

A MEMORANDUM REPORT

JULY 1980

BONEY DIKE MARSH WATER BUDGET

by

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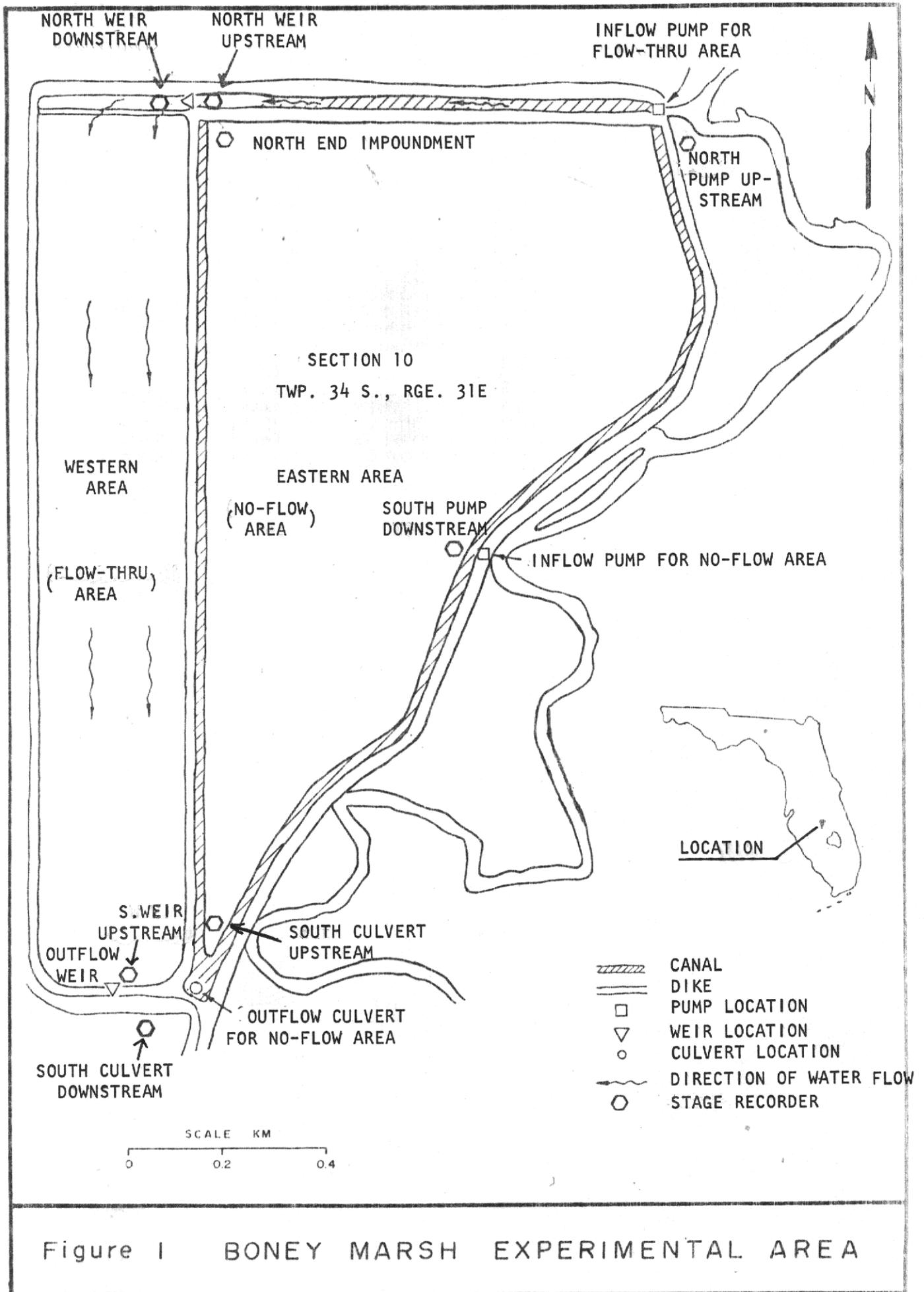
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INTRODUCTION

A detailed investigation of the Boney Dike marsh water budget has been done to provide hydrologic data for a nutrient budget of the marsh. This experimental marsh area is located along the west bank of the Kissimmee River just north of structure 65B (see Figure 1). It is a unique system of levees and discharge structures especially designed for a quantitative study of a water system. The levees divide the marsh into two separate enclosed areas - the western area and the eastern area (see Figure 1). A canal at the north boundary distributes water through the north weir to the western area. Stages in the western area are fluctuated seasonally to approximate stage fluctuations in the Kissimmee River floodplain prior to channelization. The eastern area is regulated to maintain approximately the same stage as the western area with a minimum inflow and outflow. When inflows are required in the eastern area, the south pump is used to get water from C-38. When stages in the eastern area are higher than desired, water is released through the culvert at the southern end. The western area is approximately 120 acres, while the eastern is on the order of 230 acres. The system was set up in such a way that one area was a high flow area and the other a low or no flow area. The environmental effects of small and large flows can be studied for the same climatological condition with this arrangement.

The north and south weir structures do not conform to standard specifications for flow measuring structures and thus have to be calibrated. Unfortunately, flow conditions near these structures do not lend themselves



to direct calibration with standard flow measuring techniques. The north weir can be calibrated by a water budget approach given only the stage-storage relationship for the canal connecting the weir with the pump station and the operating characteristics of the pump station. This is possible because both ET and seepage losses are negligible in the canal in relation to the flow and the pulse type mode of operation for the pump station which provides an adequate range of head conditions at the weir. This flow equation can be applied to other structures in the marsh area which have similar characteristics. The ET coefficient can be optimized using the eastern area where fluctuations in stages are due mainly to the difference in ET and rainfall. This coefficient can also be applied to the entire area. A seepage function is developed based on the head differential across the levees. Using these initial values for the various coefficients the process is repeated until the overall error for three water budgets is minimized.

DATA

The period for which sufficient historical data is available for the analysis of the Boney Marsh water budget begins March 26, 1976. A detailed investigation of the different components of this water budget is carried out through December 31, 1978. Areal distribution of the water levels is determined from a network of stage recorders placed at key locations throughout the marsh. The name and location of these recorders appear in Figure 1. Average daily stages for both the eastern and western areas are calculated from the stage recorders present in each respective area. The results for the eastern area appear in Tables 1A, 1B and 1C, while the results for the western area appear in Tables 2A, 2B and 2C. The daily rainfall measurements

***** 1976 *****

MEAN STAGES, IN FT. ABOVE M.S.L. FOR FLOW THROUGH AREA

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	40.14	39.80	39.56	40.11	39.96	40.56	41.47	42.01	41.17
2	.00 N	.00 N	.00 N	40.18	39.85	39.67	40.10	40.02	40.81	41.48	42.01	41.07
3	.00 N	.00 N	.00 N	40.16	39.63	39.79	40.03	40.07	40.92	41.50	42.09	41.14
4	.00 N	.00 N	.00 N	40.04	39.68	39.96	39.96	40.13	40.89	41.67	42.10	41.06
5	.00 N	.00 N	.00 N	39.93	39.79	39.89	40.01	40.14	40.87	41.74	42.06	40.99
6	.00 N	.00 N	.00 N	39.90	39.67	39.87	40.08	40.14	41.02	41.83	41.90	41.19
7	.00 N	.00 N	.00 N	39.93	39.65	39.75	40.15	40.06	41.11	41.86	41.79	41.26
8	.00 N	.00 N	.00 N	39.91	39.61	39.72	40.14	39.97	41.15	41.89	41.85	41.28
9	.00 N	.00 N	.00 N	39.98	39.57	39.75	40.05	40.05	41.19	41.82	41.88	41.28
10	.00 N	.00 N	.00 N	39.93	39.57	39.65	39.96	40.14	41.20	41.84	41.86	41.25
11	.00 N	.00 N	.00 N	39.86	39.56	39.61	40.05	40.17	41.09	41.90	41.86	41.06
12	.00 N	.00 N	.00 N	39.96	39.56	39.61	40.08	40.15	40.98	41.99	41.82	40.92
13	.00 N	.00 N	.00 N	40.07	39.63	39.58	40.00	40.30	41.05	41.97	41.55	40.89
14	.00 N	.00 N	.00 N	40.11	39.58	39.59	40.04	40.25	40.97	42.03	41.42	40.87
15	.00 N	.00 N	.00 N	40.13	39.65	39.60	40.06	40.20	41.03	42.00	41.37	40.76
16	.00 N	.00 N	.00 N	40.13	39.71	39.57	40.16	40.38	41.10	41.97	41.41	40.69
17	.00 N	.00 N	.00 N	39.99	39.65	39.55	40.08	40.44	41.14	41.93	41.37	40.61
18	.00 N	.00 N	.00 N	39.90	39.61	39.54	40.00	40.51	41.24	41.99	41.32	40.42
19	.00 N	.00 N	.00 N	39.99	39.57	39.54	40.04	40.53	41.11	41.97	41.32	40.29
20	.00 N	.00 N	.00 N	40.06	39.55	39.55	40.10	40.53	41.13	41.96	41.16	40.41
21	.00 N	.00 N	.00 N	40.08	39.58	39.53	40.18	40.43	41.19	41.93	41.05	40.44
22	.00 N	.00 N	.00 N	40.11	39.68	39.67	40.15	40.32	41.22	41.98	41.19	40.34
23	.00 N	.00 N	.00 N	40.12	39.65	39.78	40.12	40.41	41.20	41.94	41.18	40.29
24	.00 N	.00 N	.00 N	39.99	39.62	39.82	40.01	40.46	41.21	41.94	41.22	40.26
25	.00 N	.00 N	.00 N	39.91	39.60	39.86	39.94	40.47	41.07	41.91	41.25	40.22
26	.00 N	.00 N	40.09	39.99	39.58	39.76	40.02	40.51	40.99	41.97	41.31	40.24
27	.00 N	.00 N	40.00	40.00	39.57	39.69	40.08	40.51	41.05	42.14	41.16	40.20
28	.00 N	.00 N	39.91	39.99	39.59	39.74	40.08	40.38	41.15	42.17	41.05	40.20
29	.00 N	.00 N	40.01	39.92	39.61	39.82	40.08	40.32	41.18	42.19	41.14	40.21
30	.00 N	.00 N	40.07	39.93	39.60	40.08	40.10	40.38	41.33	42.04	41.30	40.19
31	.00 N	.00 N	40.13	39.58	39.58	40.01	40.01	40.54	41.93	41.93	41.30	40.22
AVG	.00 N	.00 N	7.75 N	40.01	39.63	39.70	40.06	40.29	41.07	41.90	41.53	40.69

AVG. FOR YEAR 31.12.

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED

N = RECORD NOT AVAILABLE

Table 1A

***** 1977 *****

MEAN STAGES, IN FT. ABOVE N.S.L. FOR FLOW THROUGH AREA

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	40.13	40.32	40.15	40.22	39.98	39.51	40.15	40.13	40.60	41.07	42.09	41.08
2	40.13	40.40	40.21	40.08	40.05	39.52	40.10	40.21	40.75	40.97	42.14	41.02
3	40.20	40.47	40.21	39.99	40.10	39.59	40.10	40.27	40.81	41.07	42.25	40.82
4	40.20	40.52	40.21	40.10	40.14	39.57	40.10	40.33	40.78	41.11	42.21	40.69
5	40.35	40.38	40.09	40.15	40.29	39.54	40.14	40.35	40.97	41.11	41.96	40.67
6	40.47	40.28	40.01	40.17	40.24	39.52	40.15	40.25	41.06	41.18	41.82	40.66
7	40.33	40.40	40.10	40.18	40.08	39.49	40.15	40.18	41.02	41.29	41.83	40.63
8	40.40	40.46	40.15	40.19	40.00	39.48	40.04	40.32	41.02	41.29	41.83	40.63
9	40.40	40.50	40.18	40.05	39.96	39.45	39.96	40.39	41.08	41.25	41.76	40.64
10	40.43	40.46	40.30	39.99	40.07	39.44	39.94	40.42	41.00	41.44	41.65	40.46
11	40.33	40.44	40.26	40.06	40.12	39.42	39.90	40.46	40.93	41.63	41.57	40.33
12	40.55	40.28	40.10	40.14	40.15	39.41	39.86	40.49	41.04	41.65	41.39	40.46
13	40.57	40.19	40.01	40.13	40.17	39.42	39.88	40.39	41.14	41.62	41.26	40.55
14	40.63	40.24	40.08	40.19	40.06	39.39	39.86	40.43	41.19	41.60	41.33	40.56
15	40.47	40.25	40.14	40.13	39.97	39.35	39.87	40.35	41.27	41.58	41.15	40.57
16	40.35	40.24	40.18	40.05	40.07	39.35	39.84	40.43	41.27	41.55	41.19	40.61
17	40.44	40.23	40.19	39.98	40.12	39.32	39.88	40.46	41.11	41.53	41.21	40.44
18	40.33	40.22	40.19	40.07	40.15	39.29	39.86	40.48	41.00	41.52	41.23	40.33
19	40.40	40.17	40.08	40.13	40.12	39.26	40.05	40.51	41.08	41.50	41.11	40.51
20	40.50	40.10	40.00	40.13	40.04	39.43	40.10	40.39	41.11	41.68	41.01	40.51
21	40.45	40.13	40.09	40.20	39.95	39.46	40.12	40.31	41.13	41.83	41.07	40.55
22	40.33	40.19	40.14	40.21	39.73	39.54	40.15	40.41	41.18	42.04	41.11	40.55
23	40.51	40.11	40.10	40.07	39.69	39.86	40.06	40.51	41.15	42.16	41.22	40.55
24	40.52	40.15	40.05	39.99	39.65	39.88	39.99	40.51	41.04	42.09	41.25	40.39
25	40.51	40.19	40.11	40.10	39.61	39.97	40.08	40.51	40.93	42.03	41.22	40.33
26	40.53	40.08	40.03	40.17	39.58	39.92	40.13	40.54	41.03	42.10	41.07	40.43
27	40.39	40.01	39.97	40.19	39.56	40.03	40.17	40.42	41.12	42.16	40.94	40.49
28	40.53	40.00	40.03	40.20	39.57	40.08	40.17	40.36	41.15	42.16	41.00	40.50
29	40.43	40.00	40.09	40.19	39.58	40.12	40.18	40.48	41.19	42.03	41.17	40.54
30	40.30	40.05	40.15	40.05	39.55	40.14	40.07	40.53	41.21	41.93	41.14	40.55
31	40.43	39.51	40.19	39.51	39.51	40.00	40.00	40.54	41.21	42.04	41.14	40.40
AVG	40.43	40.27	40.13	40.12	39.93	39.59	40.03	40.40	41.05	41.62	41.44	40.56

