	1140
SPUD ISLAND	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	70	0	43	180
STATEN ISLAND	119	10	0	0	0	0	1425	0	0	0	0	0	0	6774	0	0	0	19	570	0	1042	9840
WRIGHT TRACT	120	95	0	0	0	0	0	0	247	0	0	0	76	798	0	0	0	67	110	0	37	1430
UNDESIGNATED AREA	121	19	314	0	0	0	0	0	0	0	0	0	0	57	0	0	0	133	5130	0	497	6150
UNDESIGNATED AREA	122	295	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	475	150	0	8380	9300
DECKER ISLAND	123	0	114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	486	600
LITTLE HOLLAND TRACT	124	0	0	0	19	0	0	0	0	0	0	0	437	0	0	0	0	29	160	0	95	740
UNDESIGNATED AREA	125	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	1060	304	467	1860
UNDESIGNATED AREA	126	124	0	0	931	998	2081	105	1311	2242	0	0	238	4712	0	0	0	10	460	0	2578	15790
LITTLE HOLLAND TRACT	127	0	0	0	19	0	67	0	0	0	0	0	931	0	0	0	0	0	220	86	247	1570
UNDESIGNATED AREA	128	57	238	618	342	732	228	0	0	105	0	0	0	304	0	0	0	0	60	0	2036	4720
UNDESINATED AREA	129	76	931	67	0	437	276	0	0	304	29	38	0	314	0	0	0	371	1770	0	1427	6040
UNDESIGNATED AREA	130	1378	2375	2090	228	1938	1758	0	1463	5301	8189	57	19	684	0	86	741	29	210	276	6038	32860
BETHEL ISLAND	131	494	608	38	0	0	798	0	0	0	0	0	0	0	0	0	0	0	0	0	1472	3410
CONEY ISLAND	132	10	48	0	0	0	789	0	0	0	0	0	0	0	0	0	0	10	140	0	203	1200
DUTCH SL & PART OF SAND MND SL	133	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	250	0	72	370
FALSE R.,PIPER SL.,ROCK SL.,etc	134	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	257	1040	0	324	1650
FISHERMAN CUT WATERWAY	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	70	0	41	140
FRANKS TRACT	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	238	3300	0	12	3550
OLD R., HOLLAND CUT,& INDIAN SL.	137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	190	1120	0	300	1610
QUIMBY ISLAND	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	770	770
RHODE ISLAND	139	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	0	0	70
SAN JOAQUIN RIVER WATERWAY	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	2150	0	133	2340
SJ WATERWAY N. OF INDUSTRIAL STRIP	141	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1560	0	1	1580
TAYLOR SLOUGH WATERWAY	142	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	150	0	82	280
TOTAL		37032	32477	38071	28809	25899	99472	1712	29831	42971	23702	4527	22510	125640	0	86	751	9093	52360	5287	118620	

Table C-2. DICU Land Use Acreage for Critical Water Years, page 1 of 2

SUB-AREA NAME	#	UR	PA	AL	F	SB	GR	RI	TR	TO	OR	VI	SF	CR	PP	VV	OO	RV	WS	DG	NV	TOTAL
UNION ISLAND (EAST)	1	0	0	2765	0	770	1929	0	1017	2071	428	0	1587	152	0	0	0	10	80	0	1111	11920
UNION ISLAND (WEST)	2	0	0	1929	0	1634	770	0	1150	3373	0	0	1634	1682	0	0	0	19	380	0	1039	13610
GRAND ISLAND	3	304	29	1910	219	532	5026	0	114	2204	1720	0	637	2888	0	0	0	19	0	0	968	16570
MOSSDALE	4	399	114	2793	257	181	627	0	713	352	181	19	0	456	0	0	19	19	500	0	1380	8010
MERRITT ISLAND	5	0	19	143	0	38	960	0	152	485	247	304	1330	646	0	0	0	0	0	0	516	4840
LISBON DISTRICT	6	0	0	418	86	152	1444	0	0	979	48	95	1188	1045	0	0	0	0	0	0	535	5990
ANDRUS ISLAND (LOWER)	7	57	10	190	143	0	988	0	0	0	0	0	0	1796	0	0	0	0	0	0	316	3500
SHERMAN ISLAND	8	29	266	513	266	0	5111	0	371	0	0	0	1843	836	0	0	0	0	20	0	1185	10440
NEW HOPE TRACT	9	447	599	922	57	152	1748	0	209	637	143	67	437	3401	0	0	0	0	220	0	921	9960
SUTTER ISLAND	10	0	0	76	0	95	485	0	0	86	960	48	152	380	0	0	0	0	0	0	118	2400
ROUGH AND READY	11	988	0	0	0	0	38	0	0	0	0	0	0	247	0	0	0	0	220	10	187	1690
MOSS TRACT (BOGGS)	12	1786	19	67	86	0	333	0	0	0	0	0	0	0	0	0	0	0	140	0	239	2670
ANDRUS ISLAND (MIDDLE)	13	171	0	0	95	0	561	0	0	105	114	0	0	532	0	0	0	0	0	0	132	1710
RYER ISLAND	14	10	0	627	266	1387	3373	0	48	1121	304	418	998	2394	0	0	0	19	120	0	905	11990
ROBERTS ISLAND (MIDDLE)	15	542	0	2993	133	295	2765	0	1055	1216	114	0	1872	542	0	0	0	29	60	0	924	12540
EGBERT TRACT	16	0	285	0	114	124	969	0	0	428	0	0	494	817	0	0	0	152	90	0	2327	5800
EGBERT TRACT	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	590	590
ROBERTS ISLAND (UPPER)	18	0	38	2841	19	228	1501	0	219	1045	323	29	713	371	0	0	0	0	20	0	603	7950
TERMINOUS TRACT	19	209	10	475	950	399	1777	0	1653	447	0	0	114	3610	0	0	0	143	440	0	863	11090
PIERSON DISTRICT	20	67	0	1891	0	219	1663	0	0	960	1406	504	181	1245	0	0	0	0	0	0	534	8670
WALNUT GROVE	21	105	0	0	0	0	238	0	0	0	19	0	0	38	0	0	0	0	0	0	20	420
ANDRUS ISLAND (UPPER)	22	19	0	228	0	171	390	0	0	0	409	0	19	903	0	0	0	0	0	0	121	2260
TYLER ISLAND	23	19	10	19	228	0	3230	0	0	114	247	0	0	4342	0	0	0	19	0	0	852	9080
POCKET DISTRICT	24	1197	0	266	67	0	931	0	29	114	10	0	38	95	0	0	0	0	340	0	283	3370
ROBERTS ISLAND (LOWER)	25	285	0	361	504	57	2081	0	2271	637	38	0	295	3344	0	0	0	67	470	0	1130	11540
SCRIBNER	26	0	0	285	0	48	276	0	0	190	152	0	124	323	0	0	0	0	0	0	172	1570
HOOD JUNCTION	27	0	0	0	0	0	0	0	0	0	114	0	0	0	0	0	0	10	0	0	6	130
RANDALL ISLAND	28	0	0	19	0	0	0	0	0	0	352	0	0	0	0	0	0	0	0	0	29	400
BOULDIN ISLAND	29	95	0	124	0	0	2337	0	190	76	0	0	0	2442	0	0	0	10	820	0	706	6800
GLIDE DISTRICT	30	0	0	67	0	48	390	0	0	523	0	0	133	0	0	0	0	0	0	0	209	1370
EL PESCADERO	31	19	57	2299	0	190	513	0	200	1340	76	0	656	456	0	0	0	0	180	0	624	6610
HOTCHKISS TRACT	32	247	1596	105	48	0	162	0	0	0	0	0	0	0	0	0	0	0	20	0	1182	3360
BRYON TRACT	33	399	380	57	143	409	1691	0	722	0	0	0	200	732	0	0	0	10	250	0	1457	6450
CLIFTON COURT	34	0	19	0	0	181	295	0	0	0	0	0	0	0	0	0	0	38	2420	0	477	3430
INACTIVE	35	0	0	703	0	95	342	0	0	266	133	0	105	361	0	0	0	0	0	0	125	2130
WEBER TRACT	36	684	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	36	820
JERSEY ISLAND	37	0	1919	0	0	0	29	0	0	0	0	0	0	513	0	0	0	0	0	0	989	3450
WEST SACRAMENTO	38	3012	76	1045	124	466	1767	0	276	893	133	0	722	314	10	0	0	29	340	0	1653	10860
NETHERLANDS (COUNTIES 48 & 57)	39	162	133	3154	67	1520	5558	0	238	4000	0	247	4703	2945	0	0	0	10	350	0	1783	24870
UNNAMED	40	29	2280	228	352	124	1150	238	0	190	152	219	143	827	0	0	0	0	10	0	598	6540
PICO AND NAGLEE	41	789	304	1226	418	1140	798	0	0	437	29	0	276	1150	0	0	0	0	240	0	1163	7970
TWITCHELL ISLAND	42	0	114	0	200	152	703	0	124	0	0	0	57	1748	0	0	0	57	0	0	425	3580
SMITH RANCH	43	713	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	160	0	48	940
PRIVATELY OWNED	44	0	0	0	57	0	466	200	0	0	0	0	399	523	0	0	0	0	0	0	225	1870
SMITH TRACT	45	1862	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	0	148	2080
PROSPECT ISLAND	46	0	0	0	0	0	247	0	0	656	0	0	57	485	0	0	0	67	580	0	368	2460
MILDRED ISLAND	47	0	0	0	0	0	0	0	0	0	0	29	0	732	0	0	0	38	250	0	261	1310
VENICE ISLAND	48	0	0	0	10	0	133	0	0	0	0	0	0	2432	0	0	0	190	1240	0	525	4530
ORWOOD TRACT	49	0	0	200	0	0	1064	0	608	0	0	0	0	760	0	0	0	0	20	0	358	3010
HOLLAND TRACT	50	0	2518	19	0	0	504	0	0	0	0	0	0	114	0	0	0	0	0	0	1085	4240
WEBB TRACT	51	0	0	0	1739	0	1986	0	0	0	0	0	0	770	0	0	0	38	50	0	987	5570
MANDEVILLE ISLAND	52	19	29	0	162	0	1235	0	466	0	0	437	0	2774	0	0	0	456	1690	0	1102	8370
BACON ISLAND	53	19	0	0	105	0	209	0	3667	0	0	86	0	922	0	0	0	314	580	0	828	6730
EMPIRE TRACT	54	10	0	0	0	0	181	0	0	0	0	0	0	3002	0	0	0	171	590	0	496	4450
MCDONALD TRACT	55	38	0	0	0	0	152	0	0	0	0	0	0	2565	0	0	0	0	250	0	645	3650
BRACK TRACT	56	95	836	152	0	589	333	0	0	133	0	0	0	2252	0	0	0	0	220	0	500	5110
PALM TRACT	57	0	29	0	0	0	1397	0	0	0	0	0	0	722	0	0	0	0	40	0	362	2550
RINDGE TRACT	58	0	0	0	703	0	447	0	409	0	0	0	0	4598	0	0	0	57	210	0	566	6990
JONES TRACT (LOWER)	59	10	0	0	732	0	494	0	779	0	0	0	19	3221	0	0	0	0	110	0	615	5980
JONES TRACT (UPPER)	60	0	0	0	285	475	352	0	1378	0	0	0	171	2869	0	0	0	171	220	0	739	6660
VICTORIA ISLAND	61	10	0	0	1036	238	1416	0	1539	0	0	0	352	1758	0	0	0	67	340	0	844	7600
MEDFORD ISLAND	62	19	0	0	0	0	0	0	0	0	0	0	0	732	0	0	0	162	350	0	447	1710
BISHOP TRACT	63	10	0	0	238	276	532	0	0	0	0	0	0	1169	0	0	0	19	130	0	246	2620
KING ISLAND	64	29	0	0	0	0	247	0	114	0	0	0	0	2309	0	0	0	181	380	0	610	3870
PESCADERO DISTRICT	65	76	29	1539	371	38	874	0	152	817	67	0	0	969	0	0	0	0	140	0	448	5520
PESCADERO DISTRICT	66	352	38	1121	380	0	361	0	67	276	0	0	0	998	0	0	10	0	180	0	507	4290
BRADFORD ISLAND	67	19	342	0	0	0	124	0	0	0	0	0	0	1093	0	0	0	0	0	0	592	2170
HASTINGS TRACT	68	0	1283	0	0	1634	931	0	0	580	0	10	67	1501	171	0	0	0	60	0	923	7160
STEWART TRACT	69	29	0	1321	0	513	219	0	143	817	399	0	38	428	0	0	0	0	280	0	353	4540
RIVER JUNCTION	70	19	57	371	0	0	10	0	0	0	0	0	0	361	0	0	0	0	20	0	392	1230
VEALE TRACT	71	0	105	361	86	0	447	0	0	0	0	0	0	67	0	0	0	10	30	0	234	1340
BRANNON ISLAND	72	143	38	200	380	0	2755	0	0	57	162	19	266	2613	0	0	0	10	10	0	947	7600
YOLANO (COUNTIES 48 & 57)	73	38	4931	0	333	1777	1615	0	0	361	0	0	0	2936	0	0	0	0	40	0	1889	13920
WOODWARD ISLAND	74	0	0	0	0	0	0	0	0	0	0	0	0	1511	0	0	0	0	250	0	359	2120
SARGENT-BARNHART TRACT	75	19	10	0	0	0	200	0	86	0	0	0	67	694	0	0	0	29	60	0	135	1300
MCMULLIN RANCH	76	0	0	504	48	95	352	0	342	29	0	0	0	352	0	0	0	0	40	0	178	1940
INACTIVE	77	0	5425	0	779	1121	1425	0	0	285	0	0	599	3515	0	0	0	76	950	504	5551	20230
UNNAMED	78	0	0	38	0	257	874	0	0	0	0	0	200	969	0	0	0	0	0	0	532	2870
KASSON	79	266	133	266	447	0	561	0	67	228	0	0	0	86	0	0	0	0	40	0	456	2550

