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Water Budget Analysis for Stormwater Treatment Area 2

(Water Year 2007; May 1, 2006–April 30, 2007)

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EXECUTIVE SUMMARY

This report presents a water budget for Stormwater Treatment Area 2 (STA-2) during the one-year period from May 1, 2006–April 30, 2007 (Water Year 2007, or WY2007). It supplements the previous water budget report on STA-2, published December 2007, which covers the first five years of operation.

STA-2 is a primary component of the Everglades Construction Project mandated by the 1994 Everglades Forever Act (Section 373.4592, Florida Statutes) and is located in Palm Beach County, Florida. Construction of STA-2 was completed in June 1999. STA-2 provides a total effective treatment area of 6,430 acres and treats discharges from pump station S-6 and agricultural pump station G-328. STA-2 was expanded from three treatment cells to four treatment cells in WY2007. Cell 1, Cell 2, Cell 3, and Cell 4 parallel each other (1,990 acres, 2,220 acres, 2,220 acres, and 2,015 acres, respectively). Upon satisfying the start-up requirements for the net improvement in total phosphorous and mercury, flow-through operations began for Cells 1, 2, and 3 in earnest with the 2001 wet season. The first water quality collection sampling at Cell 4 was on June 13, 2007. As Cell 4 did not begin flow-through operations in WY2007, this report covers water budgets for Cells 1, 2, and 3 and the entire STA without Cell 4.

During WY2007, STA-2 received 252,336 acre-feet (ac-ft) of water from pumping operations. An additional 23,526 ac-ft of water was received via rainfall; 28,249 ac-ft of water was lost through evapotranspiration. Net seepage was estimated to be 2 percent of the water budget during this period, losing 4,165 ac-ft of water to surrounding water bodies and the surficial aquifer. Outflow from STA-2 through G-335 was 86 percent of the inflow or 217,572 ac-ft. This volume entered the L-6 Canal. The error in the water budget was 11 percent. On the average, Cell 1 retained water for 18 days whereas Cell 2 and Cell 3 retained water for 8 and 9 days, respectively.

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ac	acre
ac-ft	acre-feet
ac-ft/d	acre-feet per day
cfs	cubic feet per second
cm	centimeter
DBHYDRO	South Florida Water Management District corporate environmental database
DBKEY	database key (identifies a unique record)
District	South Florida Water Management District
ET	evapotranspiration
ft	feet
HLR	hydraulic loading rate
in	inch
MHRT	mean hydraulic retention time
mm	millimeter
NGVD	National Geodetic Vertical Datum
NPDES	National Pollution Discharge Elimination System
SAV	submerged aquatic vegetation
SFWMD	South Florida Water Management District
SSE	sum of the squared daily error
STA	Stormwater Treatment Area
stage	water surface elevation
WCA	Water Conservation Area
WY	water year for the District (May 1 – April 30)

INTRODUCTION

This water budget report for Stormwater Treatment Area 2 (STA-2) covers operation from May 1, 2006–April 30, 2007 (Water Year 2007, or WY2007). It is based upon daily water budgets for three treatment cells in STA-2 and for the entire STA. Daily results were aggregated to develop monthly water budgets and an annual water budget for WY2007. The information presented in this report coincides with the WY2007 period used in the *2008 South Florida Environmental Report – Volume I* (SFWMD, 2008), which includes all previous consolidated reports from 1999–2007.

STA-2 is a component of the Everglades Construction Project mandated by the 1994 Everglades Forever Act (Section 373.4592, Florida Statutes). STA-2 is located in Palm Beach County, Florida, situated generally on and surrounding the former Brown's Farm Wildlife Management Area and positioned immediately west of Water Conservation Area 2A (WCA-2A, **Figure 1**). Treatment Cells 1, 2, and 3 in STA-2 provide a total effective area of 6,430 acres to treat stormwater runoff originating from the Hillsboro Canal and Ocean Canal drainage basins upstream from pump station S-6. The effective treatment area of STA-2 has since been expanded to include a fourth treatment cell, which was flow capable by December 31, 2006. The first water quality collection sampling at Cell 4 was on June 13, 2007. Due to drought conditions, Cell 4 did not begin flow-through operations in WY2007. Therefore, it has been omitted in this report.

This section of the report presents background information and information about hydrometeorological monitoring at STA-2. It is followed by the sections describing the operation of STA-2 and the sources of data used for the report. The actual water budget analyses are presented, followed by a summary, recommendations, and conclusions.

Background

STA-2 treats discharge from pump station S-6 and agricultural pump station G-328. Combined with other elements of the Everglades Construction Project, STA-2 is designed to reduce the long-term, flow-weighted mean total phosphorus concentration in discharges to WCA-2A. Outflows from STA-2 will help in the reestablishment of sheet flow along the northwesterly perimeter of WCA-2A. Average annual inflow volumes and loads on which the design of STA-2 was based were 174,641 acre-feet (ac-ft) and 33,760 kilograms (33.76 metric tons) of total phosphorus per year.

Construction of STA-2 was completed in June 1999. On September 29, 2000, the Florida Department of Environmental Protection issued the Everglades Forever Act Permit #0126704 and the associated National Pollution Discharge Elimination System (NPDES) Permit (FL0177946) for operation of STA-2. Discharge operations were authorized in fall 2000.