AVG. FOR YEAR 40.35

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED

N = RECORD NOT AVAILABLE

Table 1B

***** 1978 *****

MEAN STAGES, IN FT. ABOVE M.S.L. FOR FLOW THROUGH AREA

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	40.32	40.11	40.22	40.12	40.18	39.47	40.18	40.57	40.50	41.54	41.14	40.72
2	40.43	40.11	40.25	40.03	40.26	39.47	40.14	40.54	40.88	42.01	41.18	40.51
3	40.43	40.15	40.29	40.15	40.34	39.48	40.35	40.58	41.01	42.05	41.29	40.41
4	40.51	40.05	40.11	40.22	40.29	39.47	40.19	40.61	41.11	42.13	41.08	40.55
5	40.52	39.96	40.01	40.26	40.03	39.71	40.26	40.44	41.12	42.16	40.99	40.60
6	40.45	39.99	40.12	40.26	39.94	39.72	40.31	40.36	41.16	42.16	41.08	40.57
7	40.33	40.06	40.19	40.28	39.86	39.73	40.42	40.48	41.19	42.03	41.29	40.65
8	40.27	40.18	40.23	40.12	39.79	39.75	40.22	40.48	41.15	41.93	41.17	40.44
9	40.43	40.25	40.30	40.03	39.74	39.75	40.25	40.56	41.07	42.01	41.17	40.33
10	40.43	40.24	40.20	40.15	39.70	39.73	40.27	40.61	40.99	41.92	41.19	40.28
11	40.51	40.07	40.10	40.07	39.67	39.75	40.31	40.65	41.05	42.09	41.07	40.49
12	40.57	40.08	40.01	40.05	39.65	39.90	40.33	40.46	41.11	42.20	40.98	40.57
13	40.57	40.04	40.12	40.00	39.63	39.89	40.34	40.37	41.17	42.19	41.00	40.60
14	40.40	40.11	40.18	40.11	39.56	40.17	40.25	40.50	41.21	42.07	41.08	40.64
15	40.32	40.15	40.23	40.04	39.53	40.26	40.21	40.52	41.23	41.36	41.13	40.65
16	40.43	40.20	40.26	39.97	39.51	40.34	40.25	40.56	41.08	42.02	41.12	40.47
17	40.50	40.21	40.26	40.12	39.67	40.20	40.25	40.57	40.97	42.06	41.11	40.38
18	40.54	40.09	40.09	40.19	39.65	40.15	40.43	40.58	41.05	42.07	40.93	40.57
19	40.67	39.99	40.00	40.25	39.63	40.26	40.37	40.49	41.08	42.07	40.82	40.60
20	40.52	40.12	40.13	40.28	39.62	40.33	40.35	40.35	41.08	41.93	40.92	40.61
21	40.42	40.19	40.21	40.27	39.58	40.32	40.28	40.47	41.11	41.84	40.92	40.63
22	40.32	40.21	40.25	40.10	39.56	40.34	40.26	40.51	41.35	41.78	40.89	40.65
23	40.45	40.20	40.29	39.99	39.55	40.40	40.26	40.53	41.11	41.85	40.71	40.47
24	40.37	40.21	40.28	40.13	39.54	40.27	40.26	40.56	41.09	41.87	40.79	40.40
25	40.44	40.08	40.10	40.19	39.53	40.18	40.33	40.57	41.16	41.70	40.64	40.35
26	40.48	40.01	40.00	40.24	39.51	40.24	40.31	40.38	41.31	41.58	40.57	40.51
27	40.44	40.10	40.14	40.24	39.52	40.29	40.37	40.28	41.49	41.58	40.59	40.61
28	40.23	40.14	40.19	40.04	39.51	40.31	40.60	40.47	41.80	41.46	40.74	40.68
29	40.21	40.25	40.25	40.19	39.50	40.32	40.61	40.57	41.97	41.33	40.74	40.64
30	40.25	40.28	40.28	40.07	39.50	40.34	40.63	40.66	41.97	41.38	40.65	40.46
31	40.15	40.29	40.29		39.49		40.64	40.78		41.33		40.37
AVG	40.42	40.12	40.18	40.14	39.71	40.02	40.33	40.52	41.20	41.89	40.97	40.53

AVG. FOR YEAR 40.39

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 1C

***** 1976 *****

MEAN STAGES, IN FT. ABOVE M.S.L. FOR NON FLOW THROUGH AREA

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	39.49	39.25	39.30	39.30	39.66	40.50	41.45	41.91	41.11
2	.00 N	.00 N	.00 N	39.47	39.25	39.44	39.28	39.78	40.46	41.42	41.88	41.10
3	.00 N	.00 N	.00 N	39.45	39.25	39.68	39.27	39.85	40.52	41.41	41.93	41.09
4	.00 N	.00 N	.00 N	39.43	39.22	39.86	39.24	39.88	40.51	41.47	41.91	41.08
5	.00 N	.00 N	.00 N	39.43	39.21	39.85	39.21	39.86	40.51	41.55	41.88	41.08
6	.00 N	.00 N	.00 N	39.47	39.18	39.84	39.19	39.88	40.61	41.64	41.85	41.16
7	.00 N	.00 N	.00 N	39.51	39.14	39.80	39.17	39.87	40.69	41.69	41.82	41.17
8	.00 N	.00 N	.00 N	39.54	39.11	39.78	39.18	39.84	40.79	41.78	41.77	41.17
9	.00 N	.00 N	.00 N	39.53	39.08	39.79	39.17	39.83	40.88	41.77	41.72	41.14
10	.00 N	.00 N	.00 N	39.52	39.06	39.75	39.14	39.85	40.97	41.75	41.68	41.10
11	.00 N	.00 N	.00 N	39.51	39.05	39.62	39.13	39.86	40.96	41.87	41.56	41.02
12	.00 N	.00 N	.00 N	39.52	39.04	39.52	39.16	39.89	40.96	41.94	41.60	40.95
13	.00 N	.00 N	.00 N	39.52	39.10	39.42	39.15	39.89	41.05	41.93	41.64	40.96
14	.00 N	.00 N	.00 N	39.51	39.10	39.12	39.12	40.00	41.03	41.91	41.48	40.75
15	.00 N	.00 N	.00 N	39.51	39.18	39.36	39.09	39.98	41.01	41.92	41.40	40.62
16	.00 N	.00 N	.00 N	39.49	39.42	39.32	39.17	40.11	40.99	41.92	41.33	40.51
17	.00 N	.00 N	.00 N	39.48	39.45	39.30	39.24	40.18	40.98	41.82	41.27	40.43
18	.00 N	.00 N	.00 N	39.47	39.43	39.27	39.26	40.29	41.15	41.83	41.22	40.38
19	.00 N	.00 N	.00 N	39.45	39.43	39.27	39.25	40.35	41.13	41.93	41.19	40.36
20	.00 N	.00 N	.00 N	39.46	39.36	39.29	39.23	40.34	41.11	41.94	41.16	40.36
21	.00 N	.00 N	.00 N	39.45	39.38	39.28	39.34	40.38	41.15	41.94	41.14	40.34
22	.00 N	.00 N	.00 N	39.44	39.53	39.32	39.32	40.37	41.16	41.94	41.11	40.33
23	.00 N	.00 N	.00 N	39.42	39.55	39.45	39.32	40.35	41.14	41.95	41.09	40.34
24	.00 N	.00 N	.00 N	39.40	39.51	39.48	39.28	40.34	41.13	41.95	41.08	40.33
25	.00 N	.00 N	.00 N	39.38	39.51	39.42	39.26	40.33	41.12	42.10	41.06	40.32
26	.00 N	.00 N	39.55	39.37	39.47	39.37	39.25	40.31	41.11	42.09	41.05	40.36
27	.00 N	.00 N	39.55	39.34	39.38	39.34	39.51	40.36	41.10	42.06	41.04	40.35
28	.00 N	.00 N	39.54	39.30	39.36	39.29	39.59	40.36	41.10	41.99	41.03	40.34
29	.00 N	.00 N	39.53	39.29	39.37	39.28	39.57	40.34	41.18	41.98	41.06	40.32
30	.00 N	.00 N	39.52	39.26	39.33	39.29	39.73	40.32	41.16	41.96	41.12	40.31
31	.00 N	.00 N	39.49	39.29	39.29	39.68	39.68	40.31	41.15	41.94	41.12	40.37
AVG	.00 N	.00 N	7.65 N	39.45	39.23	39.48	39.29	40.10	40.94	41.84	41.43	40.68

AVG. FOR YEAR 39.91

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

TABLE 2A

***** 1977 *****
 MEAN STAGES IN FT. ABOVE M. S. L. FOR NON FLOW THROUGH AREA

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	40.34	40.22	39.74	39.93	39.39	39.23	39.70	39.85	40.54	41.21	42.20	41.16
2	40.33	40.22	39.73	39.92	40.00	39.21	39.70	39.95	40.66	41.19	42.18	41.06
3	40.37	40.22	39.72	39.91	39.38	39.33	39.38	40.02	40.73	41.27	42.26	40.94
4	40.33	40.22	39.71	39.90	39.97	39.32	39.78	40.11	40.72	41.24	42.31	40.85
5	40.33	40.22	39.73	39.90	40.10	39.27	39.90	40.19	40.89	41.21	42.20	40.74
6	40.35	40.22	39.72	39.89	40.10	39.25	39.94	40.18	40.97	41.28	42.11	40.67
7	40.33	40.21	39.72	39.94	40.11	39.20	39.98	40.15	41.05	41.37	41.99	40.58
8	40.33	40.21	39.70	39.92	40.09	39.20	39.95	40.23	41.03	41.35	41.89	40.55
9	40.32	40.20	39.69	39.92	40.10	39.18	39.92	40.34	41.12	41.32	41.83	40.56
10	40.33	40.18	39.80	39.90	40.12	39.16	39.96	40.39	41.10	41.46	41.71	40.53
11	40.31	40.14	39.80	39.90	40.15	39.14	39.94	40.45	41.08	41.57	41.60	40.53
12	40.30	40.09	39.79	39.88	40.12	39.14	39.92	40.46	41.17	41.65	41.50	40.52
13	40.29	40.04	39.79	39.88	40.11	39.14	39.94	40.46	41.15	41.73	41.42	40.51
14	40.28	39.95	39.78	39.87	40.09	39.13	39.94	40.43	41.20	41.83	41.37	40.51
15	40.30	39.91	39.77	39.92	40.08	39.11	39.95	40.42	41.25	41.81	41.31	40.52
16	40.31	39.88	39.77	39.91	40.06	39.10	39.95	40.40	41.26	41.78	41.27	40.58
17	40.30	39.81	39.76	39.89	40.05	39.09	40.00	40.38	41.23	41.84	41.24	40.58
18	40.30	39.78	39.76	39.88	40.03	39.07	39.99	40.38	41.20	41.82	41.23	40.58
19	40.28	39.76	39.74	39.86	39.97	39.05	40.02	40.45	41.22	41.78	41.21	40.57
20	40.26	39.77	39.73	39.93	39.90	39.20	40.01	40.44	41.20	41.83	41.20	40.55
21	40.26	39.55	39.71	40.00	39.86	39.31	39.96	40.42	41.19	41.90	41.19	40.56
22	40.26	39.72	39.71	40.07	39.72	39.23	39.95	40.51	41.22	41.90	41.18	40.55
23	40.25	39.72	39.69	40.05	39.55	39.44	39.95	40.54	41.20	42.07	41.24	40.53
24	40.25	39.79	39.68	40.04	39.41	39.40	39.94	40.53	41.19	42.09	41.24	40.53
25	40.25	39.77	39.74	40.01	39.32	39.33	39.92	40.51	41.17	42.08	41.22	40.56
26	40.25	39.78	39.77	40.02	39.34	39.36	39.90	40.51	41.19	42.15	41.21	40.55
27	40.25	39.76	39.79	40.00	39.35	39.58	39.88	40.51	41.18	42.14	41.19	40.55
28	40.23	39.76	39.95	39.99	39.32	39.50	39.86	40.52	41.16	42.19	41.17	40.54
29	40.22	39.99	39.99	40.03	39.35	39.47	39.93	40.58	41.13	42.17	41.28	40.53
30	40.21	39.96	39.96	40.00	39.28	39.60	39.90	40.59	41.23	42.15	41.25	40.53
31	40.23	39.94	39.94	39.94	39.24	39.88	39.88	40.56	41.23	42.12	41.25	40.52
AVG.	40.29	39.98	39.77	39.94	39.33	39.26	39.91	40.37	41.09	41.73	41.54	40.62

AVG. FOR YEAR 40.25

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OF ALL OF RECORD IS MISSING AND THIS ESTIMATED
 H = RECORD NOT AVAILABLE