Table C-2. DICU Land Use Acreage for Critical Water Years, page 2 of 2

SUB-AREA NAME	#	UR	PA	AL	F	SD	GR	RI	TR	TO	OR	VI	SF	CR	PP	VV	OO	RV	WS	DO	NV	TOTAL
CANAL RANCH	80	0	152	599	0	0	665	0	0	0	0	0	86	1150	0	0	0	0	110	0	338	3100
CANAL RANCH	81	0	0	0	0	0	48	0	0	0	0	0	29	86	0	0	0	0	0	0	27	190
STARK TRACT	82	0	0	238	0	48	133	0	0	152	0	38	0	0	0	0	0	0	70	0	61	740
LIBERTY ISLAND (COUNTIES 48 & 57)	83	0	0	0	0	437	409	0	0	0	0	0	656	2727	0	0	0	86	20	0	685	5020
WALTHALL TRACT	84	0	0	428	86	0	0	0	295	162	0	0	0	0	0	0	0	0	90	0	229	1290
PARADISE JUNCTION	85	380	266	1672	1102	276	713	0	228	456	19	0	0	428	0	0	0	10	120	0	1020	6690
WETHERBEE LAKE	86	48	0	10	0	0	0	0	0	0	57	0	0	0	0	0	0	0	40	0	45	200
CACHE-HAAS AREA	87	29	1254	0	114	209	418	0	57	0	0	0	447	428	0	0	0	0	50	0	424	3430
CACHE-HAAS AREA	88	0	314	0	152	371	228	0	0	0	0	0	0	76	0	0	0	0	0	0	999	2140
PETER POCKET	89	0	1302	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	188	1530
MOSSDALE 2	90	67	0	0	0	0	76	0	0	124	10	0	95	0	0	0	0	0	0	0	38	410
MOSSDALE 2	91	76	0	190	19	48	95	0	219	0	0	0	38	0	0	0	0	0	90	0	275	1050
UNDESIGNATED AREA	92	143	10	0	38	0	105	0	0	0	171	114	114	57	0	0	0	1843	11960	0	3135	17690
UNDESIGNATED AREA	93	2195	238	19	19	57	428	0	0	152	0	0	371	219	0	0	0	228	340	67	3547	7880
EHRHARDT CLUB (ARD)	94	0	0	0	181	0	48	0	0	0	0	0	162	86	0	0	0	0	0	0	123	600
COSUMNES-MOKELUMNE	95	0	1701	0	0	105	361	19	0	0	0	0	0	741	0	0	0	513	10	0	1060	4510
DEAD HORSE ISLAND	96	0	0	0	0	0	19	0	0	152	0	0	0	19	0	0	0	0	0	0	10	200
HOOD AREA	97	38	0	0	10	0	38	0	0	0	0	0	48	48	0	0	0	0	0	0	28	210
IDA ISLAND	98	29	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0	2	60
LOCKE AREA	99	38	0	0	0	0	86	0	0	0	86	0	0	0	0	0	0	333	30	0	127	700
MCCORMACK-WILLIAMSON TRACT	100	0	0	0	76	124	456	0	0	86	0	0	124	570	0	0	0	10	0	0	94	1540
STONE LAKE AREA	101	143	770	485	86	209	760	0	48	0	0	0	219	798	0	0	0	456	130	0	1076	5180
UNDESIGNATED AREA	102	846	76	0	0	95	713	0	0	57	0	0	0	38	0	0	0	0	440	0	435	2700
UNDESIGNATED AREA	103	8303	3363	7686	9111	1311	4123	0	1492	5358	5510	285	200	5187	0	0	19	152	760	29	7601	60490
ACKER ISLAND	104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	30	0	21	80
ATLAS TRACT	105	0	0	0	38	0	76	0	0	133	0	0	0	0	0	0	0	0	40	0	63	350
ATLAS TRACT	106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	30	0	11	70
DREXLER TRACT	107	0	0	570	0	29	181	0	1207	855	0	0	0	0	0	0	0	133	120	0	215	3310
ELMWOOD TRACT	108	0	0	0	0	0	219	0	76	0	0	0	0	447	0	0	0	0	40	0	108	890
FERN ISLAND	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	40	0	14	130
HEADREACH ISLAND	110	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	70	0	34	200
HENNING TRACT	111	38	0	0	0	0	209	0	646	0	0	0	0	1283	0	0	0	38	160	0	566	2940
HOG ISLAND	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	70	0	86	270
HOWKER LAKE TRACT	113	10	0	684	0	0	722	0	162	171	0	0	133	342	0	0	0	38	20	0	198	2480
MORRISON ISLAND	114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	30	0	21	80
RIO BLANCO TRACT	115	0	0	0	86	0	276	0	0	200	0	0	76	0	0	0	0	0	40	0	112	790
SHIMA TRACT	116	0	10	0	0	219	675	0	0	76	76	0	86	285	0	0	0	0	110	0	373	1910
SHIN KEE TRACT	117	0	0	0	76	133	133	0	0	162	0	0	57	352	0	0	0	0	30	0	147	1090
SPUD ISLAND	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	70	0	43	180
STATEN ISLAND	119	0	0	200	0	0	2062	0	0	0	0	0	133	5890	0	0	0	19	570	0	936	9810
WRIGHT TRACT	120	95	0	0	0	304	76	0	276	0	0	0	0	380	0	0	0	67	110	0	122	1430
UNDESIGNATED AREA	121	19	238	0	0	57	0	0	0	0	0	0	67	0	0	0	0	133	5130	0	506	6150
UNDESIGNATED AREA	122	295	532	0	0	751	836	0	0	0	0	0	76	504	19	0	0	475	150	133	5529	9300
DECKER ISLAND	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	600
LITTLE HOLLAND TRACT	124	0	0	0	0	0	181	0	0	0	0	0	143	67	0	0	0	29	160	0	160	740
UNDESIGNATED AREA	125	0	0	0	0	29	190	0	0	0	0	0	0	0	0	0	0	0	1060	0	581	1860
UNDESIGNATED AREA	126	0	285	0	57	3591	371	0	827	4503	0	0	1045	1796	0	0	0	10	460	38	1777	14760
LITTLE HOLLAND TRACT	127	0	0	0	323	0	57	0	0	0	0	0	561	57	0	0	0	0	220	10	342	1570
UNDESIGNATED AREA	128	57	238	618	342	732	228	0	0	105	0	0	0	304	0	0	0	0	60	0	2036	4720
UNDESINATED AREA	129	76	931	67	0	437	276	0	0	304	29	38	0	314	0	0	0	371	1770	0	1427	6040
UNDESIGNATED AREA	130	1378	2375	2090	228	1938	1758	0	1463	5301	8189	57	19	684	0	86	741	29	210	276	7648	34470
BETHEL ISLAND	131	494	608	38'	0	0	798	0	0	0	0	0	0	0	0	0	0	0	0	0	1472	3410
CONEY ISLAND	132	10	48	0	0	0	789	0	0	0	0	0	0	0	0	0	0	10	140	0	203	1200
DUTCH SL & PART OF SAND MND SL	133	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	250	0	72	370
FALSE R.,PIPER SL.,ROCK SL.,etc	134	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	257	1040	0	324	1650
FISHERMAN CUT WATERWAY	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	70	0	41	140
FRANKS TRACT	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	238	3300	0	12	3550
OLD R., HOLLAND CUT, & INDIAN SL.	137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	190	1120	0	300	1610
QUIMBY ISLAND	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	770	770
RHODE ISLAND	139	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	0	0	70
SAN JOAQUIN RIVER WATERWAY	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	2150	0	133	2340
SJ WATERWAY N. OF INDUSTRIAL STRIP	141	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1560	0	1	1580
TAYLOR SLOUGH WATERWAY	142	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	150	0	82	280
TOTAL		30788	38791	52425	24877	29330	97156	457	27564	47037	22627	3063	27871	121738	200	86	789	8957	52360	1067	- -103587	

Table C–3. Subarea to Node Diversion Allocation Factors, *page 1 of 4*

DELTA ISLAND (SUBAREA) DIVERSION ALLOCATION FACTORS (%)
FOR DWR/RMA DELTA MODEL NODES (4/20/88). MODIFIED FOR DSM NODES BY PNT (NM 2/21/92)

ISL	NODE	DIV %	ISL	NODE	DIV %	ISL	NODE	DIV %
1	52	2.08	10	301	25.98	25	23	3.97
1	53	5.95	10	302	9.09	25	24	3.97
1	104	10.12	10	303	25.32	25	25	5.36
1	105	3.87	10	304	6.49	25	26	6.55
1	106	27.10	10	339	8.44	25	138	15.67
1	107	10.71	10	340	24.68	25	139	15.66
1	108	2.08	11	16	100.00	25	140	3.97
1	109	11.90	12	13	61.11	25	141	2.38
1	111	5.95	12	14	38.89	25	142	5.36
1	170	10.42	13	292	28.99	25	146	5.36
1	171	2.08	13	294	17.39	25	147	10.32
1	172	7.74	13	347	33.33	25	148	7.94
2	71	4.06	13	348	20.29	26	336	100.00
2	112	14.37	14	302	8.14	27	338	100.00
2	113	7.03	14	304	14.66	28	338	77.27
2	172	8.12	14	305	18.28	28	339	22.73
2	174	6.25	14	306	14.33	29	39	13.20
2	175	8.44	14	307	15.96	29	40	11.00
2	176	9.38	14	308	7.49	29	245	6.60
2	177	14.38	14	316	15.00	29	250	6.60
2	178	2.19	14	350	6.14	29	251	6.60
2	182	3.12	15	11	9.83	29	268	37.10
2	183	2.19	15	12	6.88	29	271	18.90
2	187	5.94	15	13	8.84	30	333	75.00
2	188	5.00	15	14	4.57	30	334	25.00
2	189	2.19	15	107	59.63	31	60	2.97
2	190	2.19	15	108	10.25	31	61	8.92
2	191	1.09	16	316	100.00	31	62	5.52
2	192	4.06	17	316	100.00	31	64	2.97
3	303	8.08	18	8	1.73	31	65	2.97
3	304	10.05	18	9	13.61	31	66	2.97
3	305	9.71	18	10	21.04	31	67	60.31
3	306	15.12	18	11	6.68	31	68	2.97
3	340	9.97	18	48	3.96	31	171	4.46
3	341	7.39	18	49	6.44	31	172	2.97
3	342	2.58	18	50	8.42	31	175	2.97
3	343	2.92	18	51	1.73	32	205	22.22
3	344	17.35	18	52	5.69	32	206	22.22
3	346	3.26	18	104	3.71	32	222	11.11
3	347	8.59	18	105	13.37	32	223	44.45
3	348	4.98	18	106	5.20	33	77	4.18
4	7	12.46	18	107	8.42	33	78	9.32
4	8	2.13	19	246	15.82	33	79	11.26
4	9	12.77	19	247	11.65	33	80	2.25
4	10	17.02	19	250	7.47	33	81	2.25
4	11	18.54	19	266	26.37	33	82	2.25
4	12	24.31	19	268	11.21	33	196	4.50
4	13	12.77	19	278	27.48	33	197	3.21
5	296	13.03	20	253	27.31	33	198	20.35
5	297	5.88	20	339	9.25	33	209	20.49
5	298	14.71	20	340	20.70	33	210	1.61
5	299	9.87	20	341	32.17	33	211	9.97
5	337	15.13	20	342	10.57	33	212	8.36
5	338	22.47	21	256	100.00	34	70	25.00
5	339	18.91	22	288	15.75	34	71	25.00
6	334	33.33	22	290	22.83	34	179	25.00
6	335	33.33	22	292	9.45	34	209	25.00
6	336	33.34	22	343	15.75	35	253	36.00
7	40	10.00	22	344	24.41	35	338	64.00
7	41	20.00	22	346	11.81	36	18	50.00
7	271	44.00	23	271	9.90	36	19	50.00
7	294	26.00	23	280	1.69	37	44	19.80
8	43	2.06	23	282	4.83	37	45	26.74
8	44	7.06	23	284	7.97	37	222	11.38
8	45	42.36	23	286	9.18	37	223	17.32
8	46	18.52	23	288	13.04	37	226	24.76
8	240	3.82	23	290	13.29	38	330	33.33
8	352	6.18	23	292	17.39	38	331	33.33
8	353	12.65	23	294	18.84	38	332	33.34
8	354	7.35	23	342	0.97	39	296	2.19
9	257	45.55	23	343	2.90	39	297	8.21
9	260	25.94	24	334	100.00	39	298	6.29
9	262	17.82	25	16	2.78	39	299	2.19
9	274	10.69	25	22	10.71	39	301	0.82

Table C–3. Subarea to Node Diversion Allocation Factors, *page 2 of 4*

DELTA ISLAND DIVERSION ALLOCATION FACTORS (%)
FOR DWR/RMA DELTA MODEL NODES (4/20/88). MODIFIED FOR DSM NODES BY PNT (NM 2/21/92)