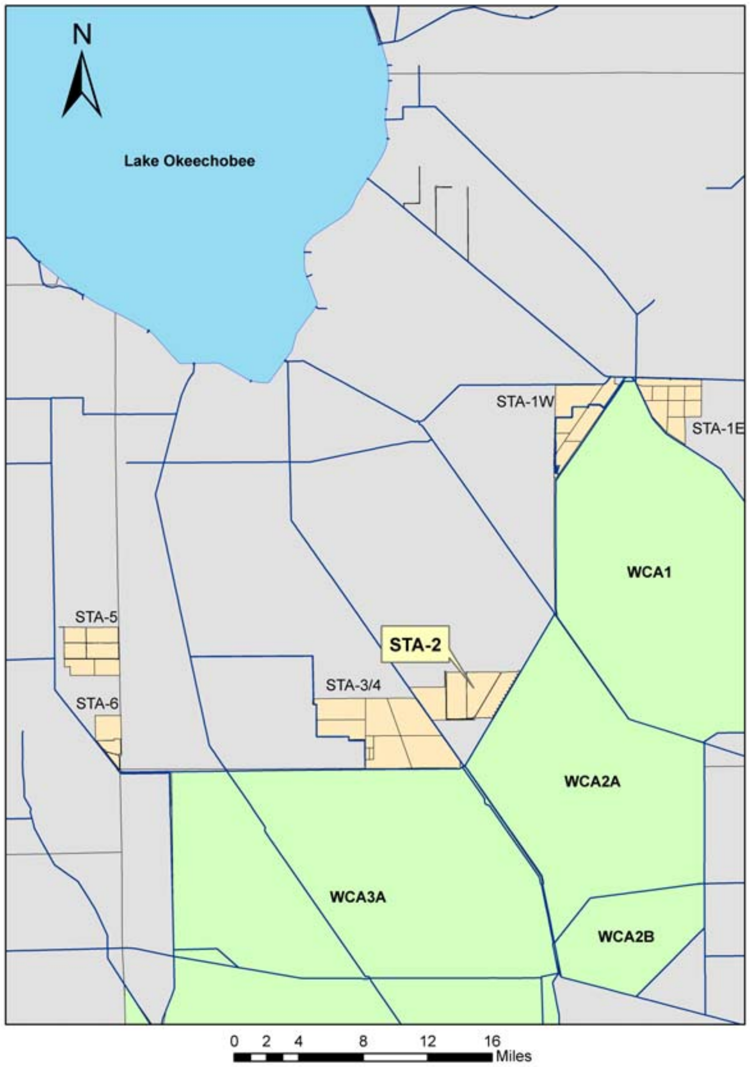

Figure 1. STA-2 site location map.

The water budget at STA-2 involves the following hydrologic/hydraulic components:

- Inflow through pumps and culverts
- Outflow through pumps, culverts, and gated structures
- Rainfall
- Evapotranspiration
- Seepage
- Change in storage
- Water budget error

Each component makes up an important part of the water budget for STA-2. The budget was developed for varying time periods from 1 day to 12 months using the following equation:

$$\frac{\Delta S}{\Delta t} = I - O + R - ET \pm G + \varepsilon \qquad (1)$$

where ΔS	=	change in storage over the time period
Δt	=	time period
I	=	average inflow over the time period
O	=	average outflow over the time period
R	=	rainfall over the time period
E	=	evapotranspiration over the time period
G	=	levee and deep seepage over the time period
ε	=	water budget error over the time period

In Equation (1), all terms have the same units, acre-feet per unit time (day, month, year). The units for rainfall and evapotranspiration (in inches or millimeters) are converted to feet and multiplied by the effective surface area in acres, (e.g., 1990 acres for Cell 1) to calculate volume of rainfall or evapotranspiration for a selected time period.

One year of daily average stage, flow, rainfall, and evapotranspiration data were used in this report. The data were analyzed daily, monthly, and annually using Equation (1).

Site Description

The total effective treatment area in STA-2, 6,430 acres, is distributed among three parallel cells: Cell 1 (1,990 acres), Cell 2 (2,220 acres), and Cell 3 (2,220 acres). Flows pass through these treatment cells from north to south and then are directed to a final discharge collection system along the southern boundary of STA-2 (**Figure 2**).

Figure 3 shows that the plant community in Cells 1 and 2 is dominated by sawgrass, cattail, and other emergent vegetation. Vegetation in Cell 3 consists almost entirely of submerged aquatic vegetation (SAV) and open water.