Table 2B

***** 1978 *****

MEAN STAGES IN FT. ABOVE N.S.L. FOR NON FLOW THROUGH AREA

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	40.51	40.06	39.91	39.87	39.30	39.24	40.01	40.62	40.89	42.08	41.28	40.64
2	40.50	39.94	39.91	39.86	39.92	39.24	40.03	40.65	40.87	42.11	41.25	40.62
3	40.49	39.96	40.01	39.85	39.97	39.26	40.17	40.64	41.05	42.13	41.21	40.60
4	40.48	39.79	40.00	39.88	39.97	39.26	40.14	40.62	41.23	42.08	41.19	40.58
5	40.48	39.75	39.99	39.89	39.84	39.60	40.11	40.62	41.27	42.14	41.17	40.57
6	40.47	39.72	39.98	39.88	39.77	39.60	40.07	40.62	41.25	42.13	41.16	40.54
7	40.47	39.72	39.96	39.88	39.66	39.56	40.12	40.61	41.23	42.12	41.36	40.54
8	40.50	39.76	39.95	39.87	39.48	39.57	40.09	40.59	41.21	42.09	41.34	40.52
9	40.49	39.88	40.08	39.86	39.35	39.53	40.06	40.56	41.19	42.13	41.31	40.50
10	40.48	39.88	39.94	39.86	39.28	39.53	40.03	40.53	41.16	42.14	41.27	40.49
11	40.47	39.88	39.92	39.85	39.24	39.57	40.00	40.59	41.14	42.16	41.27	40.47
12	40.46	39.86	39.91	39.85	39.20	39.57	39.95	40.59	41.22	42.22	41.24	40.48
13	40.47	39.87	39.90	39.85	39.17	39.55	39.94	40.59	41.20	42.19	41.23	40.47
14	40.46	39.87	39.88	39.86	39.16	39.75	39.92	40.58	41.17	42.19	41.21	40.46
15	40.46	39.87	39.88	39.85	39.14	39.87	39.94	40.55	41.30	42.16	41.19	40.54
16	40.46	39.91	39.91	39.82	39.11	39.97	39.94	40.54	41.27	42.13	41.17	40.53
17	40.45	39.91	39.86	39.83	39.32	39.93	39.95	40.52	41.24	42.09	41.15	40.51
18	40.47	39.97	39.86	39.83	39.41	39.91	40.17	40.50	41.22	42.06	41.12	40.52
19	40.51	39.97	39.85	39.89	39.35	39.90	40.26	40.59	41.20	42.07	41.10	40.50
20	40.51	39.98	39.84	39.88	39.27	39.89	40.22	40.57	41.17	42.03	41.09	40.50
21	40.51	39.97	39.84	39.85	39.26	39.90	40.17	40.55	41.16	42.01	41.03	40.49
22	40.50	39.95	39.85	39.83	39.25	39.96	40.17	40.53	41.39	41.98	40.96	40.47
23	40.53	39.95	39.85	39.82	39.23	40.09	40.13	40.52	41.37	41.94	40.90	40.48
24	40.53	39.93	39.84	39.85	39.21	40.09	40.09	40.53	41.47	41.88	40.81	40.49
25	40.53	39.91	39.84	39.81	39.20	40.19	40.10	40.51	41.45	41.78	40.75	40.49
26	40.53	39.92	39.83	39.89	39.19	40.16	40.06	40.48	41.52	41.68	40.70	40.48
27	40.52	39.91	39.83	39.88	39.19	40.16	40.20	40.47	41.59	41.62	40.66	40.53
28	40.46	39.91	39.85	39.86	39.25	40.16	40.20	40.44	41.75	41.59	40.55	40.66
29	40.41	39.88	39.88	39.84	39.26	40.07	40.37	40.52	41.84	41.50	40.63	40.63
30	40.23	39.88	39.88	39.82	39.24	40.05	40.48	40.60	42.04	41.40	40.62	40.59
31	40.15	39.87	39.87	39.22	39.22	40.05	40.57	40.74	41.34	41.34	40.62	40.56
Avg	40.49	39.89	39.90	39.86	39.39	39.77	40.13	40.57	41.30	41.97	41.07	40.53

AVG. FOR YEAR 40.30

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 2C

were taken from a rain gage located in the Boney Marsh area but the pan evaporation measurements taken on site proved unreliable and the records at S-65C were used instead. These daily values appear in Tables 3A, 3B, 3C and Tables 4A, 4B, 4C respectively.

METHODOLOGY

Calculations of Storage Change

Separate stage-storage curves were developed for the western area, the eastern area and the canal. These curves were based on contour maps of the area and the hydrologic design of the canal. The daily change in storage for each area on any given day was estimated based on the stage-storage curve and the average stage in that area at the beginning (0:00) and at the end of the day (24:00). This change in storage will be referred to as actual estimation of change in storage and symbolized by ΔS_a . The change in storage was also simulated by daily calculations of the individual components of the water budget, such as rainfall, ET, seepage, and flow through inflow-outflow structures. This change in storage takes the form

$$\Delta S_s = Q_{in} - Q_{out} - \text{Seep} - \text{ET} + \text{RF}$$

where

ΔS_s = simulated change in storage

Q_{in} = inflow

Q_{out} = outflow

Seep = seepage

ET = Evapotranspiration

RF = Rainfall

The discharges over the weirs were based on the basic flow equations. If the weir is not submerged the flow rate is based on the weir height and the upstream stage. If the weir is submerged, the downstream stage has to be

***** 1976 *****

BOREY DIKE RAINFALL, IN INCHES

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	.00 N	.00	.05 M	.07	.16	.00	.00	.00	.06
2	.00 N	.00 N	.00 N	.00 N	.09	.70 M	.00	.08	1.12	.00	.02	.00
3	.00 N	.00 N	.00 N	.00 N	.01	1.09 M	.00	.05	.00	.00	.50	.00
4	.00 N	.00 N	.00 N	.00 N	.00	1.92 M	.00	.75	.00	.00	.00	.00
5	.00 N	.00 N	.00 N	.00 N	.00	.00 M	.00	.06	.11	.00	.00	.00
6	.00 N	.00 N	.00 N	.38 M	.00	.80 M	.01	.21	.16	.00	.00	1.00
7	.00 N	.00 N	.00 N	.33 M	.00	.17	.20	.01	.50	.00	.00	.04
8	.00 N	.00 N	.00 N	.27 M	.00	.43	.00	.03	.00	.45	.00	.07
9	.00 N	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.08	.00	.00
10	.00 N	.00 N	.00 N	.00	.00	.40	.00	.32	.02	.00	.00	.00
11	.00 N	.00 N	.00 N	.00	.00	.29	.59	.44	.20	.14	.00	.00
12	.00 N	.00 N	.00 N	.00	.12	.00	.00	.23	.00	.00	.00	.00
13	.00 N	.00 N	.00 N	.00	.65	.00	.00	.14	.12	.00	.00	.00
14	.00 N	.00 N	.00 N	.00	.00	.00	.00	.37	.00	.00	.00	.00
15	.00 N	.00 N	.00 N	.00	.65	.08	.00	.00	.00	.00	.00	.00
16	.00 N	.00 N	.00 N	.00	1.57	.00	.92	.34	.00	.02	.00	.00
17	.00 N	.00 N	.00 N	.00	.28	.00	.13	.07	.00	.00	.00	.00
18	.00 N	.00 N	.00 N	.00	.00	.00	.00	.12	1.16	.00	.00	.00
19	.00 N	.00 N	.00 N	.00	.00	.13	.00	.00	.00	.00	.00	.00
20	.00 N	.00 N	.00 N	.00	.00	.37	.00	.00	.00	.11	.00	.00
21	.00 N	.00 N	.00 N	.00	.31	.08	.65	.61	.74	.00	.00	.00
22	.00 N	.00 N	.00 N	.00	1.56	.27	.00	.00	.23	.00	.00	.00
23	.00 N	.00 N	.00 N	.00	.13	1.32	.00	.00	.00	.00	.00	.13
24	.00 N	.00 N	.00 N	.00	.00	.48	.00	.00	.00	.00	.00	.01
25	.00 N	.00 N	.00 N	.00	.00	.00	.02	.00	.00	.00	.00	.00
26	.00 N	.00 N	.00	.00	.00	.00	.03	.00	.00	.00	.00	.43
27	.00 N	.00 N	.00 N	.00	.17	.00	.00	.00	.00	.00	.00	.00
28	.00 N	.00 N	.00 N	.00	.00	.00	.00	.04	.13	.00	.00	.00
29	.00 N	.00 N	.00 N	.00	.12	.11	.05	.00	.04	.00	.05	.00
30	.00 N	.00 N	.00 N	.00	.00	.20	.00	.00	.93	.00	.66	.00
31	.00 N	.00 N	.00 N	.00	.05	.00	.00	.04	.00	.00	.00	.73
TOTAL	.00 N	.00 N	.00 N	.98 M	6.01 M	8.39 M	3.04	4.09	5.46	.80	1.63	2.47

TOTAL FOR YEAR 33.37

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED

N = RECORD NOT AVAILABLE

Table 3A

***** 1977 *****

BOHEY DIKE RAINFALL, IN INCHES

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	.00	.00	.00	.00	.15	.01	.00	.00	.00	.00	.00
2	.00	.00	.00	.00	.00	.00	.00	.01	.42	.00	.00	.28
3	.32	.00	.00	.00	.00	1.04	.07	.00	.84	.00	.86	.00
4	.00	.16	.00	.00	.00	.00	.00	.00	.00	.00	1.50	.00
5	.00	.00	.13	.06	1.76	.02	.55	.07	1.16	.00	.13	.00
6	.00	.00	.02	.00	.00	.04	.00	.09	.00	.00	.00	.44
7	.00	.00	.09	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.15	.00	.00	.01	.00	.00	.00
9	.00	.00	.00	.00	.20	.00	.00	.23	.00	.00	.00	.24
10	.11	.00	.85	.00	.36	.00	.39	.00	.00	.61	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.06	.00	.20	.00	.00
12	.00	.00	.00	.00	.00	.17	.00	.25	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.22	.21	.15	.00	.00	.00	.01
14	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
15	.11	.00	.00	.00	.00	.00	.55	.07	.41	.00	.00	.18
16	.15	.00	.00	.00	.00	.07	.05	.00	.40	.00	.00	.61
17	.00	.00	.00	.00	.00	.00	.43	.00	.00	.00	.00	.10
18	.01	.00	.00	.00	.00	.00	.38	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.05	.52	.11	.38	.00	.00	.00
20	.00	.12	.00	.00	.00	1.41	.00	.05	.00	.00	.00	.00
21	.00	.00	.00	.00	.00	.63	.00	.00	.01	.00	.00	.03
22	.00	.00	.00	.00	.00	.00	.00	.07	.59	.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.01	.51	.00	.00	.93	.00
24	.00	.59	.00	.00	.00	.00	.00	.07	.00	.22	.02	.00
25	.00	.00	.07	.00	.00	.26	.17	.00	.00	.00	.00	.41
26	.00	.04	.00	.00	.59	.00	.22	.17	.48	.01	.00	.00
27	.05	.01	.00	.00	.13	.00	.00	.03	.01	.00	.00	.00
28	.00	.04	.00	.00	.29	.00	.00	.27	.00	.00	.00	.00
29	.00	.00	.00	.00	.48	.00	.00	.92	.00	.00	1.42	.00
30	.00	.00	.00	.00	.00	.00	.00	.11	.00	.00	.19	.01
31	.15	.00	.00	.00	.00	.00	.03	.02	.00	.00	.00	.00
TOTAL	.92	.96	1.16	.06	3.37	4.29	3.44	3.38	4.80	1.04	5.05	2.32

TOTAL FOR YEAR 31.29

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OF ALL OF RECORD IS MISSING AND THUS ESTIMATED

N = RECORD NOT AVAILABLE

Table 3B

***** 1978 *****
 SONEY DIKE RAINFALL, IN INCHES

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	.00	.00	.00	.00	.49	.00	.66	.15	.00	.00	.30
2	.00	.06	.00	.00	.00	.00	.39	.32	.00	.01	.00	.00
3	.02	.00	1.04	.00	.81	.25	1.51	.00	.04	.00	.00	.00
4	.00	.01	.00	.00	.41	.02	.00	.00	.08	.00	.00	.00
5	.00	.00	.00	.00	.00	2.79	.04	.42	.95	.31	.00	.00
6	.00	.00	.00	.00	.45	.05	.00	.24	.05	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.89	.00	.00	.00	1.36	.00
8	.27	.34	.02	.00	.00	.57	.00	.04	.01	.00	.00	.00
9	.04	1.16	2.00	.00	.04	.03	.01	.01	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03	.00	.00
11	.00	.00	.00	.00	.00	.62	.00	.81	.00	.82	.00	.00
12	.00	.00	.00	.00	.00	.03	.00	.06	.00	.53	.00	.00
13	.13	.00	.00	.00	.00	.00	.00	.48	.00	.02	.00	.00
14	.00	.00	.00	.00	.00	.00	.04	.00	.00	.08	.04	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.59	.00	.00	.00
16	.00	.45	.00	.00	.00	.00	.07	.02	.00	.00	.00	.00
17	.14	.02	.00	.00	1.46	.00	.34	.00	.00	.00	.00	.00
18	.00	.67	.00	.00	.65	.00	2.29	.02	.00	.00	.00	.00
19	1.43	.00	.00	.00	.00	.11	1.14	1.20	.00	.20	.00	.00
20	.00	.14	.00	.00	.00	.00	.18	.00	.00	.00	.00	.00
21	.00	.03	.00	.00	.00	.18	.00	.00	.00	.00	.15	.00
22	.00	.00	.00	.00	.00	.25	.35	.00	2.88	.00	.00	.00
23	.00	.00	.00	.00	.00	1.35	.07	.02	.00	.00	.00	.00
24	.00	.00	.00	.00	.00	.99	.02	.22	1.34	.00	.00	.28
25	.15	.00	.00	.00	.00	.20	.53	.00	.00	.00	.00	.00
26	.01	.00	.00	.00	.00	.02	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.53	.45	1.54	.00	.00	.00	.00	.54
28	.00	.00	.00	.00	.00	.00	1.93	.00	.00	.43	.00	1.36
29	.00	.00	.00	.00	.19	.00	1.26	.00	.00	.00	.00	.00
30	.00	.00	.00	.00	.00	.00	.02	.00	.64	.03	.00	.00
31	.00	.00	.00	.00	.00	.00	1.71	.00	.00	.14	.00	.00
TOTAL	2.25	2.91	3.06	.00	4.64	8.96	14.53	4.52	6.73	2.60	1.55	2.48