ISL	NODE	DIV %	ISL	NODE	DIV %	ISL	NODE	DIV %
39	302	3.28	54	243	18.62	65	158	8.64
39	311	2.74	54	245	14.89	65	159	17.29
39	336	68.53	54	247	18.62	65	163	16.05
39	339	5.75	54	250	21.81	65	167	16.05
40	253	100.00	55	26	12.96	66	151	13.00
41	58	5.79	55	29	6.48	66	152	13.00
41	59	5.79	55	30	18.52	66	155	60.00
41	60	5.79	55	32	29.63	66	158	7.00
41	61	4.13	55	141	32.41	66	159	7.00
41	62	17.36	56	264	15.42	67	42	27.27
41	63	11.57	56	266	17.01	67	43	48.49
41	64	14.05	56	276	9.52	67	226	24.24
41	150	35.52	56	278	58.05	68	316	33.34
42	41	29.71	57	86	3.47	68	320	33.33
42	42	36.59	57	89	15.28	68	321	33.33
42	43	9.13	57	92	13.19	69	7	25.45
42	240	24.57	57	93	6.94	69	8	15.76
43	241	100.00	57	200	11.11	69	51	13.95
44	257	100.00	57	201	36.12	69	52	9.70
45	21	100.00	57	203	13.89	69	54	7.88
46	316	100.00	58	24	1.98	69	164	27.26
47	126	20.00	58	25	11.86	70	1	100.00
47	127	20.00	58	26	1.98	71	201	18.29
47	128	20.00	58	29	14.41	71	202	8.61
47	135	10.00	58	30	3.95	71	203	8.61
47	136	10.00	58	32	7.91	71	204	15.06
47	137	10.00	58	241	25.71	71	205	18.29
47	145	10.00	58	242	18.64	71	206	31.14
48	32	4.38	58	243	13.56	72	41	8.11
48	35	34.37	59	122	6.91	72	240	17.76
48	38	8.75	59	124	3.72	72	348	16.99
48	39	13.12	59	142	10.64	72	350	41.70
48	245	17.50	59	143	6.91	72	351	15.44
48	251	21.88	59	144	11.17	73	318	14.60
49	82	11.06	59	145	7.45	73	320	85.40
49	85	5.11	59	146	12.78	74	82	9.77
49	86	3.83	59	147	3.72	74	84	15.04
49	197	16.60	59	148	36.70	74	85	19.58
49	199	60.42	60	113	27.75	74	86	5.26
49	200	2.98	60	114	33.97	74	118	5.26
50	93	29.11	60	115	6.22	74	119	15.03
50	98	4.96	60	116	3.35	74	194	15.03
50	203	5.68	60	117	3.35	74	195	15.03
50	204	9.22	60	118	25.36	75	21	34.43
50	205	21.97	61	75	2.33	75	24	65.57
50	215	29.06	61	77	5.91	76	3	50.00
51	38	13.40	61	78	2.33	76	5	50.00
51	40	7.22	61	79	4.66	77	314	53.61
51	41	20.62	61	80	5.74	77	317	8.98
51	42	7.22	61	81	8.07	77	318	28.43
51	224	13.40	61	82	2.87	77	319	8.98
51	226	38.14	61	113	3.75	78	316	80.82
52	35	16.50	61	114	2.15	78	350	19.18
52	38	9.90	61	115	1.25	79	1	80.00
52	100	16.50	61	116	10.39	79	3	20.00
52	130	18.86	61	117	8.61	80	262	47.81
52	133	15.56	61	188	3.75	80	264	23.68
52	224	22.68	61	189	4.66	80	276	28.51
53	86	2.58	61	190	4.66	81	274	68.54
53	89	7.74	61	191	10.40	81	276	31.46
53	92	9.96	61	192	7.53	82	54	30.17
53	93	10.32	61	194	5.20	82	55	13.21
53	98	12.90	61	195	5.74	82	56	13.21
53	100	2.58	62	32	27.54	82	170	43.41
53	121	5.16	62	35	34.78	83	316	20.00
53	122	2.58	62	133	37.68	83	317	20.00
53	124	13.00	63	242	44.00	83	318	20.00
53	125	7.74	63	246	56.00	83	319	20.00
53	126	5.16	64	242	32.84	83	321	20.00
53	127	5.16	64	243	13.73	84	5	100.00
53	128	7.38	64	246	26.47	85	162	50.00
53	130	5.16	64	247	26.96	85	163	50.00
53	213	2.58	65	151	17.28	86	6	100.00
54	32	26.06	65	153	16.05	87	319	100.00
54	243	18.62	65	156	8.64	88	320	100.00

Table C-3. Subarea to Node Diversion Allocation Factors, *page 3 of 4*

DELTA ISLAND DIVERSION ALLOCATION FACTORS (%)
FOR DWR/RMA DELTA MODEL NODES (4/20/88). MODIFIED FOR DSM NODES BY PNT (NM 2/21/92)

ISL	NODE	DIV %	ISL	NODE	DIV %	ISL	NODE	DIV %
65	158	8.64	88	320	100.00	101	253	100.00
65	159	17.29	89	320	100.00	102	20	10.09
65	163	16.05	90	163	100.00	102	54	3.72
65	167	16.05	91	6	69.70	102	55	3.72
66	151	13.00	91	162	30.30	102	56	3.72
66	152	13.00	92	40	2.47	102	58	3.72
66	155	60.00	92	41	2.47	102	59	3.72
66	158	7.00	92	42	2.53	102	149	3.72
66	159	7.00	92	43	2.53	102	168	3.72
67	42	27.27	92	44	2.53	102	169	3.72
67	43	48.49	92	45	2.53	102	171	3.72
67	226	24.24	92	46	11.94	102	241	40.10
68	316	33.34	92	47	11.94	102	242	9.86
68	320	33.33	92	240	2.53	102	274	6.47
68	321	33.33	92	253	1.08	103	1	25.29
69	7	25.45	92	255	0.11	103	3	4.73
69	8	15.76	92	256	0.10	103	13	0.12
69	51	13.95	92	257	1.16	103	18	0.81
69	52	9.70	92	260	0.11	103	21	0.81
69	54	7.88	92	262	0.11	103	63	16.17
69	164	27.26	92	264	0.11	103	66	5.69
70	1	100.00	92	266	0.11	103	67	5.89
71	201	18.29	92	271	0.48	103	68	0.57
71	202	8.61	92	276	0.10	103	150	13.48
71	203	8.61	92	278	0.10	103	155	1.07
71	204	15.06	92	280	0.48	103	241	1.55
71	205	18.29	92	282	0.48	103	242	2.05
71	206	31.14	92	284	0.48	103	246	7.59
72	41	8.11	92	286	0.48	103	253	1.74
72	240	17.76	92	288	0.48	103	274	3.27
72	348	16.99	92	290	0.48	103	276	4.58
72	350	41.70	92	292	0.48	103	278	4.59
72	351	15.44	92	294	0.48	104	26	100.00
73	318	14.60	92	301	0.65	105	242	100.00
73	320	85.40	92	302	0.65	106	242	100.00
74	82	9.77	92	303	0.65	107	110	36.81
74	84	15.04	92	304	0.65	107	111	18.06
74	85	19.58	92	305	0.48	107	112	6.94
74	86	5.26	92	306	0.48	107	113	21.35
74	118	5.26	92	307	0.65	107	114	16.84
74	119	15.03	92	334	2.00	108	22	100.00
74	194	15.03	92	335	1.52	109	32	100.00
74	195	15.03	92	336	1.35	110	30	50.00
75	21	34.43	92	337	1.35	110	32	50.00
75	24	65.57	92	338	0.65	111	130	22.83
76	3	50.00	92	339	0.65	111	135	11.41
76	5	50.00	92	340	0.65	111	136	19.02
77	314	53.61	92	341	0.65	111	137	7.61
77	317	8.98	92	342	0.48	111	142	7.61
77	318	28.43	92	343	0.48	111	143	22.28
77	319	8.98	92	344	0.48	111	144	9.24
78	316	80.82	92	346	0.48	112	26	50.00
78	350	19.18	92	347	0.48	112	29	50.00
79	1	80.00	92	348	0.48	113	108	66.67
79	3	20.00	92	350	3.18	113	113	16.67
80	262	47.81	92	351	3.18	113	114	16.66
80	264	23.68	92	352	2.53	114	24	100.00
80	276	28.51	92	353	2.53	115	246	100.00
81	274	68.54	92	354	11.94	116	241	7.95
81	276	31.46	92	355	11.85	116	242	92.05
82	54	30.17	93	253	32.37	117	246	100.00
82	55	13.21	93	257	2.08	118	26	50.00
82	56	13.21	93	332	2.39	118	29	50.00
82	170	43.41	93	333	63.16	119	260	10.72
83	316	20.00	94	253	100.00	119	262	12.60
83	317	20.00	95	253	33.33	119	264	9.38
83	318	20.00	95	257	66.67	119	266	10.99
83	319	20.00	96	256	50.00	119	268	1.88
83	321	20.00	96	280	50.00	119	269	7.51
84	5	100.00	97	337	100.00	119	271	3.75
85	162	50.00	98	348	50.00	119	280	1.88
85	163	50.00	98	350	50.00	119	282	10.72
86	6	100.00	99	342	100.00	119	284	14.48
87	319	100.00	100	253	11.48	119	286	16.09
88	320	100.00	100	257	65.57	120	23	25.23
89	320	100.00	100	260	22.95	120	24	30.63

Table C–3. Subarea to Node Diversion Allocation Factors, *page 4 of 4*

DELTA ISLAND DIVERSION ALLOCATION FACTORS (%)
FOR DWR/RMA DELTA MODEL NODES (4/20/88). MODIFIED FOR DSM NODES BY PNT (NM 2/21/92)

ISL	NODE	DIV %	ISL	NODE	DIV %
120	241	44.14	134	203	3.84
121	301	0.71	134	204	3.84
121	302	0.71	134	205	34.78
121	304	0.71	134	215	3.83
121	305	1.91	134	216	12.08
121	306	1.91	134	222	17.47
121	316	8.38	134	224	12.08
121	317	3.91	135	39	50.00
121	318	3.91	135	42	50.00
121	319	3.91	136	38	25.00
121	320	5.81	136	216	25.00
121	321	3.91	136	226	25.00
121	326	12.50	136	232	25.00
121	350	8.38	137	38	5.00
121	351	7.25	137	77	5.00
121	352	21.31	137	78	5.00
121	354	7.39	137	79	5.00
121	355	7.39	137	80	5.00
122	320	76.51	137	81	5.00
122	350	23.49	137	82	5.00
123	352	50.00	137	84	5.00
123	353	50.00	137	85	5.00
124	314	100.00	137	86	5.00
125	298	4.53	137	91	5.00
125	299	4.53	137	92	5.00
125	301	4.53	137	93	5.00
125	302	4.53	137	98	5.00
125	304	4.53	137	100	5.00
125	311	7.26	137	196	5.00
125	312	7.26	137	197	5.00
125	314	0.73	137	198	5.00
125	315	1.57	137	212	5.00
125	318	1.57	137	219	5.00
125	326	1.57	138	98	21.43
125	330	7.03	138	100	21.43
125	331	7.03	138	232	57.14
125	332	7.03	139	98	100.00
125	333	7.26	140	38	12.50
125	334	7.26	140	39	12.50
125	335	7.26	140	40	12.50
125	336	7.26	140	41	12.50
125	337	7.26	140	42	12.50
126	318	100.00	140	43	12.50
127	317	100.00	140	44	12.50
128	193	100.00	140	45	12.50
129	45	29.60	141	45	25.10
129	198	10.20	141	46	37.45
129	199	10.20	141	47	37.45
129	200	10.20	142	222	50.00
129	201	10.20	142	226	50.00
129	205	10.20			
129	223	19.40			
130	193	32.20			
130	198	61.02			
130	201	3.96			
130	206	0.94			
130	222	0.94			
130	223	0.94			
131	222	52.12			
131	226	47.88			
132	72	8.94			
132	73	11.17			
132	74	11.17			
132	75	5.59			
132	182	22.38			
132	183	11.73			
132	187	22.32			
132	192	6.70			
133	45	28.04			
133	215	6.02			
133	216	6.02			
133	222	31.88			
133	223	28.04			
134	38	12.08			

Table C-4. Subarea to Node Drainage Allocation Factors, *page 1 of 2*

DELTA ISLAND (SUBAREA) DRAINAGE ALLOCATION FACTORS (%)
FOR DWR/RMA DELTA MODEL NODES (4/20/88). MODIFIED FOR DSM NODES BY PNT (NM 2/21/92)