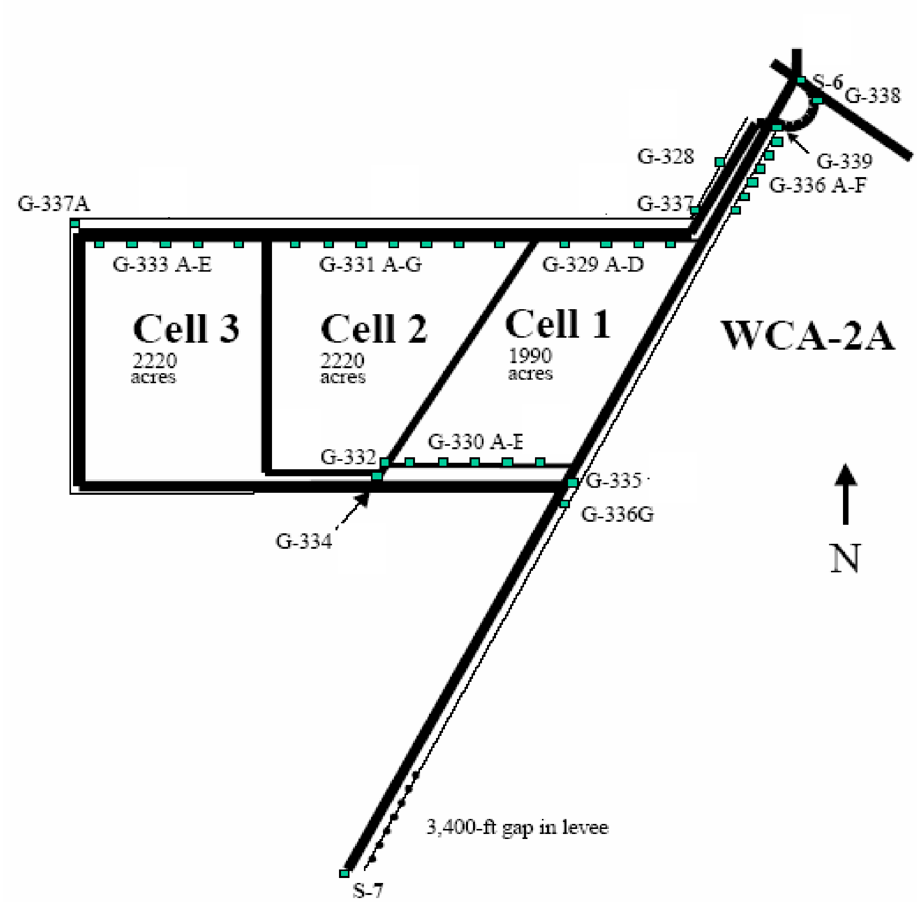

Figure 2. Schematic diagram of STA-2.

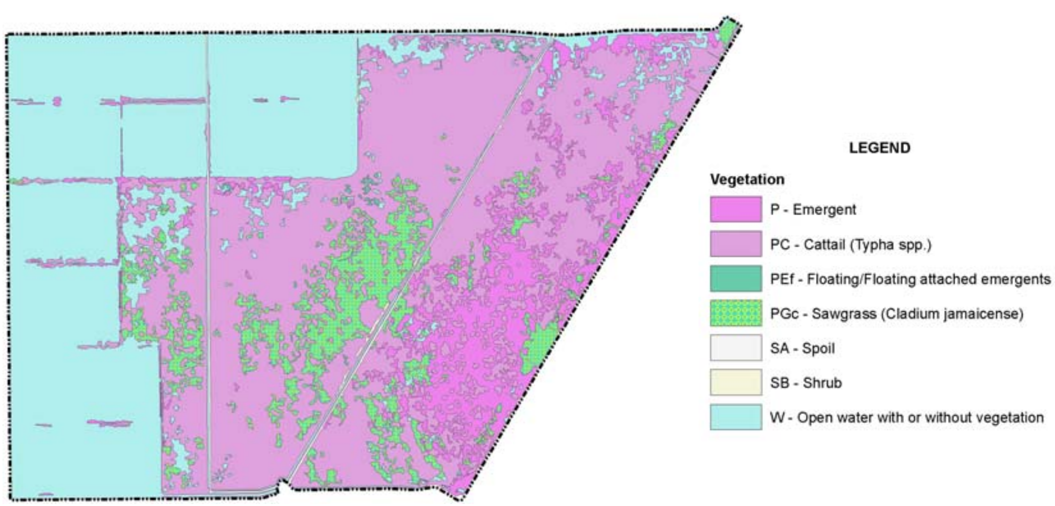

Figure 3. STA-2 vegetation**.**

STA Operation

Pump station S-6 (**Figure 2**) serves as a primary inflow pumping station to STA-2. Additionally, agricultural pump station G-328 can discharge up to 445 cubic feet per second (cfs) to STA-2 from drainage of upstream farmlands. Discharges from S-6 are conveyed to the STA-2 treatment cells through the Supply Canal and Inflow Canal. The STA-2 Supply Canal extends southwesterly from pump station S-6 approximately 18,500 feet adjacent to the L-6 Borrow Canal and the northwestern boundary of WCA-2A. Flows from the Supply Canal are conveyed to the Inflow Canal, which extends across the northern perimeter of STA-2.