TOTAL FOR YEAR 54.33

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED

N = RECORD NOT AVAILABLE

***** 1976 *****

EVAPORATION, IN INCHES, FROM STATION S-65C

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	.32	.39	.22	.28	.25	.24	.19	.20	.09
2	.00 N	.00 N	.00 N	.23	.20	.27	.19	.21	.20	.20	.16	.03
3	.00 N	.00 N	.00 N	.27	.22	.22	.19	.20	.21	.17	.14	.06
4	.00 N	.00 N	.00 N	.30	.26	.21	.23	.21	.22 N	.22	.18	.11
5	.00 N	.00 N	.00 N	.30	.25	.22 N	.25	.20	.20	.20	.17	.14
6	.00 N	.00 N	.00 N	.15	.30	.24	.28	.25	.20	.20	.15	.10
7	.00 N	.00 N	.00 N	.13	.27	.24	.25 N	.25	.20	.20	.15	.12
8	.00 N	.00 N	.00 N	.22 N	.28	.20	.26	.22	.25	.20	.20	.14
9	.00 N	.00 N	.00 N	.30	.30	.25 N	.23	.20	.20	.16	.20	.10
10	.00 N	.00 N	.00 N	.30	.30	.25 N	.24 N	.25 N	.20	.19	.17	.13
11	.00 N	.00 N	.00 N	.36	.30	.24 N	.24 N	.24 N	.20	.12	.19	.10
12	.00 N	.00 N	.00 N	.24	.25	.30	.24	.22	.21	.18	.18	.11
13	.00 N	.00 N	.00 N	.22	.30	.30	.24	.22	.21	.18	.16	.10
14	.00 N	.00 N	.00 N	.20	.26	.33	.24	.22	.21	.18	.16	.10
15	.00 N	.00 N	.00 N	.18	.28	.33	.32	.22	.20	.20	.15	.11
16	.00 N	.00 N	.00 N	.28	.23	.35	.35	.22	.23	.20	.17	.10
17	.00 N	.00 N	.00 N	.26	.26 N	.35	.35	.22	.23	.20	.17	.10
18	.00 N	.00 N	.00 N	.28	.20	.30	.28	.22	.24	.13	.20	.10
19	.00 N	.00 N	.00 N	.27	.25	.30	.27	.22	.25	.17	.22	.09
20	.00 N	.00 N	.00 N	.32	.30	.16	.20	.20	.25	.21	.16	.11
21	.00 N	.00 N	.00 N	.28	.30	.16	.25	.20	.17	.18	.13	.10
22	.00 N	.00 N	.00 N	.20	.28	.16	.22	.21	.16	.23	.10	.08
23	.00 N	.00 N	.00 N	.30	.26 N	.24 N	.24	.24	.16	.22	.10	.12
24	.00 N	.00 N	.00 N	.28	.26 N	.24 N	.22	.24	.18	.21	.18	.08
25	.00 N	.00 N	.00 N	.22	.25	.20	.27	.19	.20	.16	.16	.12
26	.00 N	.00 N	.00 N	.27	.25	.30	.31	.20	.20	.12	.14	.12
27	.00 N	.00 N	.21	.23	.28	.25	.30	.26	.20	.25	.10	.10
28	.00 N	.00 N	.19	.37	.30	.25	.30	.22	.20	.20	.10	.15
29	.00 N	.00 N	.20	.29	.22	.30	.27 N	.25	.25	.20	.10	.15
30	.00 N	.00 N	.24	.34	.22	.30	.30	.30	.20	.20	.16	.14
31	.00 N	.00 N	.26	.20	.20	.30	.30	.24	.20	.20	.16	.10
TOTAL	.00 N	.00 N	1.10 N	7.71 N	8.07 N	7.63 N	3.17 N	7.18 N	6.26 N	5.80	4.90	5.26

TOTAL FOR YEAR 59.98

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 4A

***** 1977 *****

EVAPORATION, IN INCHES, FROM STATION S-65C

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.08	.18	.12	.22	.35	.25	.26 M	.15	.25	.25	.20	.10
2	.12	.16	.23	.24	.40	.27	.26 M	.30	.20	.25	.18	.12
3	.05	.16	.23	.35	.31	.16	.26 M	.27	.08	.21	.15	.12
4	.13	.13	.20	.20	.32	.25 M	.26 M	.30	.19	.24	.13	.12
5	.05	.13	.22	.30	.30	.25 M	.26 M	.30	.17	.27	.14	.15
6	.05	.19	.40	.40	.15	.23	.26 M	.30	.14	.23	.14	.13 M
7	.07	.15	.21	.30	.30	.17	.26 M	.30	.18	.22	.16	.13 M
8	.12	.16	.15	.30	.35	.30	.26 M	.30	.20	.24	.14	.13
9	.09	.17	.30	.30	.30	.25	.26 M	.30	.20	.20	.14	.11
10	.10	.18	.20	.34	.35	.27	.26 M	.20	.20	.22	.18	.11
11	.17	.21	.19 M	.40	.18	.30	.26 M	.15	.30	.20	.22	.10
12	.10	.20	.18	.40	.20	.20	.26 M	.20	.23	.24	.15	.16
13	.13	.18	.19	.30	.20	.22	.26 M	.15	.25	.24	.15	.10
14	.10	.10	.25	.33	.30	.28	.26 M	.23 M	.22	.22	.17	.10
15	.13	.10	.13	.20	.30	.33	.26 M	.30	.24	.18	.16	.11 M
16	.12 M	.11	.22	.30	.30	.30	.26 M	.28	.25	.20	.17	.14
17	.14	.18	.15	.36	.30	.30	.26 M	.17	.25	.20	.13	.11 M
18	.14	.13	.20	.32	.30	.30	.26 M	.20	.23	.20	.15	.10
19	.09	.12	.27	.32	.30	.28 M	.28	.20	.17	.17	.13	.10
20	.09	.18	.20	.36	.30	.28 M	.26 M	.25	.11	.18	.20	.10
21	.09	.20	.26	.32	.30	.22	.26	.20	.21	.20	.15	.12
22	.09	.18	.30	.30	.40	.21	.24	.25	.13	.20	.14	.10
23	.09	.17	.30	.27	.36	.25	.25	.08	.08	.23	.20	.06
24	.10	.15	.30	.30	.30	.27	.20	.15	.23	.20	.11	.07
25	.17	.22	.20	.34	.24	.26	.23	.21	.20	.20	.15	.10
26	.13	.25	.14	.30	.35	.30	.22	.21	.20	.20	.15	.10
27	.10	.23	.26	.30	.34	.30	.30	.20	.20 M	.15	.10	.07
28	.11	.28	.26	.38	.29	.32	.30	.20	.20	.15	.14	.10
29	.10	.27	.27	.34	.30	.28	.32	.17	.20	.15	.16	.11
30	.10	.28	.28	.35	.37	.30	.28	.15	.25	.20	.13 M	.12
31	.15	.22	.26	.22	.22	.30	.30	.21	.25	.20	.10	.10
TOTAL	3.35 M	4.80	6.77 M	9.34	9.28	7.90 M	8.12 M	5.88 M	6.02 M	6.42	4.66 M	3.39 M

TOTAL FOR YEAR 76.94

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED

N = RECORD NOT AVAILABLE

Table 4B

***** 1978 *****
 EVAPORATION, IN INCHES, FROM STATION S-65C

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.04	.14	.10	.25	.25	.25	.20	.16	.17	.14	.15 M	.15 M
2	.07	.10	.10	.20	.22	.22	.21	.20	.20	.20	.16 M	.11
3	.13	.16	.10	.25	.26	.22	.20	.20	.22	.18	.16 M	.14
4	.14	.14	.15 M	.37	.19	.20	.20	.26	.20	.16	.16 M	.12
5	.10	.08	.17	.26	.17	.25	.31	.24	.20	.20	.16 M	.15
6	.12	.10	.16	.27	.25 M	.26 M	.24	.22 M	.30	.20	.16 M	.13
7	.08	.15	.17	.23	.25	.25	.18	.26	.30	.24	.16 M	.10
8	.12	.11	.20	.17	.30	.26	.13	.21	.20	.22	.16 M	.13
9	.10	.15	.20 M	.27	.30	.35	.22	.23	.20	.24	.16 M	.14
10	.13	.13	.20 M	.28	.26	.34	.25	.24	.17	.20	.16 M	.13
11	.12	.12	.20	.30	.30	.27	.30	.18	.25	.15	.16 M	.10
12	.11	.13	.20	.32	.31	.24	.20	.25	.25	.15	.16 M	.10
13	.13	.15	.20	.31	.31	.30	.20	.29	.25	.12	.16 M	.11
14	.10	.20	.22	.32	.40	.30	.20	.21	.25	.15	.16 M	.10
15	.13	.17	.24	.28	.36	.30	.20	.33	.15	.13	.16 M	.10
16	.10	.13	.24	.25	.26	.26	.30	.24	.20	.17	.16 M	.12
17	.10	.09	.20	.30	.28	.30	.19	.20	.20	.24	.16 M	.10
18	.08	.10	.20	.30	.15	.30	.22	.26	.20	.24	.16 M	.10
19	.10	.06	.20	.20	.20	.20	.22 M	.22	.20	.17	.16 M	.10
20	.13	.10	.18	.25	.28	.23	.25	.24	.20	.15	.16 M	.10
21	.15	.07	.20	.40	.28	.17	.29	.23	.23	.15	.16 M	.10
22	.10	.10	.24	.26	.33	.23	.23	.26	.20	.17	.16 M	.10
23	.10	.05	.20	.32	.32	.13	.22	.18	.20	.20	.16 M	.06
24	.12	.15	.21	.40	.17	.20	.20	.26	.17	.22	.16 M	.10
25	.13	.15	.20	.36	.24	.20	.26	.28	.15	.22	.16 M	.10
26	.10	.15	.23	.36	.26	.20	.20	.30	.18	.20	.16 M	.10
27	.15	.18	.22 M	.30	.18	.25	.23 M	.26	.16	.22	.16 M	.10
28	.12	.15	.20	.30	.20	.25	.22 M	.26	.20	.21	.16 M	.10
29	.16	.16	.23	.30	.24	.25	.22	.26	.20	.14	.16 M	.10
30	.12	.12	.20	.25	.25	.25	.20	.30	.22	.20	.16 M	.12
31	.14	.14	.20	.25	.30	.25	.22 M	.30	.22	.18	.16 M	.16
TOTAL	3.51	3.51	5.96 M	8.63	8.27 M	7.40 M	7.16 M	7.55 M	6.17	5.76	4.80 M	3.49 M

TOTAL FOR YEAR 72.21

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 4C

taken into consideration in the calculations. The governing equation takes the form of

$$Q = C_1 \cdot \text{Width} \cdot H1^{3/2} \cdot \left(1 - \left(\frac{H2}{H1}\right)^{1.5}\right)^{.385}$$

where

Q = calculated discharge

C₁ = coefficient that needs to be optimized

Width = the weir width

H1 = upstream stage above weir

H2 = downstream stage above weir (= 0 when weir is not submerged)

This equation appears in the Handbook of Hydraulics (King and Brater, 1963). The estimated discharges over the north weir, south weir and south culvert appear in Tables 5A, 5B, 5C through Tables 7A, 7B and 7C, respectively.

Both pump stations use Couch axial flow pumps which were calibrated by the manufacturer on the basis of model studies of their plant. The general form of these pump curves was verified by the District with flow measurements utilizing a pitot tube arrangement in the discharge tube of both pumps after installation. The form of the discharge equation was found but some uncertainty still remained in the absolute magnitude of the discharge. It is in the following form:

$$Q = C_2 \cdot \text{FR} \cdot (54.56 - 10.91 \cdot \text{SQRT}(46.45 - \text{UP})) \cdot \frac{\text{RPM}}{1700}$$

where

Q = flow through station

UP = upstream stage

FR = fraction of pumping

RPM = pumping rate

C₂ = coefficient that needs to be optimized for a given pump type

***** 1976 *****

DISCHARGE IN ACRE-FEET OVER NORTH WEIR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	18.58	1.88	.00	16.44	.41	19.07	24.17	21.77	.04
2	.00 N	.00 N	.00 N	20.06	16.23	.00	9.24	16.68	17.33	13.16	21.13	.00
3	.00 N	.00 N	.00 N	15.12	1.89	.64	2.01	15.40	15.61	12.83	22.73	15.90
4	.00 N	.00 N	.00 N	1.24	19.49	3.21	.40	14.83	2.34	24.14	27.01	1.93
5	.00 N	.00 N	.00 N	.14	13.97	8.02	11.88	16.57	1.15	14.87	23.23	.92
6	.00 N	.00 N	.00 N	.03	1.41	7.80	21.59	17.76	17.08	15.33	12.57	16.35
7	.00 N	.00 N	.00 N	.13	.20	4.48	19.51	1.94	14.45	17.27	12.14	18.53
8	.00 N	.00 N	.00 N	.39	.00	.95	19.66	.61	17.97	18.17	9.15	18.34
9	.00 N	.00 N	.00 N	13.17	.00	.60	1.97	18.96	20.57	11.08	8.27	17.75
10	.00 N	.00 N	.00 N	1.82	.00	.78	.41	18.82	18.56	8.02	7.88	18.99
11	.00 N	.00 N	.00 N	1.15	.00	.88	13.07	16.66	2.61	16.42	7.88	1.84
12	.00 N	.00 N	.00 N	17.25	.00	.42	19.11	14.14	.87	16.23	7.93	.78
13	.00 N	.00 N	.00 N	24.58	.00	.08	1.52	18.16	14.68	17.95	6.93	16.44
14	.00 N	.00 N	.00 N	20.22	.00	.00	15.27	1.87	2.14	16.78	1.71	18.32
15	.00 N	.00 N	.00 N	23.93	.00	.00	16.09	.86	15.10	15.22	15.22	18.24
16	.00 N	.00 N	.00 N	20.59	.00	.00	17.79	20.77	16.16	10.16	21.88	18.40
17	.00 N	.00 N	.00 N	1.27	.00	.00	2.57	18.78	17.84	7.65	18.17	17.55
18	.00 N	.00 N	.00 N	.14	.00	.00	1.04	22.50	18.44	13.33	15.86	1.88
19	.00 N	.00 N	.00 N	18.01	.00	.00	19.36	19.43	3.31	15.47	19.64	.52
20	.00 N	.00 N	.00 N	19.66	.00	.00	19.05	19.41	18.37	15.94	2.02	18.73
21	.00 N	.00 N	.00 N	18.37	.00	.00	19.19	2.28	17.94	15.69	.91	14.71
22	.00 N	.00 N	.00 N	21.17	.00	15.28	18.08	1.22	20.12	15.81	18.31	1.77
23	.00 N	.00 N	.00 N	19.58	.03	16.91	14.50	16.78	17.43	9.52	16.81	.78
24	.00 N	.00 N	.00 N	1.81	.00	16.76	1.63	19.60	19.22	7.55	16.90	.44
25	.00 N	.00 N	.00 N	.20	.00	21.21	.32	16.94	3.02	14.93	19.61	.05
26	.00 N	.00 N	9.02	19.49	.00	2.12	19.42	19.43	1.44	14.80	19.96	.12
27	.00 N	.00 N	1.10	18.35	.00	.49	18.16	18.51	18.61	17.02	2.93	.01
28	.00 N	.00 N	.10	18.86	.00	15.36	14.57	2.34	20.46	18.14	.98	.09
29	.00 N	.00 N	11.46	20.35	.00	16.94	13.50	.82	25.23	18.71	14.95	.00
30	.00 N	.00 N	17.13	20.63	.00	15.45	16.00	14.73	25.27	9.76	23.97	.09
31	.00 N	.00 N	18.98		.00	1.16		25.40		7.17		.00
TOTAL	.00 N	.00 N	57.79 N	374.30	55.10	148.38	364.61	412.61	422.39	455.00	417.75	239.33