ISL	NODE	DRN %	ISL	NODE	DRN %	ISL	NODE	DRN %
1	53	2.73	23	286	27.80	58	25	30.32
1	104	2.73	23	292	4.48	58	243	69.68
1	105	2.73	24	332	20.00	59	121	50.00
1	106	11.48	24	333	10.00	59	143	50.00
1	108	5.46	24	334	70.00	60	115	14.29
1	111	26.23	25	23	33.33	60	121	85.71
1	170	31.70	25	148	66.67	61	78	28.00
1	171	14.21	26	336	100.00	61	80	72.00
1	172	2.73	27	338	100.00	62	35	100.00
2	112	11.96	28	338	100.00	63	242	100.00
2	113	19.20	29	40	66.67	64	242	25.00
2	174	9.42	29	251	33.33	64	243	50.00
2	176	11.96	30	311	100.00	64	247	25.00
2	178	5.80	31	56	6.86	65	167	10.14
2	189	5.07	31	60	13.73	65	168	37.68
2	190	19.92	31	63	13.74	65	169	52.18
2	191	16.67	31	64	2.94	66	150	100.00
3	303	10.68	31	65	4.90	67	42	100.00
3	305	11.14	31	66	4.90	68	316	33.34
3	306	54.09	31	172	6.86	68	320	33.33
3	344	24.09	31	173	6.86	68	321	33.33
4	8	26.02	31	175	6.86	69	165	100.00
4	9	16.26	31	176	13.73	70	1	100.00
4	10	13.82	31	177	11.76	71	201	20.00
4	11	21.14	31	178	6.86	71	204	80.00
4	12	11.38	32	205	10.00	72	41	48.52
4	13	11.38	32	215	22.86	72	240	23.67
5	296	3.78	32	222	67.14	72	348	2.96
5	297	3.78	33	79	42.86	72	350	18.93
5	298	26.49	33	197	57.14	72	351	5.92
5	337	6.49	34	193	77.78	73	318	61.76
5	338	1.62	34	209	22.22	73	319	26.35
5	339	57.84	35	253	74.00	73	320	11.89
6	298	33.00	35	338	26.00	74	195	100.00
6	336	67.00	36	18	50.00	75	24	100.00
7	40	100.00	36	19	50.00	76	3	50.00
8	43	32.13	37	44	60.00	76	5	50.00
8	45	45.37	37	45	40.00	77	314	53.61
8	46	6.03	38	310	75.00	77	317	8.98
8	240	2.01	38	318	25.00	77	318	28.43
8	352	2.01	39	298	82.54	77	319	8.98
8	353	12.45	39	301	0.34	78	316	14.77
9	257	40.79	39	307	8.05	78	350	85.23
9	260	9.21	39	311	5.56	79	1	71.05
9	262	50.00	39	314	3.51	79	3	28.95
10	302	100.00	40	253	100.00	80	264	100.00
11	138	100.00	41	60	55.32	81	276	100.00
12	13	24.69	41	149	29.79	82	55	66.67
12	14	25.93	41	150	14.89	82	170	33.33
12	15	49.38	42	42	100.00	83	316	100.00
13	292	17.11	43	241	100.00	84	5	100.00
13	294	82.89	44	257	100.00	85	162	50.00
14	350	100.00	45	21	100.00	85	163	50.00
15	11	1.27	46	308	50.00	86	6	100.00
15	12	10.83	46	316	50.00	87	320	58.72
15	13	4.46	47	135	100.00	87	321	41.28
15	108	4.46	48	39	50.00	88	320	100.00
15	138	78.98	48	251	50.00	89	320	100.00
16	316	100.00	49	85	100.00	90	163	100.00
17	316	100.00	50	93	56.61	91	6	61.54
18	10	13.51	50	98	28.30	91	162	38.46
18	48	35.14	50	216	15.09	92	41	1.16
18	51	13.51	51	38	43.95	92	253	2.33
18	106	18.92	51	42	12.11	92	280	4.32
18	107	18.92	51	224	43.94	92	333	2.82
19	250	50.00	52	35	33.90	92	335	71.56
19	268	50.00	52	130	66.10	92	337	17.81
20	253	96.80	53	93	43.47	93	253	32.37
20	339	1.23	53	100	56.53	93	257	2.08
20	340	1.97	54	245	100.00	93	332	2.39
21	280	100.00	55	32	20.00	93	333	63.16
22	290	100.00	55	140	80.00	94	253	100.00
23	271	52.92	56	266	100.00	95	253	33.33
23	282	14.80	57	86	100.00	95	257	66.67

Table C-4. Subarea to Node Drainage Allocation Factors, *page 2 of 2*

DELTA ISLAND DRAINAGE ALLOCATION FACTORS (%)
FOR DWR/RMA DELTA MODEL NODES (4/20/88). MODIFIED FOR DSM NODES BY PNT (NM 2/21/92)

ISL	NODE	DRN %
96	280	100.00
97	337	100.00
98	348	50.00
98	350	50.00
99	342	100.00
100	253	50.00
100	260	50.00
101	253	100.00
102	20	10.09
102	54	3.72
102	55	3.72
102	56	3.72
102	58	3.72
102	59	3.72
102	149	3.72
102	168	3.72
102	169	3.72
102	171	3.72
102	241	40.10
102	242	9.86
102	274	6.47
103	1	25.29
103	3	4.73
103	13	0.12
103	18	0.81
103	21	0.81
103	63	16.17
103	66	5.69
103	67	5.89
103	68	0.57
103	150	13.48
103	155	1.07
103	241	1.55
103	242	2.05
103	246	7.59
103	253	1.74
103	274	3.27
103	276	4.58
103	278	4.59
104	26	100.00
105	242	100.00
106	242	100.00
107	111	33.33
107	113	66.67
108	23	100.00
109	32	100.00
110	30	50.00
110	32	50.00
111	137	40.00
111	143	60.00
112	26	50.00
112	29	50.00
113	113	50.00
113	114	50.00
114	24	100.00
115	246	100.00
116	241	100.00
117	246	100.00
118	26	50.00
118	29	50.00
119	266	10.87
119	269	89.13
120	241	100.00
121	301	0.71
121	302	0.71
121	304	0.71
121	305	1.91
121	306	1.91
121	316	8.38
121	317	3.91
121	318	3.91
121	319	3.91
121	320	5.81
121	321	3.91
121	326	12.50
121	350	8.38
121	351	7.25
121	352	21.31
121	354	7.39
121	355	7.39
122	320	76.51
122	350	23.49
123	352	50.00
123	353	50.00
124	307	50.00
124	315	50.00
125	298	4.53
125	299	4.53
125	301	4.53
125	302	4.53
125	304	4.53
125	311	7.26
125	312	7.26
125	314	0.73
125	315	1.57
125	318	1.57
125	326	1.57
125	330	7.03
125	331	7.03
125	332	7.03
125	333	7.26
125	334	7.26
125	335	7.26
125	336	7.26
125	337	7.26
126	318	100.00
127	318	100.00
128	70	100.00
129	45	29.60
129	198	10.20
129	199	10.20
129	200	10.20
129	201	10.20
129	205	10.20
129	223	19.40
130	66	2.68
130	67	2.68
130	68	2.68
130	69	2.68
130	70	2.68
130	79	2.68
130	193	2.68
130	197	2.68
130	198	9.18
130	199	2.68
130	200	9.18
130	201	6.50
130	204	6.50
130	205	6.50
130	206	0.94
130	209	2.68
130	222	0.94
130	223	33.46
131	222	50.00
131	226	50.00
132	192	100.00
133	45	28.04
133	215	6.02
133	216	6.02
133	222	31.88
133	223	28.04
134	38	12.08
134	203	3.84
134	204	3.84
134	205	34.78
134	215	3.83
134	216	12.08
134	222	17.47
134	224	12.08
135	39	50.00
135	42	50.00
136	38	25.00
136	216	25.00
136	226	25.00
136	232	25.00
137	38	5.00
137	77	5.00
137	78	5.00
137	79	5.00
137	80	5.00
137	81	5.00
137	82	5.00
137	84	5.00
137	85	5.00
137	86	5.00
137	91	5.00
137	92	5.00
137	93	5.00
137	98	5.00
137	100	5.00
137	196	5.00
137	197	5.00
137	198	5.00
137	212	5.00
137	219	5.00
138	232	100.00
139	98	100.00
140	38	12.50
140	39	12.50
140	40	12.50
140	41	12.50
140	42	12.50
140	43	12.50
140	44	12.50
140	45	12.50
141	45	25.10
141	46	37.45
141	47	37.45
142	222	50.00
142	226	50.00

Table C–5. Consumptive Use Adjustment Program Output File, *page 1 of 2*

DWR/RMA DELTA MODEL HYDROLOGY ENTRIES BY NODE (CFS)
DRAINAGES (DRN) AND DIVERSIONS (DIV) FOR OCT - WATER YEAR 91
** NET CHANNEL DEPLETION ADJUSTED FROM -1506.(DICU) TO -1171.(SIM-1995.HYD)

NODE	DRN	DIV	NODE	DRN	DIV	NODE	DRN	DIV
1	5.20	22.98	77	0.00	1.58	153	0.00	2.07
2	0.00	0.00	78	0.25	1.79	154	0.00	0.00
3	1.33	5.51	79	0.90	2.33	155	0.19	4.52
4	0.00	0.00	80	0.65	1.32	156	0.00	1.12
5	0.77	3.34	81	0.00	1.61	157	0.00	0.00
6	0.32	1.54	82	0.00	1.79	158	0.00	1.55
7	0.00	5.32	84	0.00	0.81	159	0.00	2.67
8	0.90	2.81	85	0.32	1.20	160	0.00	0.00
9	0.56	4.75	86	0.30	1.13	162	1.26	5.40
10	0.81	6.93	87	0.00	0.00	163	1.17	7.64
11	0.76	6.86	88	0.00	0.00	164	0.00	3.68
12	0.67	5.54	89	0.00	1.65	165	1.75	0.00
13	0.72	7.67	90	0.00	0.00	166	0.00	0.00
14	0.20	3.31	91	0.00	0.28	167	0.15	2.07
15	0.39	0.00	92	0.00	2.17	168	0.59	0.23
16	0.00	4.21	93	2.30	7.14	169	0.81	0.23
17	0.00	0.00	94	0.00	0.00	170	0.98	3.92
18	0.28	1.20	95	0.00	0.00	171	0.43	1.60
19	0.14	0.60	96	0.00	0.00	172	0.22	5.22
20	0.10	0.63	97	0.00	0.00	173	0.14	0.00
21	0.62	3.41	98	0.96	3.74	174	0.26	1.92
22	0.00	3.24	99	0.00	0.00	175	0.14	3.12
23	0.50	1.58	100	0.73	4.44	176	0.61	2.89
24	0.24	3.63	101	0.00	0.00	177	0.24	4.43
25	0.12	2.10	102	0.00	0.00	178	0.30	0.67
26	0.29	3.59	103	0.00	0.00	179	0.00	4.29
27	0.00	0.00	104	0.07	3.65	181	0.00	0.00
28	0.00	0.00	105	0.07	3.87	182	0.00	1.54
29	0.21	2.73	106	0.77	8.79	183	0.00	0.98
30	0.11	1.99	107	0.46	20.98	184	0.00	0.00
31	0.00	0.00	108	0.27	6.92	185	0.00	0.00
32	0.34	7.71	109	0.00	3.38	186	0.00	0.00
33	0.00	0.00	110	0.00	2.76	187	0.00	2.40
34	0.00	0.00	111	0.97	3.04	188	0.00	2.02
35	1.74	9.30	112	0.33	4.94	189	0.14	1.28
36	0.00	0.00	113	1.30	8.42	190	0.55	1.28
37	0.00	0.00	114	0.28	6.45	191	0.46	1.68
38	0.07	9.66	115	0.11	0.90	192	0.39	2.39
39	0.92	4.55	116	0.00	1.74	193	3.09	21.03
40	0.98	5.42	117	0.00	1.51	194	0.00	1.20
41	0.37	7.50	118	0.00	3.19	195	0.35	1.27
42	0.66	6.83	119	0.00	0.52	196	0.00	0.86
43	0.27	6.13	120	0.00	0.00	197	1.11	1.46
44	1.33	6.92	121	0.78	0.74	198	1.46	34.72
45	2.58	22.27	122	0.00	0.87	199	0.74	5.24
46	0.05	15.49	123	0.00	0.00	200	1.46	3.01
47	0.00	12.74	124	0.00	2.13	201	1.26	6.29
48	0.85	0.82	125	0.00	1.10	202	0.00	0.30
49	0.00	1.33	126	0.00	1.31	203	0.00	2.01
50	0.00	1.74	127	0.00	1.31	204	1.10	2.36
51	0.33	2.24	128	0.00	1.63	205	1.37	11.67
52	0.00	3.08	129	0.00	0.00	206	0.10	4.28
53	0.07	1.69	130	2.03	5.71	207	0.00	0.00
54	0.04	1.96	131	0.00	0.00	208	0.00	0.00
55	0.24	0.52	132	0.00	0.00	209	1.09	6.94
56	0.18	0.52	133	0.00	4.89	210	0.00	0.21
57	0.00	0.00	134	0.00	0.00	211	0.00	1.29
58	0.04	0.92	135	0.41	0.77	212	0.00	1.36
59	0.04	0.92	136	0.00	1.09	213	0.00	0.37
60	1.79	1.21	137	0.12	0.61	215	0.47	5.42
61	0.00	2.05	138	2.57	2.96	216	0.46	4.37
62	0.00	3.03	139	0.00	2.96	217	0.00	0.00
63	3.06	13.49	140	0.29	0.75	218	0.00	0.00
64	0.06	2.19	141	0.00	2.44	219	0.00	0.28
65	0.10	0.52	142	0.00	2.11	220	0.00	0.00
66	1.37	4.78	143	0.29	1.45	221	0.00	0.00
67	1.30	14.96	144	0.00	1.20	222	2.00	8.98
68	0.39	0.95	145	0.00	0.83	223	4.52	13.33
69	0.29	0.00	146	0.00	1.94	224	0.07	6.29
70	1.57	4.29	147	0.00	2.22	225	0.00	0.00
71	0.00	5.53	148	0.85	4.17	226	0.50	14.25
72	0.00	0.23	149	0.85	0.23	227	0.00	0.00
73	0.00	0.29	150	4.14	14.33	228	0.00	0.00
74	0.00	0.29	151	0.00	3.04	232	0.00	4.39
75	0.00	0.44	152	0.00	0.81	238	0.00	0.00