A series of inflow control structures (culverts) move water from the Inflow Canal to the treatment cells (G-329A-D into Cell 1, G-331A-G into Cell 2, and G-333A-E into Cell 3). Water travels to the south through the treatment cells eventually discharging to the Discharge Canal through each treatment cell's discharge structures (culverts G-330A-E for Cell 1, gated spillway G-332 for Cell 2, and gated spillway G-334 for Cell 3). Water then travels to the east in the Discharge Canal toward the STA-2 outflow pump station G-335, located at the southeast corner of STA-2. The outflow pump station discharges to the L-6 Canal. Discharges from the L-6 Canal flow across the L-6 Levee into the northwesterly portion of WCA-2A through structures G-336A-F and into the southwestern portion of WCA-2A through a gap in the L-6 Levee. The location of these discharges was selected because the downstream areas are impacted with cattail.

Cells 1, 2, and 3 were operational during WY2007. However, special environmental and operational conditions during this period included:

- A severe regional drought began in WY2006.
- Vegetation in Cell 3 was managed to optimize SAV performance in WY2006.
- Construction of a new treatment cell, Cell 4, started in April 2006.

Further details concerning STA-2 operations can be found in the Operation Plan Stormwater Treatment Area 2 (Updated) (SFWMD, 2006).

HYDROLOGIC AND HYDRAULIC DATA

The following sections describe the data that were used for the water budget computations and any special considerations for using the data. The source for the data was DBHYDRO, the South Florida Water Management District's corporate hydrometeorological database. The corresponding database keys (DBKEYs) and station names are provided in Appendix A, **Table A-2** through **Table A-5**.

Two hydrologic parameters, stage and rainfall, were monitored at STA-2. Gate openings and pump speeds were also monitored. Daily mean stage (water surface elevation) was recorded at the stations listed in **Table A-2** in Appendix A and shown in **Figure 2**. **Table A-3** in Appendix A lists the stations where daily mean flow data was recorded.

Rainfall

Daily rainfall data for STA-2 were collected at three sites listed in **Table A-4**. The arithmetic mean rainfall for these stations was used for the water budget analysis. **Table B-1** in Appendix B lists the daily rainfall amounts used by water year.

Stage

Stage data are collected instantaneously, averaged, and recorded as daily mean stage in DBHYDRO. The instantaneous stage is also used to compute flow at the inlet and the outlet structures. The average daily stage was computed for each treatment cell using the values at stage gages within the cell. A cell's average daily stage was used to compute change in storage in the cell by multiplying the change in stage from the previous day by the effective surface area of the cell (shown in **Table A-1**). When the water level fell below the average ground surface elevation, change in storage was determined using a wetting-drying curve described in Huebner (2007).

Flow

Daily mean flow rates were determined using two methods, culvert equations and pump performance curves. At pump stations S-6, G-328, and G-335, average daily flow was computed instantaneously using motor speed and headwater and tailwater elevation data. Daily mean flow was quality assured monthly and loaded into DBHYDRO.

Daily mean flow at the gated culverts in STA-2, G-329A-D, G-331A-G, G-333A-E, and G-330A-E was based on instantaneous flow values that were calculated using instantaneous headwater stage, tailwater stage, and gate openings. The daily mean flow at these stations was recorded in DBHYDRO.

Evapotranspiration

Evapotranspiration (ET) is the loss of water to the atmosphere by vaporization (evaporation) at the surface of a water body and plant transpiration. The evapotranspiration data used in this report were derived from ET data maintained in a preferred DBKEY for Stormwater Treatment Area 1 West (STA-1W). STA-1W is on the eastern side of the Everglades Agricultural Area. These data for ET are considered to be the highest quality available. **Table C-1** in Appendix C lists the daily ET values used by water year.

Seepage

No direct measurement of seepage was made at STA-2. Attempts to quantify seepage at STA sites have been made. The most recent detailed studies have been associated with the Everglades Nutrient Removal Project (Choi and Harvey, 2000) and those discussed in the WY1998-WY1999 water budget analysis for STA-6 (Huebner, 2001).

In the analysis, seepage was computed as:

$$G = 1.983 * K_{sp} * L * \Delta H \quad (2)$$

Where G	=	estimated seepage (ac-ft/d)
K_{sp}	=	coefficient of seepage (cfs/mi/ft)
L	=	length along the seepage boundary (mi)
ΔH	=	hydraulic head difference between the unit and the boundary (ft)
1.983	=	constant to convert from cfs to ac-ft/d

$K_{sp},$ the coefficient of seepage parameter helps quantify the amount of seepage that occurs through a levee and through the bottom of an STA cell. In this report, it has been calibrated to minimize the sum of squared daily error (SSE) for the entire STA over the five-year period from May 1, 2001–April 30, 2006. Seepage coefficients used for Cell 1, Cell 2, and Cell 3 were 0.1, 0.1, and 1.0, respectively.

WATER BUDGET

Methodology

For this analysis, STA-2 was divided into three hydrologic units: Cell 1, Cell 2, and Cell 3. A water budget analysis was performed on each unit on a daily, monthly, and annual period using Equation 1. A daily, monthly, and annual water budget was also completed for the entire STA using data from all three flow ways as well as the supply, inflow, and discharge canals. Terms in Equation (1) were converted to acre-feet (ac-ft) per unit time. The results are described in the following section of the report.

Results

Rainfall and Evapotranspiration

Rainfall data for STA-2 are presented in Appendix B. ET data are provided in Appendix C. **Figure 4** shows the monthly rainfall surplus or deficit based on the sum of rainfall minus estimated ET at STA-2.