TOTAL FOR YEAR 2947.26

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 5A

***** 1977 *****

DISCHARGE IN ACRE-FEET OVER NORTH WEIR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	1.91	19.21	23.08	.00	.00	13.24	13.62	15.71	2.30	12.45	18.71
2	.00	14.97	23.22	2.71	1.77	.00	2.68	16.51	15.12	.66	12.45	19.53
3	.00	16.63	19.29	1.90	4.38	.00	.84	19.87	2.06	18.42	10.58	1.95
4	8.22	17.95	17.88	29.30	8.45	.00	12.34	19.63	.70	20.32	8.38	.18
5	15.33	2.11	2.75	18.25	11.91	.00	13.94	16.27	14.39	15.84	.00	17.99
6	18.43	.44	1.40	17.54	9.05	.00	15.00	2.78	17.22	17.61	.00	19.28
7	16.60	17.86	21.08	18.24	.00	.00	13.78	.76	22.00	20.95	15.07	24.63
8	2.98	16.52	18.59	18.60	.00	.00	2.94	13.95	1.93	.39	14.32	20.22
9	.41	17.00	18.76	2.83	.00	.00	1.17	17.62	15.54	.00	13.71	22.15
10	14.33	15.92	24.55	1.12	7.41	.00	.51	14.95	1.64	15.82	14.08	2.31
11	12.68	16.83	18.50	13.24	8.78	.00	.45	15.41	.39	20.11	14.38	.18
12	17.25	1.73	2.81	22.09	8.97	.00	.04	14.42	16.23	5.93	.00	17.20
13	16.42	.36	1.24	18.15	7.81	.00	.02	1.52	20.88	.11	.04	24.65
14	21.69	16.74	13.68	18.34	.00	.00	.00	14.50	17.16	.24	19.56	19.53
15	2.03	29.66	20.39	18.52	9.56	.00	.00	2.22	18.76	.00	2.59	19.38
16	.63	17.15	19.04	2.62	30.54	.00	.00	17.29	15.10	.00	17.48	19.22
17	18.97	17.28	18.42	1.00	32.52	.00	.00	13.20	1.52	2.41	17.33	1.86
18	2.07	18.70	17.61	16.81	33.85	.00	.00	14.19	.47	.32	19.24	.17
19	15.20	2.03	2.24	18.25	29.97	.00	.00	15.05	14.28	.00	2.37	19.64
20	10.95	.79	1.16	20.27	11.22	.00	16.13	1.94	16.70	17.66	.96	21.44
21	16.70	15.20	15.18	18.46	5.59	.00	14.98	.48	15.66	13.55	16.20	21.76
22	1.14	21.84	18.46	17.86	4.11	.00	16.96	13.28	17.62	16.41	17.92	20.30
23	12.44	3.37	20.15	2.63	2.69	5.39	2.48	17.40	15.06	14.66	20.64	19.22
24	27.35	17.92	2.67	.97	1.78	15.73	.76	14.46	2.10	5.24	22.39	1.91
25	15.71	19.60	18.97	20.31	.76	2.42	17.46	16.87	.90	5.77	19.49	.24
26	16.95	3.05	2.54	17.79	.27	1.08	17.98	15.50	14.63	12.25	2.14	15.96
27	21.41	1.47	.79	18.14	.00	14.78	18.47	1.68	21.28	18.34	.48	20.36
28	17.51	16.66	13.15	14.42	.00	16.58	16.94	.65	19.84	11.93	.09	18.75
29	2.05		19.13	3.44	.00	15.99	18.12	13.71	21.12	.00	.07	13.09
30	.41		20.35	.00	.00	14.47	2.69	15.23	20.47	.00	.18	26.10
31	17.03		19.42	.00	.00	.84	.84	17.35		16.66		3.82
TOTAL	347.75	332.69	432.54	398.98	231.39	86.44	238.87	376.31	376.52	275.91	295.55	451.73

TOTAL FOR YEAR 3834.69

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

***** 1978 *****

DISCHARGE, IN ACRE-FEET OVER NORTH WEIR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.23	.35	22.17	2.19	20.99	.00	1.94	5.32	14.58	6.26	.04	16.10
2	16.12	18.28	20.84	.62	20.58	.00	.69	3.76	1.40	12.18	15.15	1.54
3	18.50	20.62	21.25	16.38	21.58	.00	16.57	21.06	13.89	14.04	13.34	.51
4	20.43	2.03	1.78	20.05	21.23	.00	2.30	18.46	14.49	17.31	1.46	13.98
5	20.19	.15	.13	16.22	2.24	.00	13.88	1.81	1.84	17.61	.36	17.43
6	20.03	16.83	19.42	20.01	.68	.00	16.04	.75	15.64	17.57	16.37	15.12
7	17.38	20.35	23.07	20.54	.61	.00	17.98	14.45	14.67	1.65	18.58	20.04
8	1.68	20.01	23.71	2.24	.19	.00	2.43	18.62	14.52	3.46	1.50	1.52
9	.20	21.02	20.61	.64	.00	.00	.93	18.10	1.57	20.83	14.44	.35
10	17.39	21.93	20.98	19.54	.00	.00	17.08	19.08	.45	5.29	16.60	.09
11	19.97	2.21	1.72	2.24	.00	.00	17.03	17.94	13.55	16.03	1.36	17.50
12	23.93	16.73	.12	.60	.00	.00	17.48	1.28	15.11	13.10	.41	18.20
13	19.79	2.04	19.67	.18	.00	.00	20.20	.36	15.98	14.44	8.67	17.12
14	1.85	17.92	21.40	21.39	.00	15.19	15.47	18.28	17.78	.00	15.84	17.86
15	.16	18.90	20.15	2.04	.00	17.66	1.27	13.30	13.76	.00	15.03	16.86
16	17.46	19.86	24.76	.25	.00	17.72	.86	15.21	1.06	9.91	14.26	1.64
17	19.60	18.44	20.82	17.97	.00	1.49	15.92	15.97	.19	10.10	18.75	.30
18	19.79	1.89	2.45	18.26	.00	.05	18.21	15.34	14.67	9.74	1.40	16.03
19	20.46	.23	.75	20.90	.00	16.04	16.50	1.93	15.54	11.44	.38	16.79
20	20.12	16.17	20.15	22.21	.00	16.36	2.12	.55	15.03	.00	15.34	14.03
21	1.96	19.12	21.05	18.11	.00	15.94	20.53	13.86	18.83	.00	15.76	15.84
22	.17	19.69	21.30	1.32	.00	19.07	2.59	15.96	17.75	.00	14.57	17.01
23	13.25	14.86	24.54	.35	.00	17.69	2.11	16.11	1.42	11.08	1.33	1.10
24	3.21	19.81	20.73	18.28	.00	2.02	18.47	16.30	1.05	10.69	16.24	.38
25	17.46	2.03	2.93	18.76	.00	.82	13.16	16.02	20.17	.00	1.20	.24
26	19.63	.14	1.17	19.14	.00	15.91	16.79	.85	16.63	.00	.19	13.16
27	1.82	18.06	16.65	18.69	.00	15.40	3.75	.20	18.48	10.86	14.21	15.40
28	.16	20.22	24.04	1.60	.00	14.58	16.44	14.17	26.36	.00	16.72	17.51
29	.01	20.79	20.79	18.29	.00	15.01	6.86	16.46	17.59	.00	16.94	14.36
30	14.23	23.89	23.89	2.35	.00	16.29	6.57	14.18	5.14	17.44	15.80	1.20
31	2.90	20.70	20.70	.00	.00	.00	18.56	13.92	13.08	13.08	.00	1.57
TOTAL	375.12	369.89	503.75	341.36	88.10	217.24	344.53	361.60	361.14	264.11	302.66	320.18

TOTAL FOR YEAR 3849.68

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OF ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 5C

***** 1976 *****

DISCHARGE, IN ACRE-FEET OVER SOUTH WEIR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	13.99	18.19	.04	8.35	9.78	1.56	.00	17.50	24.60
2	.00 N	.00 N	.00 N	15.54	10.96	.78	12.85	7.32	1.93	.00	22.30	16.16
3	.00 N	.00 N	.00 N	17.53	15.16	.00	10.81	9.01	12.44	.00	27.53	13.50
4	.00 N	.00 N	.00 N	15.10	3.31	1.98	7.23	4.51	16.16	.88	28.87	15.20
5	.00 N	.00 N	.00 N	10.46	9.46	10.66	4.37	6.71	14.54	.33	26.43	10.73
6	.00 N	.00 N	.00 N	7.59	13.03	.86	5.31	7.41	16.55	1.93	20.05	10.88
7	.00 N	.00 N	.00 N	4.72	.11	.59	13.09	6.45	25.47	2.57	11.24	22.44
8	.00 N	.00 N	.00 N	1.81	1.06	3.76	18.10	2.51	14.74	2.28	9.69	24.44
9	.00 N	.00 N	.00 N	.32	.49	3.79	17.53	.61	17.87	1.69	12.46	21.37
10	.00 N	.00 N	.00 N	.66	.22	8.50	10.05	2.46	19.44	7.28	11.91	27.24
11	.00 N	.00 N	.00 N	2.84	.18	4.14	6.20	8.22	18.55	6.95	11.47	20.41
12	.00 N	.00 N	.00 N	4.09	.07	3.61	8.96	6.00	11.29	14.52	9.46	10.07
13	.00 N	.00 N	.00 N	7.64	.26	3.24	12.10	.73	8.88	11.73	2.12	5.94
14	.00 N	.00 N	.00 N	16.53	.38	.00	7.62	5.08	10.64	18.55	1.06	31.21
15	.00 N	.00 N	.00 N	18.50	.20	.00	8.68	4.37	8.52	14.16	19.71	25.84
16	.00 N	.00 N	.00 N	18.83	1.78	.00	8.17	4.01	11.13	18.60	16.58	16.48
17	.00 N	.00 N	.00 N	15.82	2.53	.00	13.42	10.88	15.13	20.09	17.83	12.37
18	.00 N	.00 N	.00 N	8.34	.85	.00	7.73	15.60	18.71	21.56	14.45	7.33
19	.00 N	.00 N	.00 N	4.13	.06	.00	3.60	18.21	16.78	14.83	12.86	1.41
20	.00 N	.00 N	.00 N	8.51	.00	.00	7.26	18.89	12.46	11.17	9.96	.86
21	.00 N	.00 N	.00 N	14.98	.13	.00	19.90	17.91	14.32	7.57	3.87	3.40
22	.00 N	.00 N	.00 N	17.60	1.08	.00	22.89	12.90	14.33	13.33	2.13	3.58
23	.00 N	.00 N	.00 N	15.00	2.63	.61	18.08	8.52	13.90	15.93	4.99	1.30
24	.00 N	.00 N	.00 N	14.65	1.22	5.08	14.89	10.86	13.72	21.47	7.20	.37
25	.00 N	.00 N	.00 N	5.91	.67	5.84	8.02	13.91	10.78	13.54	8.50	.00
26	.00 N	.00 N	11.68	4.12	.41	6.54	5.64	15.36	7.23	13.41	25.92	.01
27	.00 N	.00 N	11.46	17.09	.15	2.11	9.40	16.99	6.92	19.60	25.48	1.0
28	.00 N	.00 N	5.86	23.43	.07	.42	13.33	16.19	13.32	34.53	16.40	.00
29	.00 N	.00 N	4.23	15.79	.19	1.59	12.94	12.08	.00	37.20	13.28	.00
30	.00 N	.00 N	6.11	17.49	.25	6.22	13.14	8.73	.00	31.41	20.45	.00
31	.00 N	.00 N	9.68		.03		14.87	11.09	.00	20.90		.00
TOTAL	.00 N	.00 N	49.02 N	339.01	85.13	70.36	344.53	293.30	367.71	398.41	434.23	327.24