Table C–5. Consumptive Use Adjustment Program Output File, *page 2 of 2*

DWR/RMA DELTA MODEL HYDROLOGY ENTRIES BY NODE (CFS)
DRAINAGES (DRN) AND DIVERSIONS (DIV) FOR OCT - WATER YEAR 91
** NET CHANNEL DEPLETION ADJUSTED FROM -1506.(DICU) TO -1171.(SIM-1995.HYD)

NODE	DRN	DIV	NODE	DRN	DIV	NODE	DRN	DIV
239	0.00	0.00	316	2.67	31.07	395	0.00	0.00
240	0.10	5.63	317	0.95	8.48	397	0.00	0.00
241	1.88	10.33	318	10.16	29.46	398	0.00	0.00
242	1.13	12.26	319	2.55	15.64	399	0.00	0.00
243	0.67	3.92	320	5.50	42.68	401	0.00	0.00
244	0.00	0.00	321	1.56	8.56	402	0.00	0.00
245	1.03	4.30	322	0.00	0.00	403	0.00	0.00
246	1.48	15.80	323	0.00	0.00	406	0.00	0.00
247	0.19	5.92	324	0.00	0.00	408	0.00	0.00
248	0.00	0.00	325	0.00	0.00	409	0.00	0.00
249	0.00	0.00	326	0.90	4.32	410	0.00	0.00
250	0.69	4.10	327	0.00	0.00	412	0.00	0.00
251	1.33	3.58	328	0.00	0.00	413	0.00	0.00
252	0.00	0.00	329	0.00	0.00	418	0.00	0.00
253	8.99	44.38	330	0.11	8.18	420	0.00	0.00
254	0.00	0.00	331	0.11	8.18	421	0.00	0.00
255	0.00	0.10	332	0.37	8.35	422	0.00	0.00
256	0.00	0.82	333	1.70	6.36	425	0.00	0.00
257	2.38	18.43	334	0.91	13.70	428	0.00	0.00
258	0.00	0.00	335	12.85	5.04	433	0.00	0.00
259	0.00	0.00	336	0.81	42.14	434	0.00	0.00
260	0.21	7.26	337	3.31	3.02	436	0.00	0.00
261	0.00	0.00	338	0.33	6.80	438	0.00	0.00
262	0.92	8.50	339	0.19	7.33	440	0.00	0.00
263	0.00	0.00	340	0.03	8.90	441	0.00	0.00
264	0.71	4.86	341	0.00	9.20	443	0.00	0.00
265	0.00	0.00	342	0.52	6.10	445	0.00	0.00
266	1.68	8.76	343	0.00	2.26	446	0.00	0.00
267	0.00	0.00	344	0.49	6.55	447	0.00	0.00
268	0.69	6.97	345	0.00	0.00	448	0.00	0.00
269	0.86	1.11	346	0.00	1.88	449	0.00	0.00
270	0.00	0.00	347	0.00	3.66	451	0.00	0.00
271	0.13	6.27	348	0.01	4.00	452	0.00	0.00
272	0.00	0.00	349	0.00	0.00	453	0.00	0.00
273	0.00	0.00	350	2.36	13.45	454	0.00	0.00
274	0.63	4.99	351	0.53	6.66	455	0.00	0.00
275	0.00	0.00	352	1.51	10.79	456	0.00	0.00
276	0.80	6.50	353	0.10	4.58	457	0.00	0.00
277	0.00	0.00	354	0.52	13.81			
278	0.79	15.77	355	0.52	12.64			
279	0.00	0.00	356	0.00	0.00			
280	0.82	1.01	357	0.00	0.00			
281	0.00	0.00	358	0.00	0.00			
282	0.03	2.53	359	0.00	0.00			
283	0.00	0.00	360	0.00	0.00			
284	0.00	3.44	361	0.00	0.00			
285	0.00	0.00	362	0.00	0.00			
286	0.07	3.80	363	0.00	0.00			
287	0.00	0.00	364	0.00	0.00			
288	0.00	2.53	365	0.00	0.00			
289	0.00	0.00	366	0.00	0.00			
290	0.33	2.85	367	0.00	0.00			
291	0.00	0.00	368	0.00	0.00			
292	0.03	3.37	371	0.00	0.00			
293	0.00	0.00	372	0.00	0.00			
294	0.08	3.98	373	0.00	0.00			
295	0.00	0.00	374	0.00	0.00			
296	0.01	2.02	375	0.00	0.00			
297	0.01	4.49	376	0.00	0.00			
298	3.84	4.50	377	0.00	0.00			
299	0.07	2.12	378	0.00	0.00			
300	0.00	0.00	379	0.00	0.00			
301	0.14	2.84	380	0.00	0.00			
302	0.51	4.82	381	0.00	0.00			
303	0.22	4.21	382	0.00	0.00			
304	0.12	7.31	383	0.00	0.00			
305	0.36	7.52	384	0.00	0.00			
306	1.24	8.33	385	0.00	0.00			
307	0.47	3.71	386	0.00	0.00			
308	0.42	1.48	387	0.00	0.00			
309	0.00	0.00	388	0.00	0.00			
310	2.03	0.00	389	0.00	0.00			
311	0.47	1.89	390	0.00	0.00			
312	0.11	0.53	391	0.00	0.00			
313	0.00	0.00	392	0.00	0.00			
314	4.20	19.54	393	0.00	0.00			
315	0.15	0.12	394	0.00	0.00			

Appendix D

Leach Water

An excerpt from the 1981 report entitled "Joint DWR and WPRS Delta Channel Depletion Analysis" follows (*Joint* 1981).

> The purpose of the leach water adjustment is to redistribute from one month to the next a certain volume of Delta inflow affected by the flooding and draining of the land for leaching purposes.
>
> The surveys mentioned in the introduction covered the Peripheral Canal service area comprising 175,500 acres of irrigated cropland. The surveys showed that no lands were flooded for leaching purposes prior to October 1 and essentially all lands were drained of leach water by the end of March.
>
> The following table presents the average land areas flooded in the Peripheral service area at the end of each month:

(In 1000's of acres)

September	30	0
October	31	2.8
November	30	6.8
December	31	13.4
January	31	5.9
February	28	2.0
March	30	0.13

> The above table represents only one–half (175900/350600) of the lowlands. Therefore these figures are doubled on the following table in column one to represent the total leaching in the lowlands. The land areas being flooded at the beginning and ending of each month were compared, and the differences are shown in column two.

(In 1000's of acres)

		Flooded at End of Month	*Change in Lands Flooded*
September	30	0	–
October	31	5.6	+5.6
November	30	13.6	+8.0
December	31	26.8	+13.2
January	31	11.8	–15.0
February	28	4.0	–7.8
March	30	0.3	–3.7
April	30	0	–0.3

At a meeting with Gordon Lyford and George Sato it was agreed that we assume a depth of one foot of water ponded and another foot of water stored in the soil for a total depth of two feet.

The leach water adjustment then, is two feet times the change in lands flooded. The following table represents the proposed adjustment to Delta inflow. Since Delta water requirements are subtracted from Delta inflow, a positive number represents a loss in inflow and a negative represents a gain in inflow.

(In thousand acre–feet)

	Leach Water Adjustment
September	+11.2
October	+16.0
November	+26.4
December	–30.0
January	–15.6
February	–7.4
March	–0.6
April	0
May	0
June	0
July	0
August	0
Total	**0**

Appendix E

Irrigation and Drainage Factors for Delta Subareas

An excerpt from the 1988 memorandum entitled "Irrigation and Drainage Factors for Delta Service Area Entities" follows (Irrigation 1988).

For the approximately 350 channel nodes of the RMA model, irrigation and drainage factors were computed for 142 political entities within the Delta Service Area.

Irrigation factors indicate what percentage of the entity's applied water leaves the channel in the proximity of a node of the RMA model.

Drainage factors indicate what percentage of an entity's drainage water enters the channel in the proximity of a node of the RMA model.

1977 land use sepia maps with entities delineated by cutting lines were used in conjunction with a 1987 inventory of irrigation and drainage facilities.

<u>Irrigation factors for either "Islands" ringed with irrigation facilities or "Tracts" with irrigation facilities along one, two, or three sides.</u> The cross sectional area of each irrigation facility was computed. Siphon areas were not adjusted. Irrigation pump areas were adjusted by a factor of 2. Floodgates were adjusted by a factor of 4. Adjusted areas were assigned to the nearest channel node and irrigation factors computed from the ratio of assigned adjusted area to the total adjusted cross-sectional area for the island. Record (or entities) numbers using this assumption are:

1	15	34	53	65	96
2	18	35	54	66	100
3	19	37	55	67	107
4	20	39	56	69	108
5	22	41	57	71	111
7	23	42	58	72	116
8	25	47	59	74	119
9	28	48	60	75	120
10	29	49	61	80	131
12	31	50	62	81	132
13	32	51	63	82	138
14	33	52	64	91	

Irrigation factors for small land areas near one or two channel nodes. Factors assigned by inspection. Record numbers using this assumption are:

6	30	76	95	110	124
11	36	84	97	112	127
16	38	85	98	113	139
17	43	86	99	114	142
21	45	87	104	115	
24	46	88	105	117	
26	68	89	106	118	
27	70	90	109	123	

Irrigation factors for large land or water areas not fitting into the first two irrigation categories. Factors were computed for channel nodes based on land and water areas assigned to the nearest node. Record numbers using this assumption are:

40	79	101	125	133
44	83	102	126	134
73	92	103	128	135
77	93	121	129	136
78	94	122	130	137
				140
				141

Drainage factors for islands with two or more drainage pumping plants. A percentage of the total island discharge was assigned to the nearest channel node for each pumping plant based on the total cross sectional area of the discharge pipes of each pumping plant. Record numbers using this assumption are:

001	012	029	041	059	078
002	013	031	050	060	079
003	015	032	051	061	082
004	018	033	052	064	087
005	020	034	053	065	107
008	023	035	055	071	111
009	025	039	058	072	119

Drainage factors for islands with one drainage pumping plant that discharges near a channel node. 100 percent of the drainage was assigned to the nearest channel node. Record numbers using this assumption are:

007	027	054	075	094	114
010	028	056	080	096	115
011	030	057	081	097	116
014	042	062	083	099	117
016	043	063	084	104	120
017	044	066	086	105	127
021	045	067	088	106	128
022	047	069	089	108	132
026	049	074	090	109	138
					139

Drainage factors for islands with one drainage pumping plant that discharges somewhere in between two channel nodes. A percentage of the total island discharge was assigned to each adjacent node based on distance from the point of discharge. Record numbers using this assumption are:

37	46	48	131

Drainage factors for undesignated areas. Undesignated areas are unlike islands in that they are large stretches of land that skirt the Delta Service Area covering several 7–1/2 minute quad sheets. Drainage factors were computed for the closest channel node based on land area. Record numbers using this assumption are:

92	102	121	125	129
93	103	122	126	130

Drainage factors for water surfaces. No drainage factors were computed. Record numbers using this assumption are:

133	135	137	141
134	136	140	142

Drainage factors for small entities that don't fit into the other categories. Factors derived by inspection. Record numbers using this assumption are:

6	68	91	112
19	70	95	113
24	73	98	118
36	76	100	123
38	77	101	124
40	85	110	

Appendix F

Sensitivity Plots

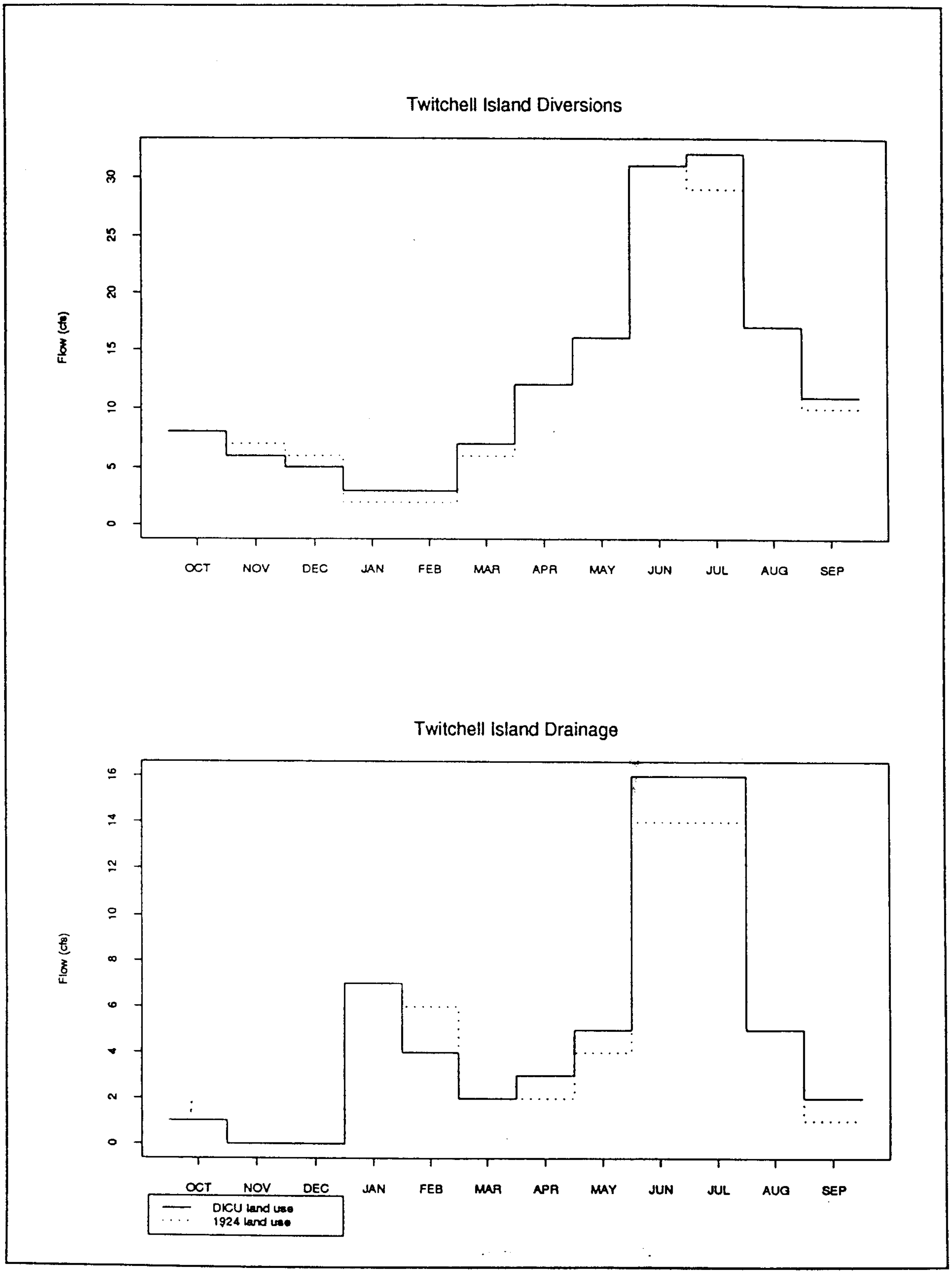

Figure F-1. DICU Model Results: 1924

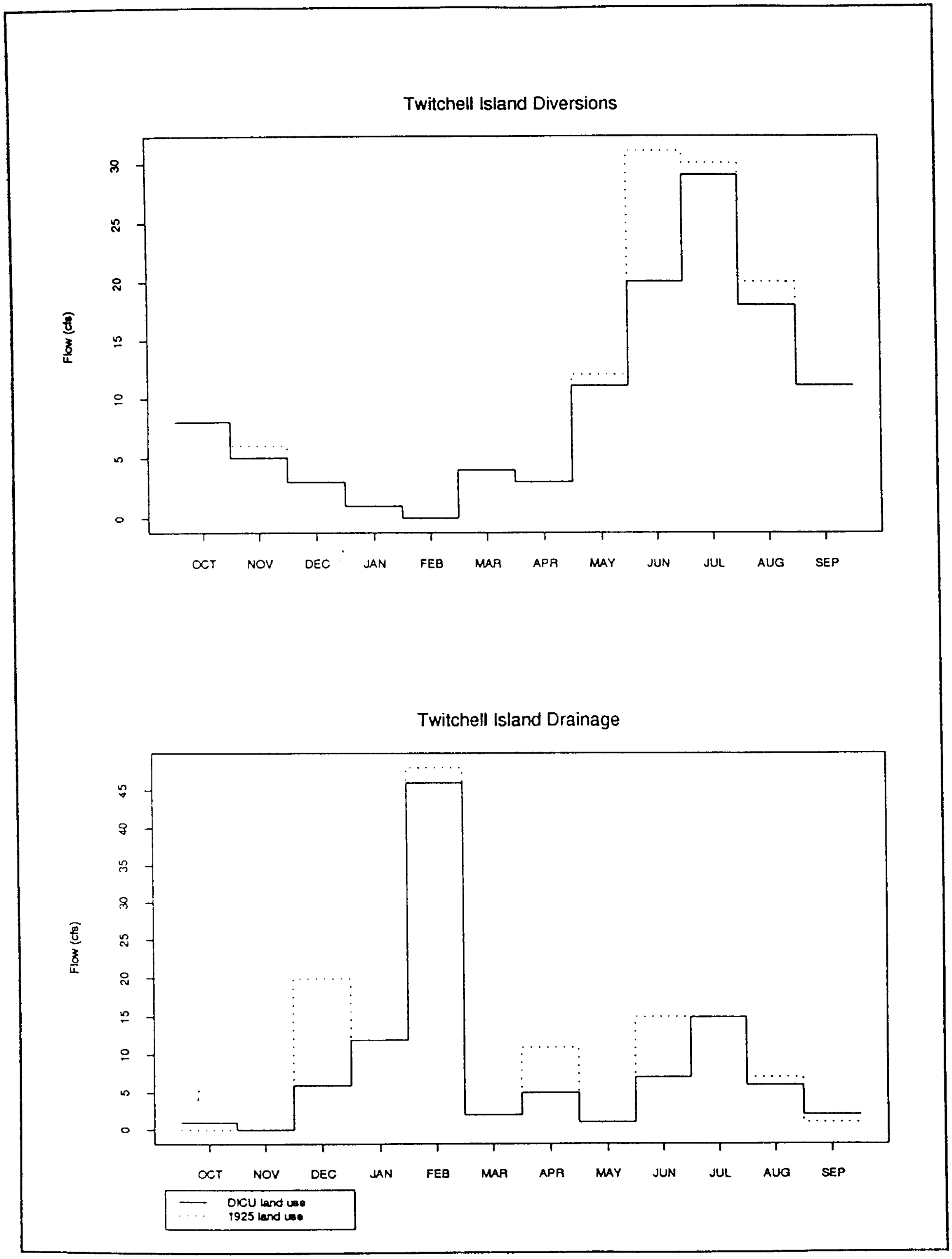

Figure F-2. DICU Model Results: 1925

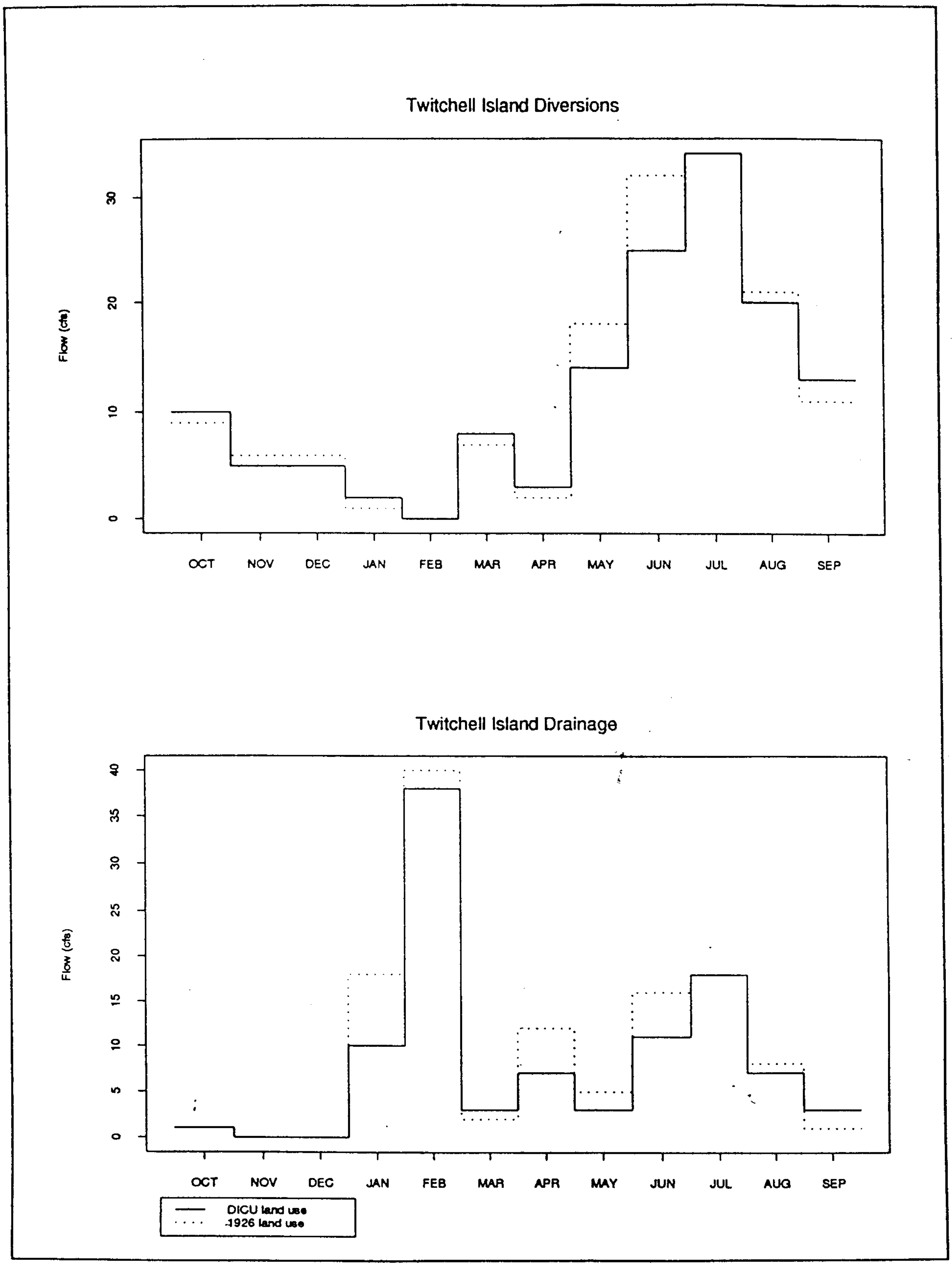

Figure F–3. DICU Model Results: 1926

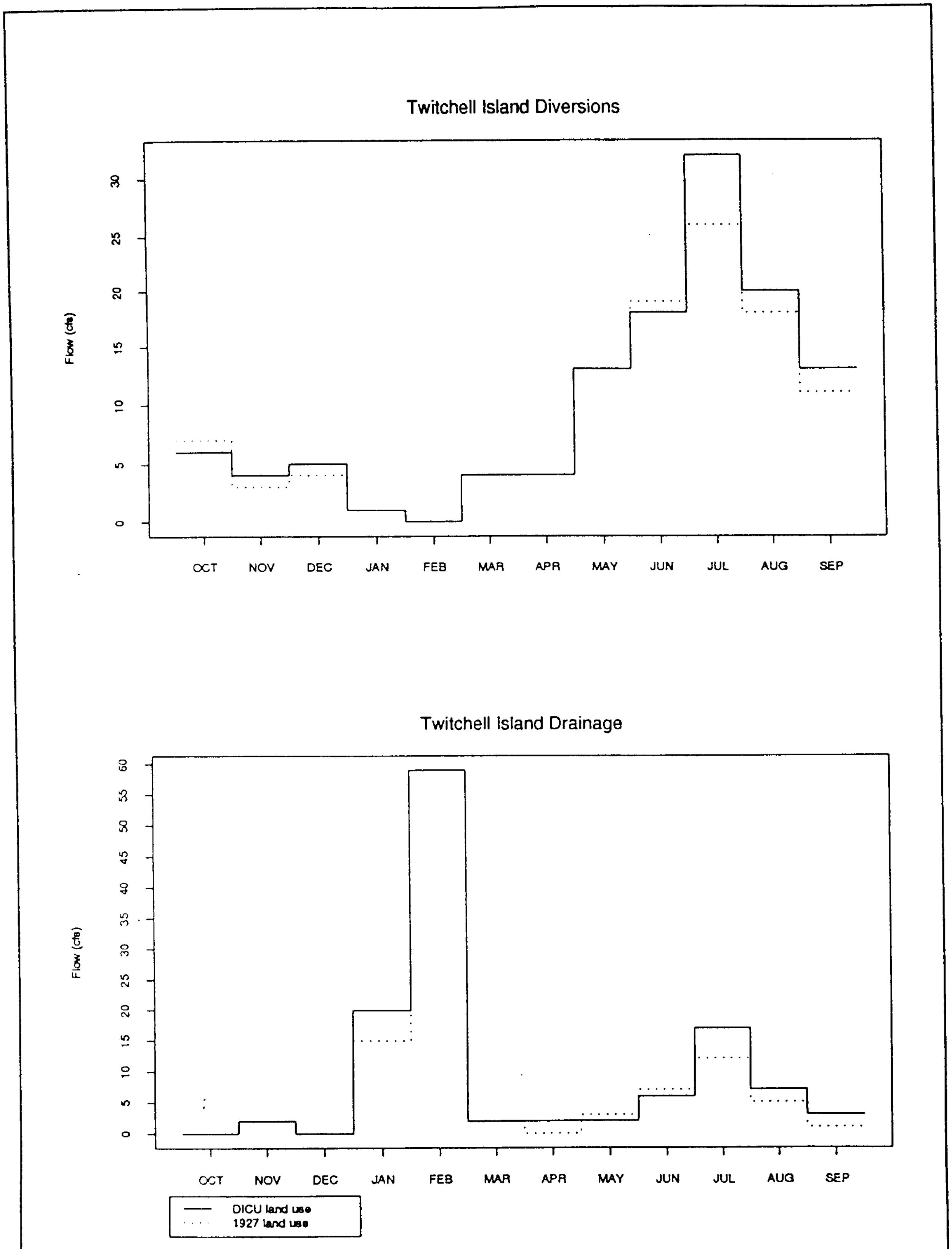

Figure F–4. DICU Model Results: 1927

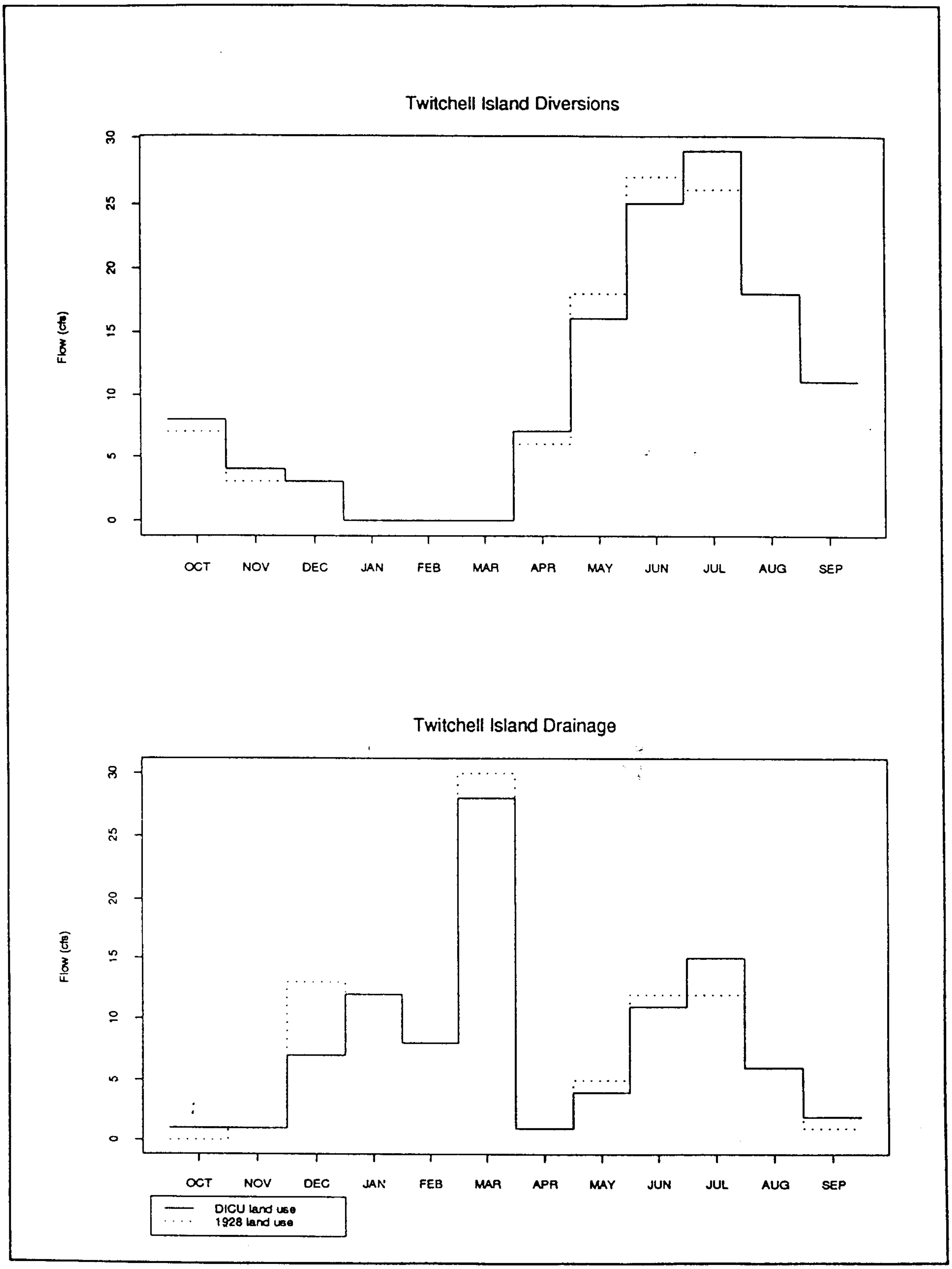

Figure F-5. DICU Model Results: 1928

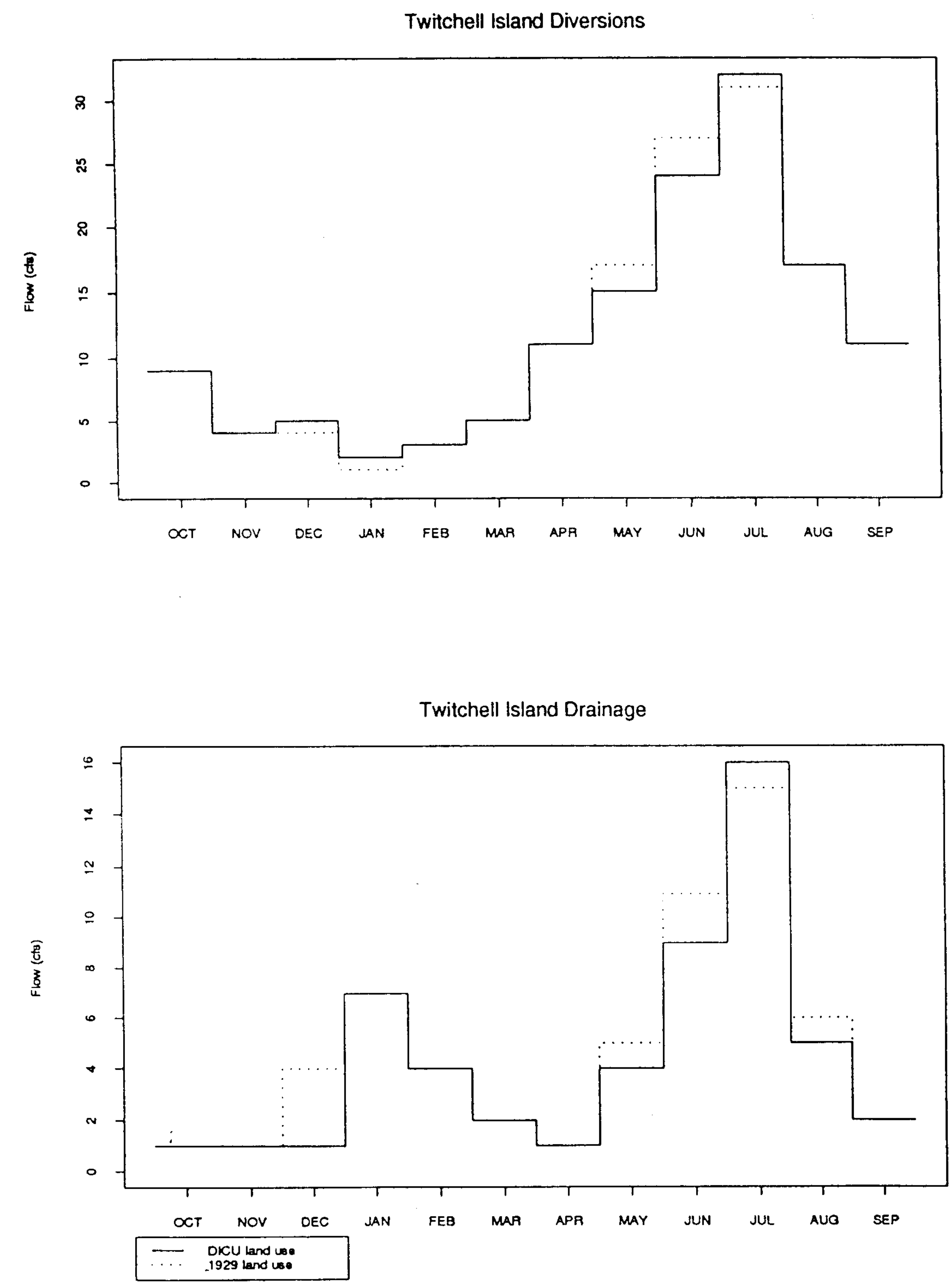

Figure F–6. DICU Model Results: 1929

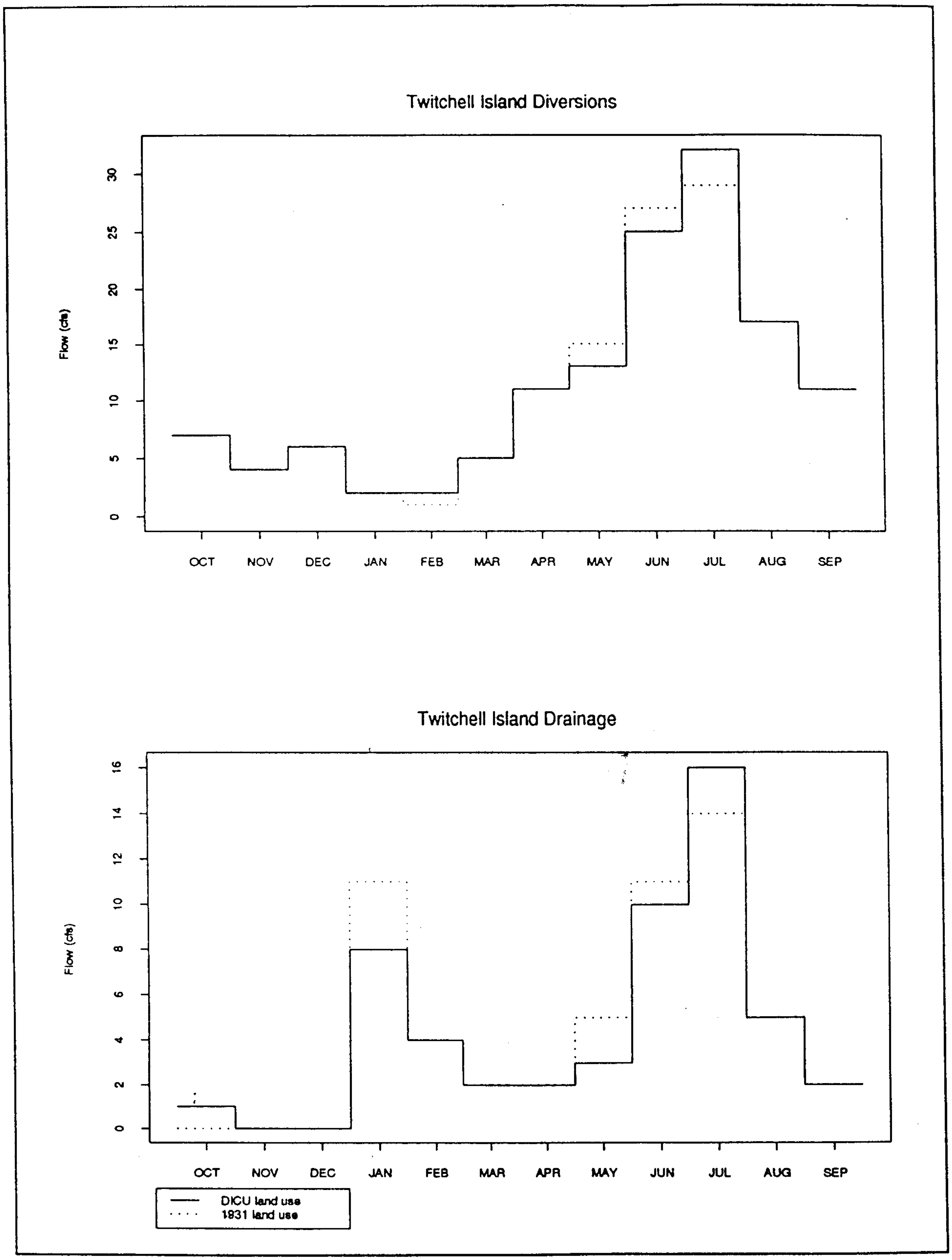

Figure F-7. DICU Model Results: 1931

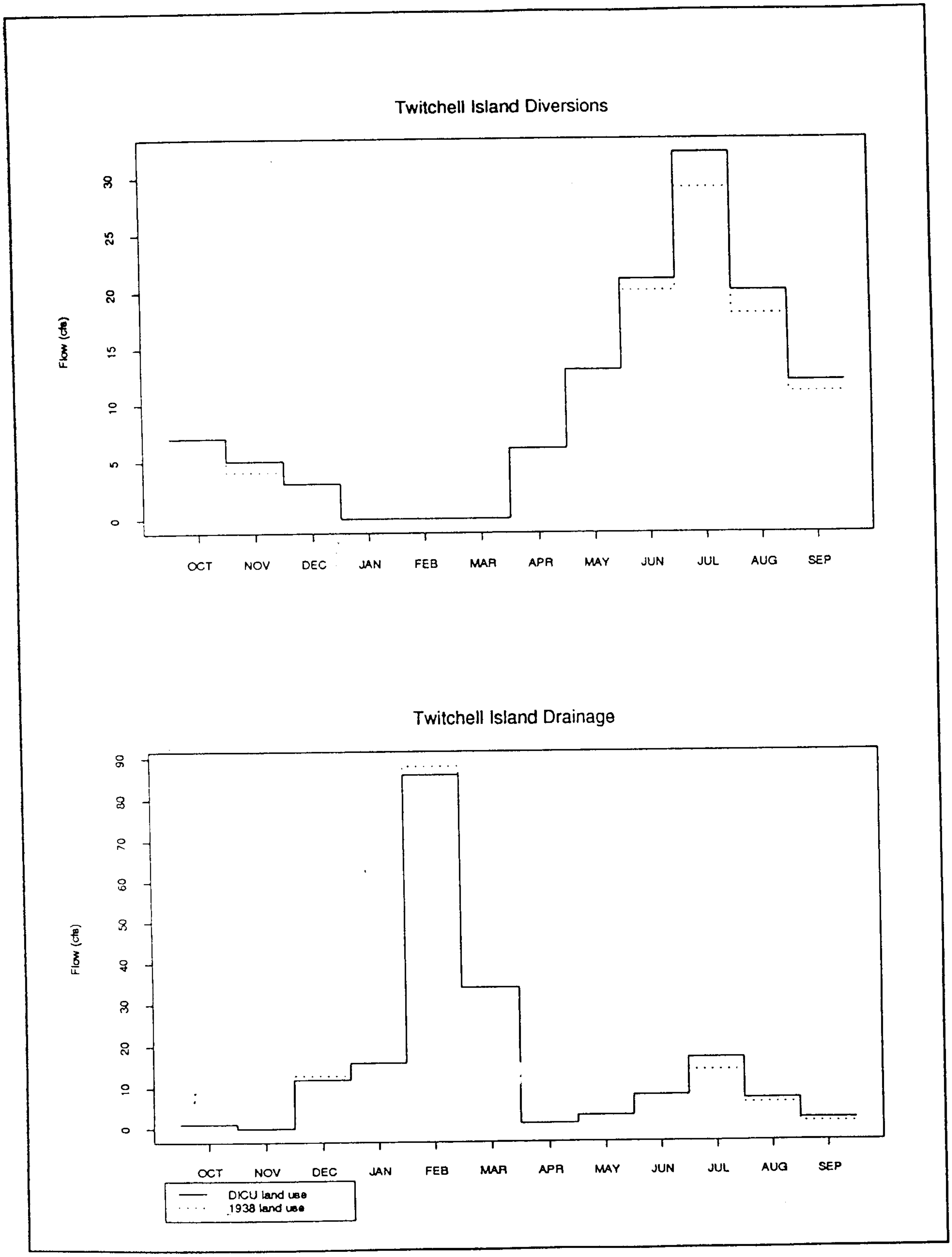

Figure F–8. DICU Model Results: 1938

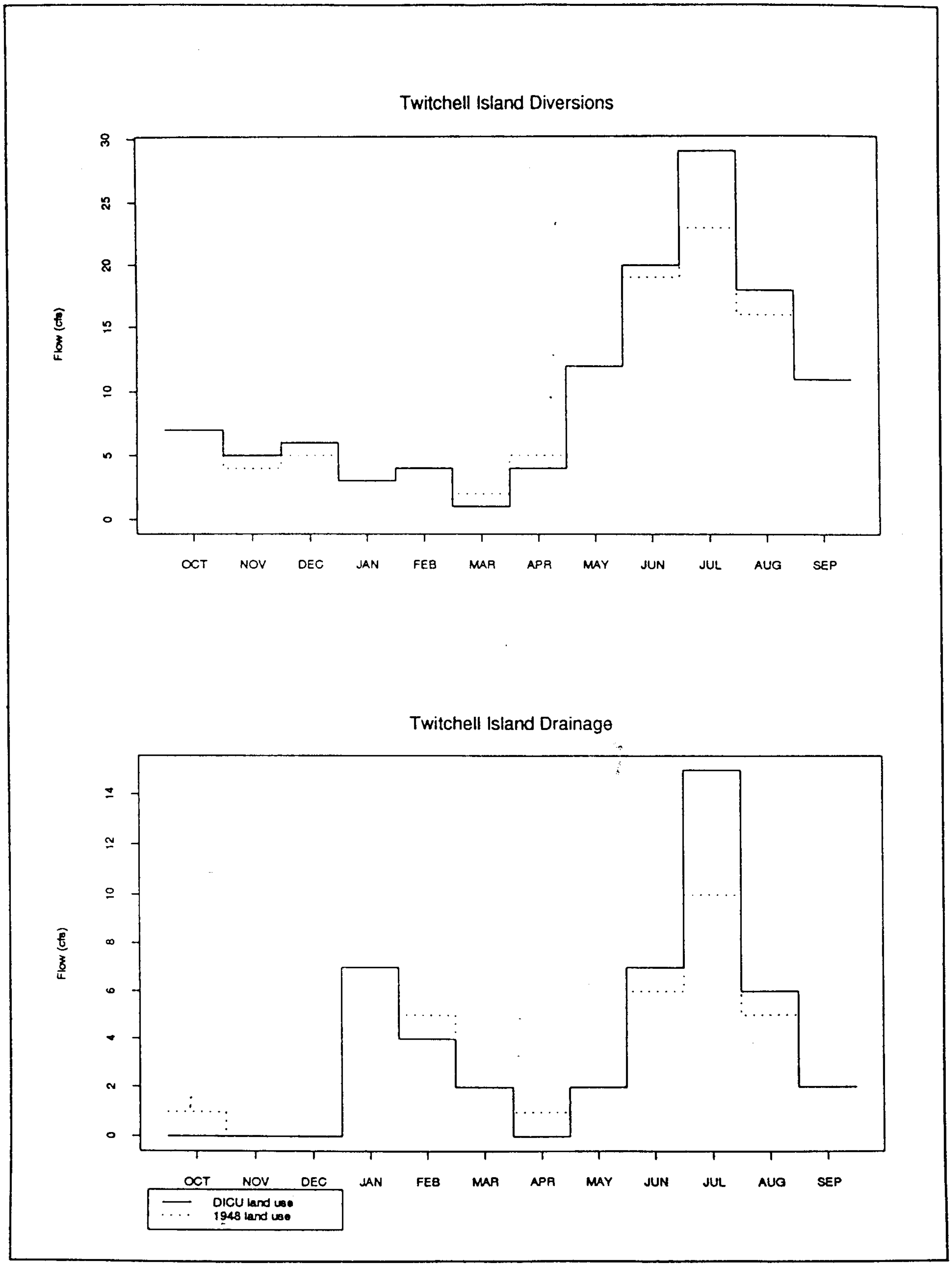

Figure F–9. DICU Model Results: 1948

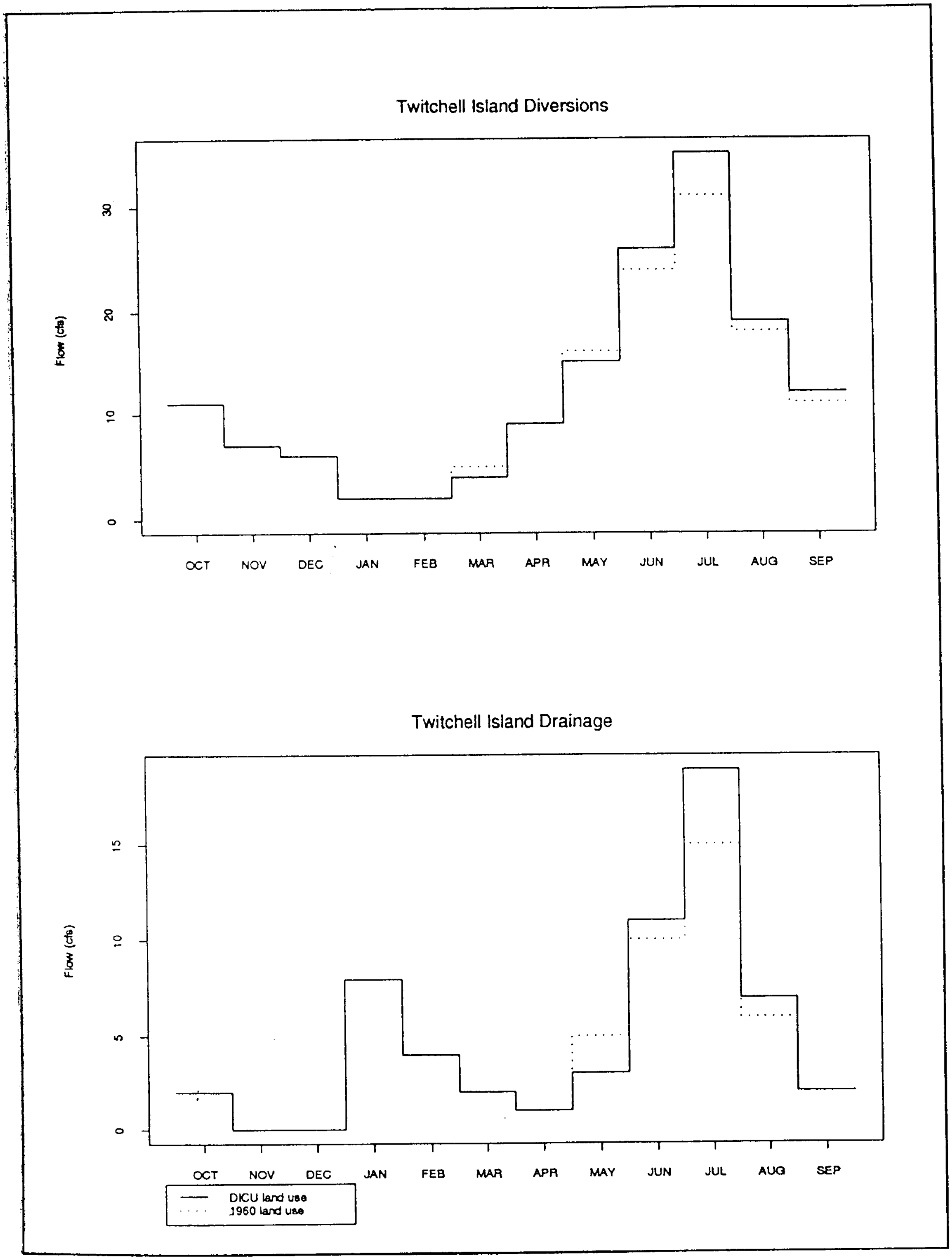

Figure F-10. DICU Model Results: 1960

Appendix G

Glossary

Applied Irrigation water (I_A) – irrigation water applied through siphons, floodgates and pumps.

Channel Depletion – In this report, water removed from the channels through irrigation facilities plus seepage available to plants.

Consumptive Use (CU) – designates the amount of water actually consumed through evaporation, transpiration and soil moisture storage.

Consumptive Use of Applied Water (CU_{AW}) – amount of applied water used to supply consumptive use demands.

Consumptive Use of Precipitation (CU_P) – amount of precipitation used to supply consumptive use demands. In DICU model bookkeeping, CU_S is included as part of CU_P.

Consumptive Use of Seepage (CU_s) – amount of seepage used to supply consumptive use demands. In DICU model bookkeeping, this value is listed as part of CU_P.

Delta Consumptive Use – see "Total Consumptive Use".

Delta Island Consumptive Use (DICU) – soil moisture budget model for estimating consumptive use.