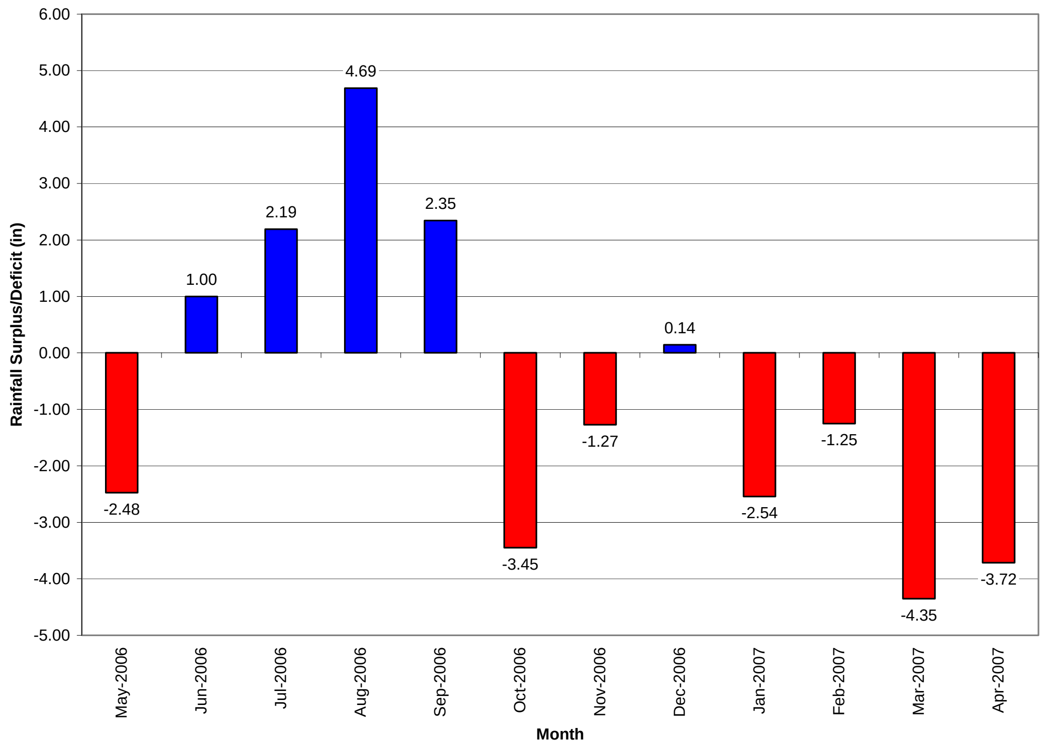

Figure 4. Monthly rainfall minus estimated evapotranspiration at STA-2.

Cell 1

Table 1 presents a summary of the annual water budget for Cell 1 at STA-2. The properties (width, length, and surface area) of Cell 1 are listed in **Table A-1**. A similar table is provided for the other hydrologic units at STA-2 in their corresponding section below. Inflow was measured at G-329A-D and outflow at G-330A-E.

Error in the annual water budget was 11 percent. Water budget error is computed daily using Equation (1) and summed for the month or water year. The percentage of days where the daily water budget did not balance within a 0.25 ft (3 in.) depth was less than 1 percent. This suggests that daily values in the budget were well quantified. Daily water budget residuals are shown in **Figure 5**.

Figure 6 shows the estimated seepage for Cell 1 over the period of study. **Figure 7** displays the water levels in the treatment cells versus the water levels in the surrounding canals. Inflow, outflow, and stage for Cell 1 are provided in **Figure 8**.

Table 2 presents the monthly results of the water budget analysis for Cell 1.

Table 1. Annual water budget summary for STA-2, Cell 1.

Cell 1	WY2007	% Inflow
INFLOW	58,671	89
SEEPAGE IN	9	0
RAIN	7,162	11
TOTAL INFLOW	65,842	% Outflow
OUTFLOW	66,356	88
SEEPAGE OUT	461	1
ET	8,600	12
TOTAL OUTFLOW	75,417	
CHANGE IN STORAGE	-2,084	ERROR %
REMAINDER	7,492	11

Note: all units in ac-ft except for percentages.