TOTAL FOR YEAR 2708.94

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

***** 1977 *****

DISCHARGE, IN ACRE-FEET OVER SOUTH WEIR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	10.24	5.01	15.78	8.58	.00	10.73	.00	.00	15.74	14.72	25.56
2	.00	7.35	9.63	17.07	5.00	.00	13.70	.00	.19	11.52	19.63	19.63
3	.00	11.56	13.74	9.09	4.99	.00	10.50	.00	1.88	9.42	22.53	23.07
4	.01	15.28	14.41	4.59	8.88	.00	7.27	.70	2.52	13.59	40.64	13.21
5	.01	14.90	12.89	9.19	18.29	.00	7.66	2.37	4.04	15.40	31.80	21.35
6	.01	7.96	7.13	12.29	25.21	.00	10.50	2.83	9.31	16.04	17.25	23.79
7	9.43	5.83	3.48	13.23	19.63	.00	10.71	.52	13.20	1.68	18.42	21.16
8	10.33	10.51	6.88	14.29	10.55	.00	10.34	.21	13.42	1.84	26.85	25.37
9	5.32	13.99	10.32	19.16	6.11	.00	6.76	2.62	11.20	1.03	26.85	22.26
10	4.43	14.82	14.68	7.68	4.13	.00	4.77	6.04	11.57	.38	31.28	17.21
11	2.90	10.85	21.14	4.44	7.26	.00	3.98	8.08	8.00	.00	31.64	9.21
12	12.44	7.58	16.44	6.82	11.63	.00	3.99	10.04	8.00	.00	22.95	5.52
13	13.45	1.60	6.56	12.20	14.36	.00	3.56	9.19	13.67	.00	11.48	10.01
14	15.21	.28	4.41	13.73	14.25	.00	3.01	6.68	18.20	.00	16.43	13.93
15	15.90	1.11	2.17	19.47	8.58	.00	2.46	7.71	22.35	.00	19.41	16.10
16	3.21	24.75	12.54	13.75	6.90	.00	2.11	5.56	24.46	.00	15.34	19.68
17	4.83	22.14	14.77	7.58	12.44	.00	2.05	8.23	20.63	.00	17.77	19.26
18	6.82	16.23	15.86	4.17	11.05	.00	2.36	11.03	12.25	.00	13.24	11.01
19	3.43	20.84	15.80	6.73	12.44	.00	2.05	11.25	9.72	.00	8.82	6.24
20	5.13	14.23	8.87	11.24	8.54	.00	4.55	6.75	13.78	.00	9.36	10.79
21	3.43	7.49	5.14	15.87	3.91	.00	8.17	6.75	15.14	1.08	17.34	14.22
22	5.74	7.80	6.98	16.85	.62	.00	9.73	5.05	17.41	6.57	13.34	16.75
23	3.00	11.63	10.90	15.56	.00	.00	11.23	8.80	18.24	16.30	17.48	16.96
24	10.52	7.79	13.16	9.31	.00	.00	7.56	12.64	15.36	18.09	21.86	14.89
25	10.27	9.79	7.36	5.36	.00	1.06	4.83	12.95	7.72	9.18	22.33	7.97
26	11.46	10.94	9.08	9.93	.00	4.11	7.29	12.57	7.05	10.00	18.19	6.80
27	19.35	5.94	5.41	13.91	.00	3.31	10.71	12.19	11.86	13.79	10.03	9.43
28	21.42	2.98	2.75	15.79	.00	2.62	12.70	7.93	15.79	18.13	10.57	12.02
29	18.86	4.11	4.11	16.85	.00	6.93	13.66	6.95	18.36	17.39	17.64	13.30
30	9.92	15.25	9.31	15.25	.00	9.52	13.97	12.44	21.24	10.39	23.64	15.05
31	7.34	.00	13.22	.00	.00	.00	7.19	12.59	.00	11.51	.00	15.48
TOTAL	256.62	296.51	307.15	347.18	215.59	27.55	229.65	215.18	366.92	221.35	594.03	484.53

TOTAL FOR YEAR 3562.77

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THIS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 6B

***** 1970 *****

DISCHARGE IN ACRE-FEET OVER SOUTH WEIR

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	10.61	5.32	9.55	16.30	4.93	.00	13.86	19.94	.78	3.31	20.36	22.29
2	7.62	3.62	15.40	9.40	9.66	.00	7.89	13.90	.16	4.14	14.85	19.99
3	10.33	7.52	19.10	4.35	14.77	.00	6.09	15.20	.77	8.72	14.07	12.05
4	13.00	12.14	18.45	7.98	23.79	.00	13.24	15.99	4.15	13.43	11.97	10.75
5	15.25	5.37	9.54	12.62	24.57	.64	7.56	11.61	6.55	19.63	6.62	13.97
6	13.91	3.43	4.84	12.54	12.51	.76	10.82	7.64	7.93	21.05	5.47	16.10
7	10.49	6.23	6.56	14.20	7.35	.02	14.73	4.99	11.09	16.22	11.32	16.10
8	5.51	8.78	13.17	14.20	4.82	.07	19.13	7.53	13.01	9.11	15.74	15.50
9	5.32	20.40	26.96	7.33	3.84	.06	10.39	11.54	11.54	9.59	14.04	9.29
10	10.19	18.49	27.19	3.92	3.10	.00	7.56	14.11	6.25	9.89	14.77	5.08
11	14.08	16.18	16.59	5.31	2.54	.00	9.93	18.03	4.76	10.57	13.14	2.68
12	16.15	7.89	8.48	2.47	1.87	.00	13.58	18.37	7.11	22.17	8.47	5.19
13	18.88	9.57	4.20	.93	1.24	.00	16.25	8.71	9.90	26.31	5.89	9.43
14	17.76	5.94	8.30	1.14	.35	.00	18.35	7.29	13.95	20.33	8.07	12.28
15	10.40	8.63	13.41	3.62	.00	.00	15.34	10.47	19.53	12.73	11.90	14.00
16	7.10	13.05	14.94	2.23	.00	3.37	8.49	12.16	16.68	12.92	18.84	13.35
17	11.31	16.03	15.88	1.05	.32	.00	5.10	12.87	9.47	17.47	23.66	6.53
18	15.57	17.26	15.03	2.86	1.06	3.46	13.76	13.73	7.26	20.46	21.63	5.69
19	19.22	9.37	6.72	7.72	.84	2.47	28.19	12.90	13.87	21.72	12.72	9.89
20	24.52	4.50	4.25	13.19	.40	5.52	26.50	9.72	17.54	17.29	10.68	12.51
21	19.37	7.24	8.53	16.40	.13	9.79	15.86	5.91	18.63	10.97	18.61	13.53
22	11.03	10.82	13.32	14.41	.00	15.69	17.05	7.53	27.39	6.98	23.13	15.57
23	7.36	11.56	15.40	7.26	.00	23.89	8.72	10.24	30.60	10.53	19.42	12.11
24	3.73	10.72	18.25	3.63	.00	27.77	5.70	12.87	19.23	21.44	13.22	7.78
25	7.19	12.09	14.94	7.18	.00	17.29	10.43	13.68	13.82	21.84	11.96	5.16
26	9.87	6.34	7.57	11.60	.00	9.91	13.37	12.82	3.70	15.13	7.86	3.47
27	14.54	3.01	4.23	14.48	.00	15.67	15.78	6.96	.00	20.57	9.62	7.15
28	16.33	5.98	6.44	14.17	.00	19.03	8.19	1.52	.00	20.88	15.49	18.91
29	9.29	12.20	12.20	6.18	.00	15.43	14.19	1.94	3.77	16.42	19.04	24.36
30	7.57	16.00	16.00	7.59	.00	13.36	11.88	.82	3.89	18.77	21.54	18.82
31	8.57	17.56	17.56	.00	.00	.00	16.35	.60	.00	24.35	.00	13.64
TOTAL	373.67	267.48	332.99	246.96	118.09	130.73	404.48	321.59	335.33	484.94	424.11	373.45

TOTAL FOR YEAR 3906.82

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

***** 1976 *****

DISCHARGE IN ACRE-FEET FROM SOUTH CULVERT

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	.00	.00	.00	.12	.00	.00	.00	.00	.02
2	.00 N	.00 N	.00 N	.00	.00	.00	.18	.31	.00	.00	.00	.02
3	.00 N	.00 N	.00 N	.00	.00	.00	.04	1.34	.00	.00	.00	.00
4	.00 N	.00 N	.00 N	.00	.00	.77	.00	1.12	.00	.00	.00	.00
5	.00 N	.00 N	.00 N	.00	.00	2.86	.00	.00	.00	.00	.00	.00
6	.00 N	.00 N	.00 N	.00	.00	2.30	.00	.00	.00	.00	.00	.06
7	.00 N	.00 N	.00 N	.00	.00	1.78	.00	.00	.00	.00	.00	.41
8	.00 N	.00 N	.00 N	.00	.00	1.07	.00	.00	.00	.00	.00	.82
9	.00 N	.00 N	.00 N	.00	.00	.85	.00	.00	.00	.00	.00	.47
10	.00 N	.00 N	.00 N	.00	.00	.72	.00	.00	.00	.00	.00	5.47
11	.00 N	.00 N	.00 N	.00	.00	7.10	.00	.00	.00	.00	.00	8.28
12	.00 N	.00 N	.00 N	.00	.00	6.29	.00	.00	.00	.00	.00	11.95
13	.00 N	.00 N	.00 N	.00	.00	3.06	.00	.00	.00	.00	.00	9.25
14	.00 N	.00 N	.00 N	.00	.00	1.51	.00	.00	.00	.00	.00	14.36
15	.00 N	.00 N	.00 N	.00	.00	.95	.00	.00	.00	.00	.00	21.79
16	.00 N	.00 N	.00 N	.00	.00	.54	.00	.00	.00	.00	.00	17.06
17	.00 N	.00 N	.00 N	.00	.00	.19	.00	.00	.00	.00	.00	11.94
18	.00 N	.00 N	.00 N	.00	.00	.02	.01	.00	.00	.00	.00	5.68
19	.00 N	.00 N	.00 N	.00	.00	.01	.00	.00	.00	.00	.00	.00
20	.00 N	.00 N	.00 N	.00	.00	.02	.00	.00	.00	.00	.00	.00
21	.00 N	.00 N	.00 N	1.57	.00	.10	.22	.00	.00	.00	.42	.00
22	.00 N	.00 N	.00 N	2.83	.00	.09	.55	.00	.00	.00	.23	.00
23	.00 N	.00 N	.00 N	2.42	.00	1.46	.35	.00	.00	.00	.05	.00
24	.00 N	.00 N	.00 N	2.00	.00	3.63	.25	.00	.00	.00	.00	.00
25	.00 N	.00 N	.00 N	1.46	.00	2.46	.01	.00	.00	.00	.00	.00
26	.00 N	.00 N	.00	1.27	.00	1.45	.00	.00	.00	.00	.00	.00
27	.00 N	.00 N	.00	1.13	.00	.65	.00	.00	.00	.00	.00	.00
28	.00 N	.00 N	.00	.72	.00	.22	.00	.00	.00	.00	.00	.00
29	.00 N	.00 N	.00	.35	.00	.02	.01	.00	.00	.00	.00	.00
30	.00 N	.00 N	.00	.13	.00	.01	.23	.00	.00	.00	.02	.00
31	.00 N	.00 N	.00	.00	.00	.02	.02	.00	.00	.00	.00	.00
TOTAL	.00 N	.00 N	.00 N	13.88	.00	40.13	1.99	2.77	.00	.00	84.08	99.00

TOTAL FOR YEAR 241.85

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 7A

***** 1977 *****

DISCHARGE, IN ACRE-FEET FROM SOUTH CULVERT

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	.00	.00	.00	.00	.19	.00	1.18	1.21	.00	.00	3.58
2	.00	.00	.00	.00	.00	.11	.00	2.29	.34	.00	.00	10.77
3	.00	.00	.00	.00	.00	1.01	.00	4.42	.00	.04	.00	13.69
4	.00	.00	.00	.00	.00	1.89	.14	1.42	.00	.00	.00	9.67
5	.00	.00	.00	.00	.32	1.08	.99	.00	.00	.00	.00	6.36
6	.00	.00	.00	.00	.79	.49	2.21	.00	.00	.00	11.58	4.05
7	.00	.00	.00	.00	.62	.08	3.38	.00	.00	.00	22.99	1.71
8	.00	.00	.00	.00	.54	.02	3.03	.00	.00	.00	16.87	.99
9	.00	.00	.00	.00	.45	.00	2.24	.00	.00	.00	13.06	.82
10	.00	.00	.00	.00	.67	.00	2.08	.00	.00	.00	10.87	.94
11	.00	.00	.01	.00	1.01	.00	2.68	.01	.00	.00	8.68	4.71
12	.00	.00	.01	.00	.88	.00	2.22	.02	.00	.00	4.71	.63
13	.00	.00	.00	.00	.72	.00	2.55	.09	.00	.00	2.24	.46
14	.00	.00	.00	.00	.51	.00	2.50	.03	.00	.00	.39	.46
15	.00	.04	.00	.00	.30	.00	2.51	.00	.00	.00	.01	.37
16	.00	1.03	.00	.00	.17	.00	2.68	.00	.00	.00	.00	.39
17	.00	.58	.00	.00	.09	.00	3.20	.00	.00	.00	.00	.86
18	.00	.02	.00	.00	.02	.00	3.97	.00	.00	.00	.00	1.59
19	.00	.00	.00	.00	2.52	.00	3.84	.01	.00	.00	.00	1.53
20	.00	.00	.00	.00	4.64	.00	4.54	.01	.00	.00	.00	1.30
21	.00	.00	.00	.00	3.12	.00	4.10	.00	.00	.00	.00	1.10
22	.00	.00	.00	.15	10.79	.00	3.51	.32	.00	.00	.00	1.03
23	.00	.00	.00	.12	10.00	.00	2.87	.67	.00	.00	.00	.78
24	.00	.01	.00	.05	4.75	.00	2.71	.99	.00	.09	.00	.35
25	.00	.00	.00	.00	1.90	.00	2.09	.67	.00	.30	.00	.25
26	.00	.00	.00	.01	1.05	.00	2.22	.55	.00	.00	.00	.95
27	.00	.00	.00	.00	1.73	.18	1.54	.66	.00	.00	.00	.58
28	.00	.00	.00	.00	1.40	.93	1.30	.69	.00	.00	.00	.52
29	.00	.00	.00	.02	1.70	.00	2.15	.85	.00	.00	.00	.46
30	.00	.00	.00	.00	1.54	.00	2.23	2.04	.00	.00	.00	.39
31	.00	.00	.00	.00	.66	.00	1.38	1.69	.00	.00	.00	.26
TOTAL	.00	1.68	.02	.35	52.89	5.08	70.96	18.61	1.56	.43	91.40	66.54