Delta water requirement – see "Total Consumptive Use".

Department of Water Resources Delta Simulation Model (DWRDSM) – a model used to simulate Delta hydrodynamics and water quality.

Department of Water Resources Planning Simulation Model (DWRSIM) – a statewide water allocation model used to simulate the Central Valley Project and the State Water Project systems.

Diversion – see "Channel Depletion".

Drainage – See "Returns".

Evaporation Pan – In this report "evaporation pan" refers to a U. S. Weather Bureau Class A evaporation.

Evapotranspiration (ET) – The quantity of water transpired by plants, retained in plant tissue, and evaporated from plant foliage from surrounding surfaces and from adjacent soil.

Field Capacity – The volume of water remaining in a well–drained soil when velocity of downward flow into unsaturated soil has become negligible. It is expressed as a percentage of weight of oven dry soil or as a soil moisture tension value.

Gross channel depletions (GCD) – see "Total Consumptive Use".

Growing Season – A period during which crops experience their greatest growth and water use.

Internal Delta Net Use – see "Net Channel Depletion".

Irrigation Drainage – See "Drainage".

Irrigation Efficiency (η) – The ratio of minimum irrigation requirement to applied irrigation water.

Leach Water (LW) – heavy applications of water made periodically to leach salts from the root zone.

Minimum Irrigation Requirement (Applied Water Requirement or I_R***)*** – amount of water required to be delivered to a field headgate for irrigation purposes.

Net channel depletions (*NCD*) – on a Delta–wide basis, the difference between total Delta diversion and total Delta drainage for a given period of time.

Neutron Probe – An instrument, based upon the principle of neutron moderation, for determination of soil moisture content.