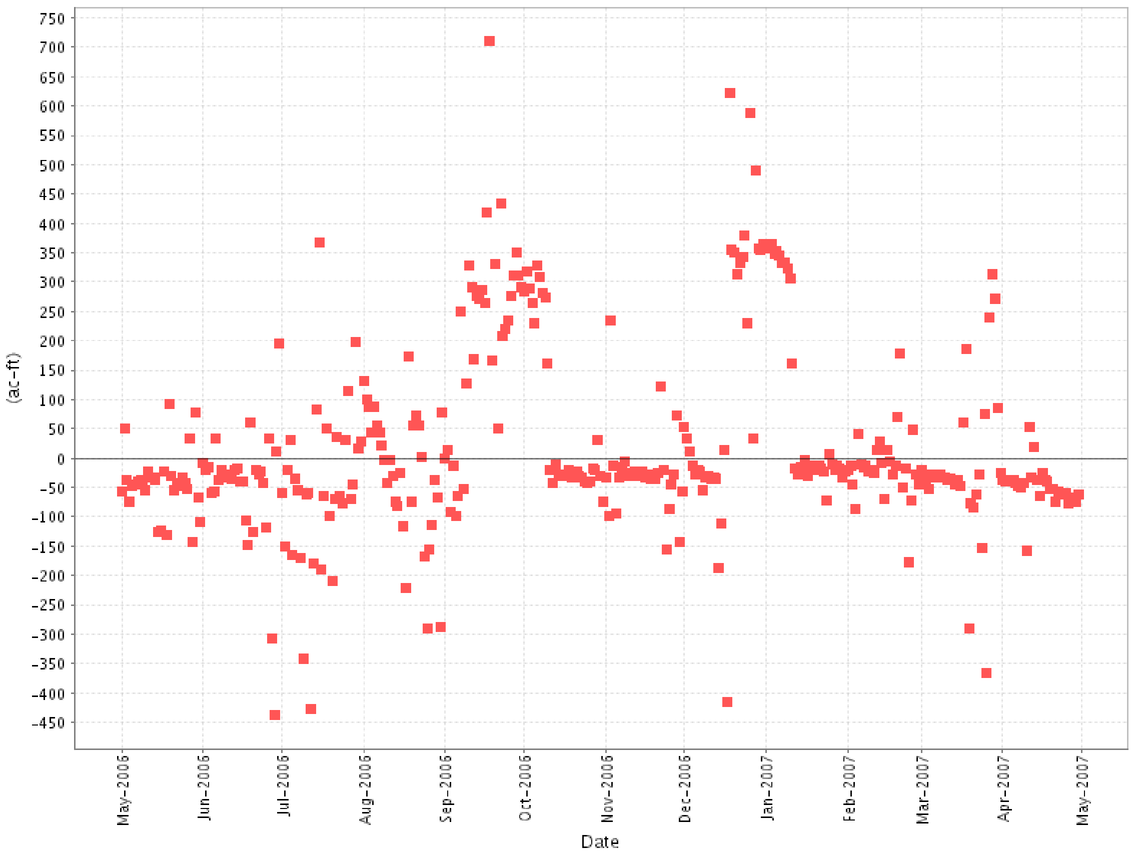

Figure 5. Daily water budget residuals for STA-2, Cell 1.

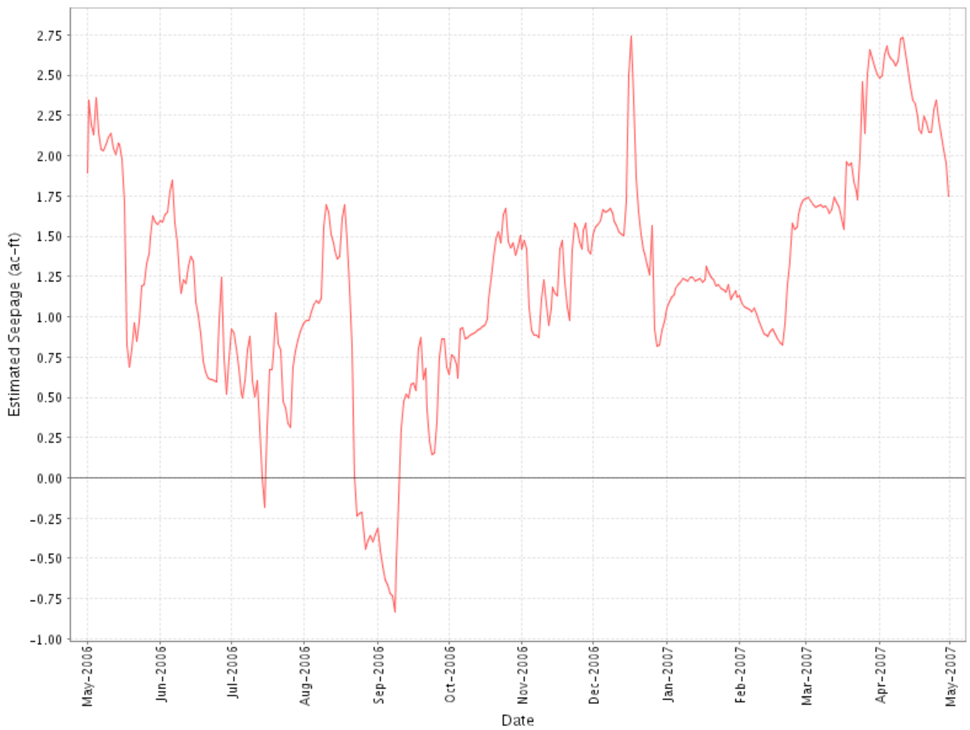

Figure 6. Estimated seepage for STA-2, Cell 1.