TOTAL FOR YEAR 309.52

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED

N = RECORD NOT AVAILABLE

Table 7B

***** 1978 *****

DISCHARGE, IN ACRE-FEET FROM SOUTH CULVERT

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.24	.00	.00	.00	.00	.00	.00	.83	.00	.00	.00	.84
2	.03	.00	.00	.00	.00	.00	.00	1.76	.00	.00	.00	.83
3	.01	.00	.62	.00	.00	.14	.14	1.94	.00	.00	.00	.61
4	.00	.00	1.35	.00	.00	.60	.60	1.44	.00	.00	.00	.26
5	.00	.00	1.05	.00	.00	.33	.33	1.28	.00	.00	.00	.18
6	.00	.00	.86	.00	.16	.04	.04	1.29	.00	.00	.00	.12
7	.00	.00	.75	.00	14.79	.00	.05	1.22	.00	.00	.00	.04
8	.00	.00	.25	.00	11.07	.00	.13	1.14	.00	.00	.00	.01
9	.00	.00	2.56	.00	5.23	.00	.02	.92	.00	.00	.00	.00
10	.00	.00	1.32	.00	2.56	.00	.00	.36	.00	.00	.00	.00
11	.00	.00	.06	.00	1.58	.00	.00	.38	.00	.00	.00	.00
12	.00	.00	.01	.00	.69	.00	.00	.59	.00	.00	.00	.00
13	.00	.00	.00	.00	.13	.00	.00	.60	.00	.00	.00	.00
14	.00	.00	.00	.00	.09	.00	.00	.75	.00	.00	.00	.00
15	.00	.00	.00	.00	.01	.00	.00	.45	.00	.00	.00	.14
16	.00	.00	.00	.00	.00	.00	.00	.33	.00	.00	.00	.03
17	.00	.00	.00	.00	.00	.00	.00	.18	.00	.00	.00	.02
18	.00	.00	.00	.13	.00	.00	.07	.14	.00	.00	.00	.00
19	.35	.00	.00	.01	.00	.00	.80	.48	.00	.00	.00	.00
20	1.01	.00	.00	.00	.00	.00	1.48	1.10	.00	.00	.00	.00
21	1.10	.00	.00	.00	.00	.00	.73	.86	.00	.00	.00	.00
22	1.09	.00	.00	.00	.00	.00	.39	.51	.00	.00	.00	.00
23	1.01	.00	.00	.00	.00	.01	.15	.36	.00	.00	.00	.00
24	.97	.00	.00	.33	.00	.52	.03	.37	.00	.00	.00	.00
25	.53	.00	.00	.06	.00	1.27	.00	.28	.12	.00	.00	.00
26	.71	.00	.00	.02	.00	.82	.00	.11	.83	.00	.00	.00
27	.55	.00	.00	.00	.00	.53	.00	.01	1.78	.00	.00	.00
28	.04	.00	.00	.00	.00	.33	.00	.00	.79	.00	.00	.98
29	.00	.00	.00	.00	.00	.06	.00	.00	.00	.00	.00	.122
30	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.87
31	.00	.00	.00	.00	.00	.12	.12	.00	.00	.00	.75	4.23
TOTAL	7.64	.00	8.85	.55	70.89	3.70	5.08	19.68	3.95	65.04	249.93	10.18

TOTAL FOR YEAR 445.79

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 7C

The north pump was operated at approximately design discharge on a 8-12 hours per day, 5 days per week schedule. Stages upstream of the weir were measured continuously by a standard stage recorder. Stages were discretized on an hourly basis and flow computed hourly for the period of record using a standard form of the flow equation for a weir and an assumed discharge coefficient. Hourly values were summed over a 24 hour day and compared to the daily inflow from the pump and observed fluctuations in daily storage. The weir flow coefficient was adjusted until mass balance over the entire period of record was obtained given a pump flow scaling parameter. The pump scaling parameter was then adjusted and in the process repeated until the RMS (root mean square) error in daily mass balance equation was minimized. The computed pumpage through the north pump appears in Tables 8A, 8B and 8C while the south pump appears in Tables 9A, 9B and 9C.

In addition to the coefficient that needed to be optimized for the flow equations, there were coefficients associated with evaporation and seepage rates.

The equation for evaporation is

$$\text{Evap} = C_3 * \text{Pan} * \text{Area}$$

where

Evap = the approximate volume of evapotranspiration

Pan = pan evaporation

Area = surface area of study

C_3 = the coefficient to be optimized

and the seepage equation

$$\text{Seep} = \text{Miles} * \text{HD} * C_4$$

where

Miles = miles of levee

***** 1976 *****

DISCHARGE, IN ACRE-FEET FROM NORTH PUMP

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	19.66	.00	.00	17.32	.00	17.47	20.78	23.03	.00
2	.00 N	.00 N	.00 N	20.80	16.78	.00	8.82	18.46	17.50	.00	23.48	.00
3	.00 N	.00 N	.00 N	17.30	.00	.00	.00	16.34	16.99	.00	18.22	18.90
4	.00 N	.00 N	.00 N	.00	20.96	.00	.00	17.31	.00	18.89	19.77	.00
5	.00 N	.00 N	.00 N	.00	13.73	.00	13.94	16.01	.00	24.52	22.46	.00
6	.00 N	.00 N	.00 N	.00	.00	.00	24.74	18.41	19.84	19.47	.00	18.18
7	.00 N	.00 N	.00 N	.00	.00	.00	20.70	.00	14.71	20.59	.00	18.80
8	.00 N	.00 N	.00 N	.00	.00	.00	22.44	.00	18.78	20.91	20.00	19.10
9	.00 N	.00 N	.00 N	14.67	.00	.00	.00	21.87	22.70	.00	19.06	17.52
10	.00 N	.00 N	.00 N	.00	.00	.00	.00	19.09	19.55	.00	20.52	19.29
11	.00 N	.00 N	.00 N	.00	.00	.00	.00	16.55	.00	19.17	19.74	.00
12	.00 N	.00 N	.00 N	18.97	.00	.00	20.02	12.76	.00	29.94	26.94	.00
13	.00 N	.00 N	.00 N	25.00	.00	.00	.00	17.19	.00	20.74	.00	.00
14	.00 N	.00 N	.00 N	19.67	.00	.00	16.89	.00	.00	11.24	.00	17.66
15	.00 N	.00 N	.00 N	24.55	.00	.00	16.15	.00	17.09	18.36	13.88	18.96
16	.00 N	.00 N	.00 N	19.99	.00	.00	18.81	20.60	17.52	.00	25.02	19.50
17	.00 N	.00 N	.00 N	.00	.00	.00	.00	17.94	19.97	.00	18.52	19.11
18	.00 N	.00 N	.00 N	.00	.00	.00	.00	22.91	18.65	18.94	16.82	.00
19	.00 N	.00 N	.00 N	20.13	.00	.00	19.33	23.58	.00	20.92	21.33	.00
20	.00 N	.00 N	.00 N	18.61	.00	.00	17.92	18.59	18.80	20.70	.00	19.96
21	.00 N	.00 N	.00 N	18.74	.00	.00	19.14	.00	16.85	21.45	.00	12.91
22	.00 N	.00 N	.00 N	22.24	.00	18.42	19.94	.00	17.89	18.52	21.20	.00
23	.00 N	.00 N	.00 N	19.32	.00	13.85	25.41	17.45	15.02	.00	19.95	.00
24	.00 N	.00 N	.00 N	.00	.00	15.36	.00	18.52	17.02	.00	17.50	.00
25	.00 N	.00 N	.00 N	.00	.00	21.42	.00	16.48	.00	19.56	21.47	.00
26	.00 N	.00 N	15.30	19.44	.00	.00	21.30	18.31	.00	20.44	22.02	.00
27	.00 N	.00 N	.00	17.56	.00	.00	13.36	18.23	18.20	23.11	.00	.00
28	.00 N	.00 N	.00	19.33	.00	16.72	15.71	.00	17.87	21.85	.00	.00
29	.00 N	.00 N	13.58	19.65	.00	16.70	14.56	.00	22.24	18.51	14.96	.00
30	.00 N	.00 N	18.62	18.82	.00	15.92	16.71	16.49	20.95	.00	23.37	.00
31	.00 N	.00 N	18.91	.00	.00	.00	.00	26.81	.00	.00	.00	.00
TOTAL	.00 N	.00 N	66.41 N	374.10	51.47	120.39	370.51	409.90	403.87	428.67	449.26	241.25

TOTAL FOR YEAR 2915.83

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

***** 1977 *****

DISCHARGE IN ACRE-FEET FROM NORTH PUMP

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	.00	19.69	25.38	.00	.00	15.56	16.54	14.88	.00	22.26	20.48
2	.00	15.63	23.77	.00	11.41	.00	.00	16.49	15.47	.00	21.11	19.88
3	.00	17.55	19.40	.00	18.71	.00	.00	17.06	.00	19.57	19.53	.00
4	10.63	19.03	17.38	22.92	17.32	.00	17.98	19.60	.00	20.13	12.03	.00
5	16.74	.00	.00	18.47	21.45	.00	15.82	17.72	16.48	15.71	.00	20.00
6	18.09	.00	.00	17.13	19.02	.00	13.74	.00	18.47	17.78	.00	19.72
7	18.37	18.03	18.19	18.72	.00	.00	15.46	.00	18.34	19.80	19.82	25.23
8	.00	17.90	18.47	18.62	.00	.00	.00	16.23	.00	.00	20.41	20.05
9	.00	19.07	18.63	.00	.00	.00	.00	16.77	16.72	.00	18.58	22.66
10	20.63	16.82	23.47	.00	10.40	.00	.00	18.19	.00	18.82	18.46	.00
11	21.01	18.37	18.60	17.89	17.88	.00	.00	16.31	.00	23.11	17.98	.00
12	18.68	.00	.00	23.92	17.83	.00	.00	14.48	18.85	7.23	.00	19.63
13	17.94	.00	.00	20.15	18.90	.00	.00	.00	21.38	.00	.00	25.23
14	24.24	19.98	14.17	18.26	.00	.00	.00	16.61	17.68	.00	23.22	19.31
15	.00	22.67	19.64	18.50	.00	.00	.00	18.45	19.32	.00	.00	19.70
16	.00	17.13	19.09	.00	19.57	.00	.00	16.07	15.75	.00	13.73	18.96
17	21.23	18.47	19.48	20.47	18.36	.00	.00	18.45	.00	.00	19.28	.00
18	.00	20.19	18.41	19.99	17.99	.00	.00	16.07	.00	.00	18.74	.00
19	17.96	.00	.00	19.64	15.24	.00	18.99	15.15	15.78	.00	.00	22.50
20	18.53	.00	.00	21.47	.00	.00	15.56	.00	16.16	22.22	.00	21.46
21	17.26	17.71	17.76	19.34	.00	.00	14.59	.00	17.79	22.60	18.65	22.12
22	24.70	24.70	18.19	19.53	.00	.00	17.98	16.10	18.71	23.80	18.28	19.85
23	16.77	.00	19.53	.00	.00	9.00	.00	17.63	15.30	21.09	19.48	19.64
24	22.45	17.39	.00	.00	.00	15.24	.00	16.34	.00	.00	22.67	.00
25	20.68	19.03	16.76	23.36	.00	.00	16.95	17.23	.00	.00	20.80	.00
26	20.19	.00	.00	19.62	.00	.00	16.03	17.18	14.67	19.63	.00	18.61
27	21.49	.00	.00	19.91	.00	18.22	15.96	.00	21.75	19.69	.00	20.38
28	13.70	16.45	15.04	11.60	.00	17.48	14.71	.00	21.50	16.99	.00	18.66
29	.00	.00	19.75	15.07	.00	16.26	15.96	16.16	22.26	.00	.00	12.59
30	.00	.00	19.54	.00	.00	14.56	.00	16.55	22.05	.00	.00	29.13
31	17.95	.00	19.35	.00	.00	.00	.00	17.52	.00	22.70	.00	.00