Pan – See "Evaporation Pan".

Precipitation (*P*) – The deposition of water from the atmosphere upon the Earth's surface in the form of rain, snow, sleet, mist or hail.

Returns – In this report, water returned to the channel through irrigation facilities.

Riparian Vegetation – Vegetation growing on the banks of a stream or other body of water.

Root Zone – The portion of the soil profile through which plant roots readily penetrate to obtain water and plant nutrients, expressed in inches or feet of depth.

Rooting Depth – The portion of the soil profile containing nearly all of the plant roots.

Runoff (RO) – excess moisture that is created when the amount of moisture in the soil is greater than the field capacity.

Seepage (S) – water that seeps from channels onto islands in the Delta Lowlands because of the head difference between water elevations in the channels and water elevations in drainage ditches in the islands.

Soil Moisture (SM) – the amount of water available to plants that is stored in the rooting zone. Usually expressed as a percentage of the dry weight of the soil.

Soil Moisture Change (Soil Moisture Depletion) – normally, the loss in soil moisture per unit time resulting from transpiration and surface evaporation. The change may become a positive value as a result of precipitation or irrigation.

Solar Radiation – short–wave energy originating from the sun. Solar radiation is the earth's principle source of energy.

Subarea to Node Allocation Program (NODCU) – a program used to determine irrigation diversions and drainage volumes, assign drainage salinity concentrations for each DICU subarea, and allocate volumes and concentrations to DWRDSM nodes.

Total Consumptive Use (*TCU*) – see "Consumptive Use".

Transpiration – the process by which water vapor is transferred to the atmosphere through living plants.