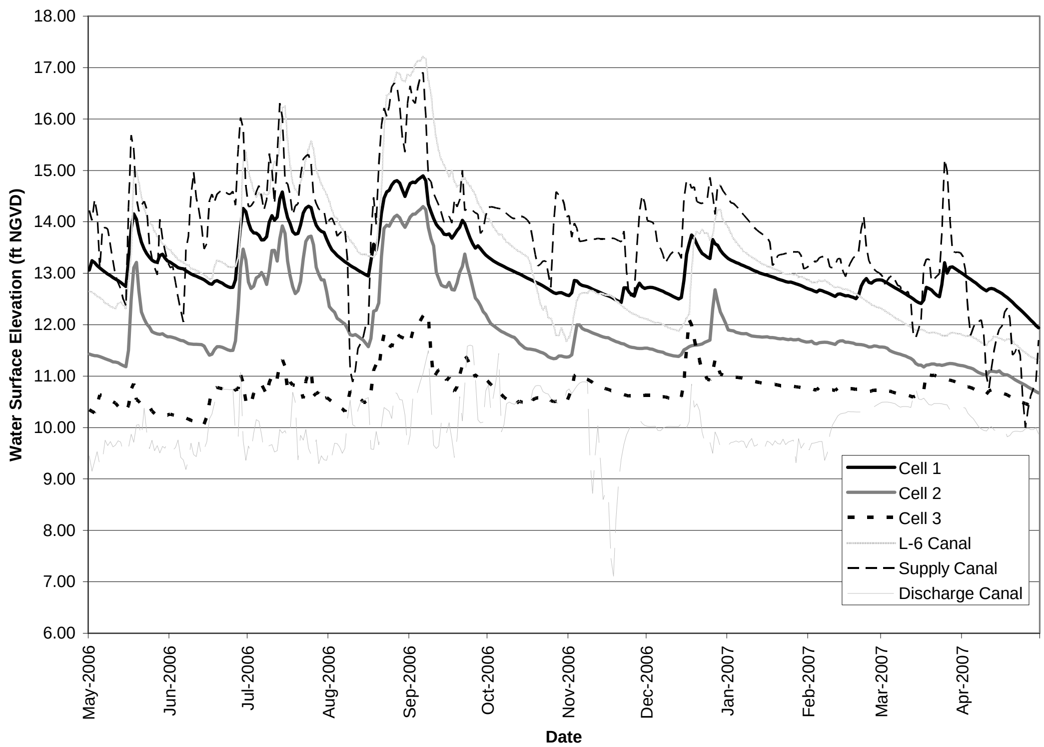

Figure 7. Stage in STA-2, Cells 1, 2, and 3 and surrounding areas.

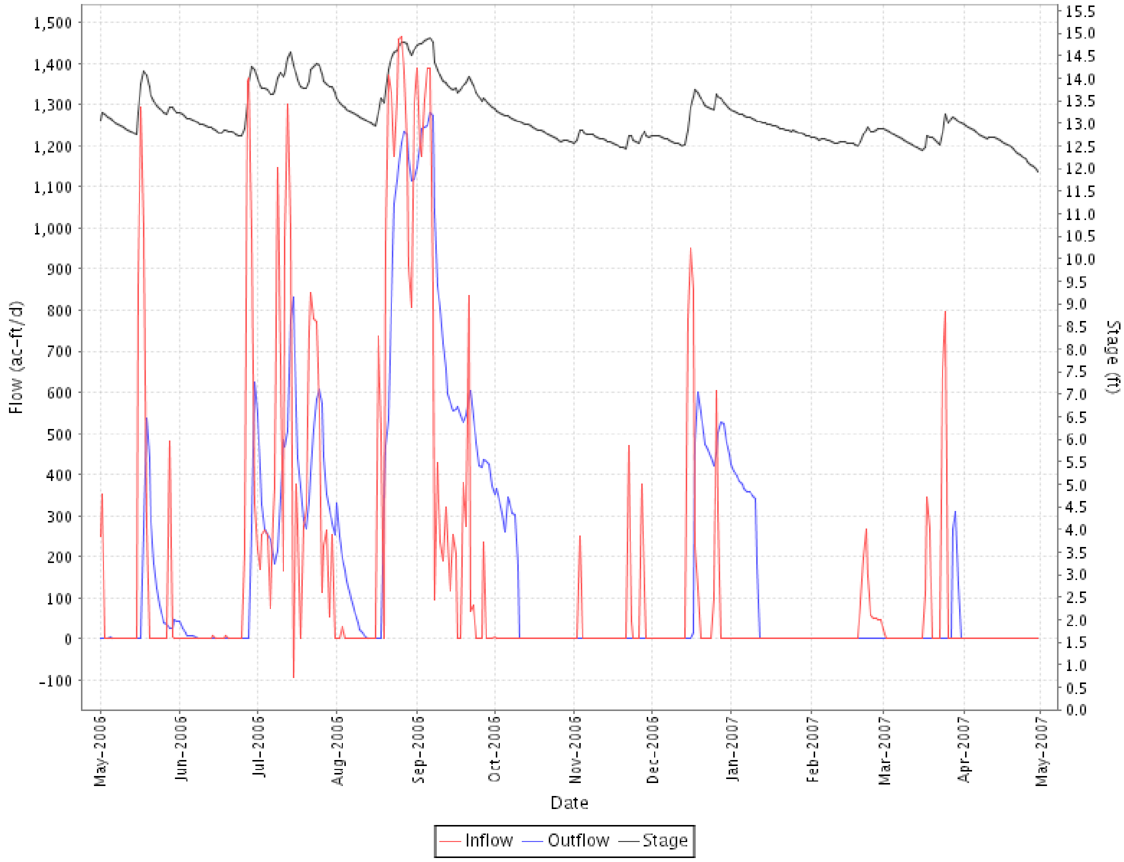

Figure 8. Inflow, outflow, and stage for STA-2, Cell 1.