TOTAL 330.59 335.12 414.31 412.57 224.68 30.75 224.29 375.71 379.31 308.87 345.03 455.79

TOTAL FOR YEAR 3947.03

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 8B

***** 1978 *****

DISCHARGE, IN ACRE-FEET FROM NORTH PUMP

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	.00	22.34	.00	18.78	.00	.00	.00	15.95	.00	.00	16.57
2	18.36	20.89	20.94	.00	16.46	.00	.00	.00	.00	11.54	17.58	.00
3	18.75	20.87	21.08	18.81	17.13	.00	18.15	22.81	17.99	16.16	15.99	.00
4	20.93	.00	.00	19.70	17.67	.00	.00	21.23	15.51	18.62	.00	16.38
5	20.28	.00	.00	14.73	.00	.00	18.26	.00	.00	17.33	.00	18.68
6	20.15	19.33	21.89	19.17	.00	.00	16.93	.00	17.73	18.12	16.56	17.38
7	17.29	20.80	23.68	19.31	.00	.00	17.97	.00	17.32	.00	19.44	19.56
8	.00	20.02	23.91	.00	.00	.00	.00	21.44	15.95	.00	.00	.00
9	.00	20.48	19.94	.00	.00	.00	.00	21.85	.00	20.06	15.68	.00
10	19.84	22.79	20.95	19.02	.00	.00	21.68	22.50	.00	.00	20.00	.00
11	20.25	.00	.00	.00	.00	.00	15.96	20.17	15.82	19.98	.00	21.35
12	24.70	19.17	.00	.00	.00	.00	18.90	.00	16.94	18.44	.00	21.22
13	19.27	.00	22.74	.00	.00	.00	22.93	.00	18.26	19.61	9.84	18.15
14	.00	20.23	21.61	20.82	.00	19.81	15.73	18.64	21.63	.00	18.86	17.08
15	.00	19.06	20.27	.00	.00	18.05	.00	17.08	14.26	.00	15.65	17.42
16	19.96	20.05	20.10	.00	.00	18.70	.00	17.69	.00	17.84	14.95	.00
17	19.72	18.42	19.13	18.23	.00	.00	18.43	17.92	.00	16.68	20.11	.00
18	20.03	.00	.00	17.36	.00	.00	17.54	16.72	17.59	15.63	.00	16.57
19	20.09	.00	.00	21.38	.00	18.54	17.35	.00	16.65	15.35	.00	17.08
20	20.25	18.43	21.12	20.50	.00	17.63	.00	.00	15.91	.00	17.81	16.74
21	.00	19.46	18.65	15.92	.00	17.16	18.71	17.49	18.96	.00	16.18	16.74
22	.00	19.59	20.77	.00	.00	16.07	.00	18.82	18.57	.00	15.48	18.68
23	20.83	14.43	23.37	17.47	.00	17.47	.00	18.82	.00	16.68	.00	.00
24	1.55	20.84	17.18	18.59	.00	.00	19.89	18.03	.00	16.51	17.62	.00
25	19.15	.00	.00	17.25	.00	.00	15.34	17.64	16.19	.00	.00	.00
26	19.84	.00	.00	17.00	.00	20.20	16.89	.00	14.86	.00	.00	16.95
27	.00	20.75	18.48	15.18	.00	16.53	.00	15.76	17.36	15.76	17.08	16.95
28	.00	20.43	18.52	.00	.00	17.11	14.94	18.39	16.26	.00	18.66	17.25
29	.00	.00	18.58	17.73	.00	17.25	.00	17.67	.00	.00	17.81	13.35
30	16.49	21.32	21.32	.00	.00	18.89	.00	15.60	.00	22.75	17.62	.00
31	1.72	19.79	19.79	.00	.00	.00	16.59	15.27	.00	17.00	.00	.00
TOTAL	379.45	376.44	475.66	312.10	70.04	233.41	321.29	332.82	339.75	314.12	322.92	334.70

TOTAL FOR YEAR 3572.90

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

***** 1976 *****

DISCHARGE, IN ACRE-FEET FROM SOUTH PUMP

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	20.27	.00	.00
2	.00 N	.00 N	.00 N	.00	.00	.00	.00	17.92	17.13	.00	.00	.00
3	.00 N	.00 N	.00 N	.00	.00	.00	.00	15.88	17.69	.00	.00	.00
4	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	18.04	.00	.00
5	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	25.56	.00	.00
6	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	19.44	18.44	.00	.00
7	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	14.71	16.73	.00	.00
8	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	17.17	18.31	.00	.00
9	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	22.70	.00	.00	.00
10	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	19.18	.00	.00	.00
11	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	21.35	.00	.00
12	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	13.51	.00	.00
13	.00 N	.00 N	.00 N	.00	.00	.00	.00	16.86	17.44	10.15	.00	.00
14	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	19.23	.00	.00
15	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00 N	.00 N	.00 N	.00	.00	.00	.00	12.67	.00	.00	.00	.00
17	.00 N	.00 N	.00 N	.00	.00	.00	.00	16.88	.00	.00	.00	.00
18	.00 N	.00 N	.00 N	.00	.00	.00	.00	21.48	18.32	.00	.00	.00
19	.00 N	.00 N	.00 N	.00	.00	.00	.00	22.46	.00	.00	.00	.00
20	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	17.17	.00	.00
21	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	.00	.00	.00
22	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	.00	.00	.00
23	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	18.02	.00	.00
25	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00 N	.00 N	.00 N	.00	.00	.00	18.65	.00	.00	.00	.00	.00
27	.00 N	.00 N	.00 N	.00	.00	.00	15.80	.00	.00	.00	.00	.00
28	.00 N	.00 N	.00 N	.00	.00	.00	14.57	.00	19.25	.00	.00	.00
29	.00 N	.00 N	.00 N	.00	.00	.00	15.70	.00	19.56	.00	.00	.00
30	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	.00	.00	.00
31	.00 N	.00 N	.00 N	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	.00 N	.00 N	.00 N	.00	.00	.00	64.72	124.15	202.59	216.84	.00	.00

TOTAL FOR YEAR 608.30

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

***** 1977 *****

DISCHARGE IN ACRE-FEET FROM SOUTH PUMP

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	.00	.00	.00	.00	.00	16.04	.00	.00	.00	19.41	.00
2	.00	.00	.00	.00	.00	.00	.00	15.09	15.81	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	15.05	.00	19.77	.00	.00
4	10.84	.00	.00	.00	.00	.00	16.77	22.28	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	15.91	18.04	16.32	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	13.35	.00	18.60	17.78	.00	.00
7	.00	.00	.00	9.18	.00	.00	15.52	.00	.00	19.62	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	17.35	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.00	17.10	19.21	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	13.43	.00	19.21	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	14.52	.00	24.25	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	19.02	17.68	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00	23.24	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	17.72	21.61	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00	14.32	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	15.00	.00	.00	.00	.00
21	.00	.00	.00	.00	.00	.00	.00	.00	.00	10.16	.00	.00
22	.00	.00	.00	13.67	.00	.00	.00	.00	.00	18.79	.00	.00
23	.00	.00	.00	13.30	.00	.00	.00	16.25	.00	24.16	.00	.00
24	.00	.00	.00	.00	.00	10.67	.00	.00	.00	20.53	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	2.60	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.83	18.69	.00	.00	.00	18.23	.00	.00
28	.00	.00	18.31	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	.00	.00	24.26	5.69	.00	.00	15.85	.00	.00	18.55	.00	.00
30	.00	.00	.00	.00	.00	14.66	.00	.00	.00	.00	.00	.00
31	.00	.00	.00	.00	.00	.00	.00	.00	21.87	.00	.00	.00
TOTAL	10.94	.00	42.57	44.44	.83	44.02	92.54	164.31	128.55	287.90	19.41	.00

TOTAL FOR YEAR 835.41

LETTERS FOLLOWING NUMBERS MEAN:

N = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

***** 1978 *****

DISCHARGE IN ACRE-FEET FROM SOUTH PUMP

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	.00	.00	.00	.00	.00	.00	.00	.00	33.97	.00	.00	.00
2	.00	.00	.00	.00	16.65	.00	.00	.00	.00	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	32.84	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	35.34	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00	17.62	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.00	.00	.00	18.35	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	16.42	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	19.60	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	18.77	.00	.00	15.31	.00	.00	27.76
16	.00	.00	.00	.00	.00	17.65	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	16.39	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
22	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	.00	.00	.00	18.44	.00	.00	.00	.00	.00	.00	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	16.28	.00	.00	.00
27	.00	.00	.00	.00	.00	.00	.00	.00	18.26	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	.00	.00	32.32	.00	.00	.00
29	.00	.00	.00	.00	.00	.00	.00	18.73	24.95	.00	.00	.00
30	.00	.00	.00	.00	.00	.00	.00	17.55	21.67	.00	.00	.00
31	.00	.00	.00	.00	.00	.00	.00	28.59	.00	.00	.00	.00
TOTAL	.00	.00	.00	35.33	16.65	56.02	.00	64.57	247.36	35.97	.00	27.76

TOTAL FOR YEAR 483.96

LETTERS FOLLOWING NUMBERS MEAN:

M = PART OR ALL OF RECORD IS MISSING AND THUS ESTIMATED
 N = RECORD NOT AVAILABLE

Table 9C

HD = head difference across levy

C_4 = coefficient that needs to be optimized

The optimized coefficients appear in the following table:

TABLE 10

Optimized Coefficient

C_1 = Weir discharge coefficient	3.0
C_2 = Pumping coefficient	.96
C_3 = Evapotranspiration coefficient	.70
C_4 = Seepage coefficient	.06

Error Analysis

The actual error and the root mean square error for each area is calculated daily and monthly for each year. The actual error is defined as the difference between the actual changed storage (ΔS_a) and the simulated changed storage (ΔS_s). Therefore, $\epsilon = \Delta S_a - \Delta S_s$ where ϵ = error. The root mean square error is calculated by

$$RMS = \sqrt{\frac{\sum_{i=1}^N \epsilon_i^2}{N}}$$

where

Σ = summation of ϵ^2 for N time increments

RMS = root mean square error

N = number of days or months error summed over

Root mean square errors are minimized by optimizing the value of the coefficients while keeping them in the acceptable range which is subject to the constraint that the long term error is negligible. The steps

of this process are as follows:

- 1) Optimizing the pumping and discharge coefficients. This is done in the canal area because there are large changes in stage due mainly to flow through the structures. Rainfall, seepage and ET are of smaller orders of magnitude. First, we determine the smallest RMS error by varying the pumping coefficient. Then we vary the discharge coefficient within the acceptable range to achieve a mass balance. These coefficients can be used on all structures in the Boney Dike Marsh because they are similar in nature.
- 2) Optimizing the ET coefficient so that RMS error is the smallest. This is done by minimizing the RMS error for the eastern area where most changes in error are due to rainfall and ET.
- 3) Determining the seepage coefficient which best leads to a mass balance and the lowest overall RMS error.
- 4) Repeating steps until coefficients stabilize.

Interpretation of Errors

There is a mass balance for the three year period. The total error over the 350 acres of land was only -157 acre feet of water. This error is small when we consider that over this period more than 12,000 acre feet flowed through the east and west areas. ET and rainfall are on the order of 3 to 5 thousand acre feet each and there is a seepage function to consider.

In determining more detail about the error we look at the individual budgets in the marsh area.

RESULTS

A detailed error analysis can be seen in Tables 11, 12 and 13.

TABLE 11

Mass Balance Errors (Acre-Feet)

<u>Year</u>	<u>Canal</u>	<u>Western (Flow) Area</u>	<u>Eastern (No-Flow) Area</u>
1976	72.3	-73.7	-47.7
1977	-65.5	61.4	-76.2
1978	2.2	90.0	-117.0
	<u>4.5</u>	<u>77.7</u>	<u>-240.07</u>

A negative error indicates that ΔS_s is higher than the ΔS_a . A positive error indicates that the ΔS_a is higher than the ΔS_s .

TABLE 12

Daily RMS Error (Acre-feet)

<u>Year</u>	<u>Canal</u>	<u>Western (Flow) Area</u>	<u>Eastern (No-Flow) Area</u>
1976	3.52	7.35	4.84
1977	3.03	6.05	5.30
1978	2.12	5.92	6.10

TABLE 13

Monthly RMS Error (Acre-feet)

<u>Year</u>	<u>Canal</u>	<u>Western (Flow) Area</u>	<u>Eastern (No-Flow) Area</u>
1976	19.13	38.61	42.75
1977	22.38	74.30	69.57
1978	25.81	69.39	62.05

Canal

Reviewing the canal results, the error is mainly involved with flow rates. This error was expressed as a percentage of total flow. The total flow for the three year period of record was calculated to be 10,734 ac/ft. The period of record was 1,010 days. The average daily error is therefore 27%. A noticeable trend, however, is the daily RMS value dropped as weir height data increased. In 1978 a total of 3,872 acre feet of water flowed which gave a daily average of 10.6 acre feet per day. The RMS value for this year was 2.12 so that the percentage of error is about 20%.

The average monthly flow is about 325 acre feet. The monthly RMS error is about 22 acre feet which gives us a monthly error of 6.7%. This fact illustrates that most of the daily error compensates itself on a monthly basis. On a yearly basis the largest mass balance error is 70 acre feet over the total flow for that year giving a maximum percentage of error of 2% per year. Over a three year period the mass balance error is nearly 0.

Western Area

The error in this area is due to a combination of all of the components of the water budget. The daily RMS error is between 6 and 7 acre-feet over 120 acres area. This error amounts to an error in stage of about a half inch per day. This daily error is quite small when the flow errors are taken into account. Also, stage fluctuations at the north and south ends are out of phase and vary quite a bit in magnitude due to large inflows over the north weir which affects the northern recorder earlier and to a larger degree than the south recorder. The maximum monthly RMS occurred in 1977 and was 74.30 acre feet. This error is equivalent to one half foot

in stage per month. This means about 2/3 of the daily error compensates itself over a month. The largest error for a given year is 90 acre feet which indicates that the monthly sums tend to compensate themselves over the year. Over the three year period there was a total of 77.706 acre feet error, or about 3/4 foot. This number is very good considering 10,000 acre feet of water flowed into the area over the north weir and ET, rainfall, and seepage are substantial for this area.

Eastern Area

The daily RMS errors are slightly smaller for the eastern area than the western area and range between 5 and 6 acre feet. Over an area of 230 acres the error amounts to about a quarter of an inch in depth. The stage variation over the entire area at a given time varies more than this amount and the error may be due to calculations of the average stage rather than the estimated components of the water budget. The largest monthly RMS value in any year was 70 acre feet. This amounts to an error of about 3/10 foot per month, therefore, about half the daily error compensates itself over a month. After a three year period the stage difference due to this error would be about a foot off with the total error being 240 acre feet over an area of 230 acres.

CONCLUSION

A reasonable understanding of the magnitude of all the components of Boney Dike experimental marsh has been attained on a daily basis. A substantial part of the error involved appears to be associated with poor weir height and pump log data. The data improved over the three year period in the canal and western areas where RMS errors dropped substan-

tially. No effort has been made to more accurately measure the weir at the eastern area.

Over three years, 10,734 acre feet of water flowed into the canal through the north pump and 10,676 acre feet flowed over the north weir. ET, rainfall and seepage had a negligible effect. Ten thousand six hundred seventy six (10,676) acre feet flowed into the western area over the north weir and 10,175 acre feet flowed out over the south weir. The difference in these discharge volumes is due to evaporation during this rather dry period. The eastern area had 1,923 acre feet of inflow through the south pump and 991 acre feet outflow through the south culvert. This again was mainly due to evaporation during the dry period. Seepage plays only a minor role in the budget because inward seepage along the eastern boundary of the marsh is approximately balanced by the outward seepage along the western boundary.