Table 2. Monthly water budget for STA-2, Cell 1.

Month-Year	INFLOW	OUTFLOW	CHANGE IN STORAGE	ET	RAIN	SEEPAGE	REMAINDER
May - 2006	4504	2201	510	979	569	52	-1331
Jun - 2006	4274	1013	1903	820	986	34	-1490
Jul - 2006	12909	12659	-1062	843	1207	19	-1656
Aug - 2006	15940	13981	1927	840	1617	24	-785
Sep - 2006	12679	21876	-2541	728	1117	5	6273
Oct - 2006	5	3090	-1547	712	141	35	2144
Nov - 2006	1263	0	246	512	301	37	-769
Dec - 2006	3944	6878	1253	427	451	48	4211
Jan - 2007	0	3948	-1235	516	95	37	3172
Feb - 2007	961	0	325	524	316	32	-396
Mar - 2007	2194	710	295	800	78	59	-410
Apr - 2007	0	0	-2158	899	284	71	-1473

Note: all units in ac-ft.

Cell 2

Table 3 presents the water budget for Cell 2 in STA-2. The properties (width, length, and surface area) of Cell 2 are listed in **Table A-1** in Appendix A. Inflow to the cell was measured at G-331A-G and outflow at G-332.

Error in the water budget was negligible. The percentage of days where the daily water budget did not balance within a 0.25 ft (3 in.) depth was 5 percent. Daily water budget residuals are presented in **Figure 9**.

Figure 10 shows the estimated seepage for Cell 2 over the period of study. **Figure 7** displays the water levels in treatment cells versus the water levels in the surrounding canals. Inflow, outflow, and stage for Cell 2 are provided in
Figure 11. **Table 4** presents the monthly results of the water budget analysis for Cell 2.

Table 3. Annual water budget summaries for STA-2, Cell 2.

Cell 2	WY 2007	% Inflow
INFLOW	118,854	94
SEEPAGE IN	41	0
RAIN	7,990	6
TOTAL INFLOW	126,884	% Outflow
OUTFLOW	118,026	92
SEEPAGE OUT	825	1
ET	9,593	8
TOTAL OUTFLOW	128,445	
CHANGE IN STORAGE	-1,729	ERROR %
REMAINDER	-168	0

Note: all units in ac-ft except for percentages.

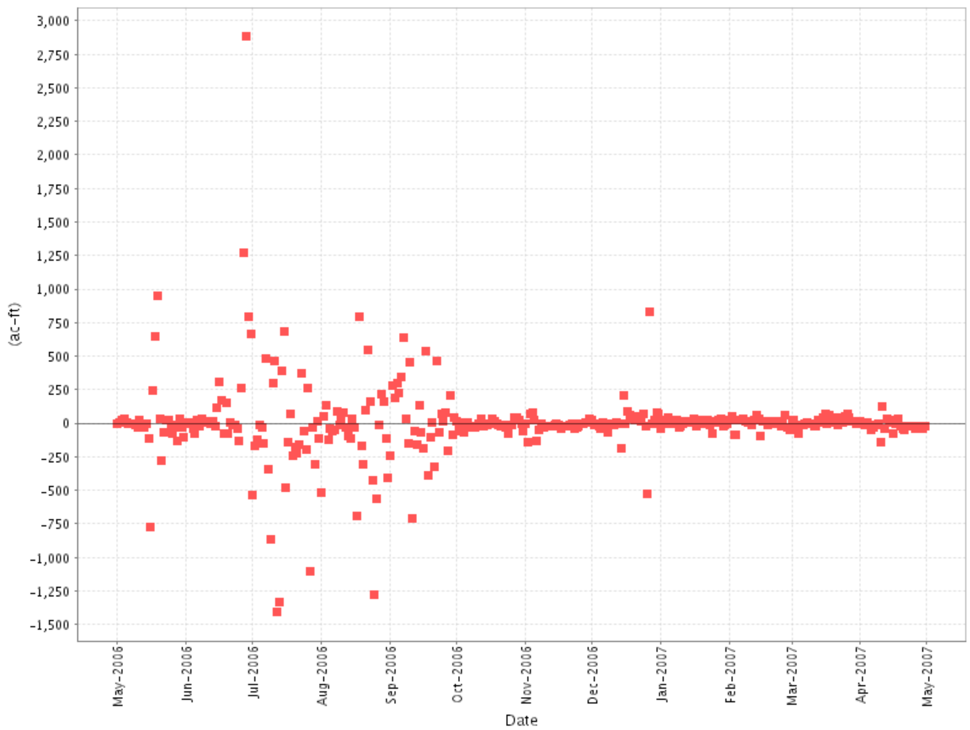

Figure 9. Daily water budget residuals for STA-2, Cell 2.

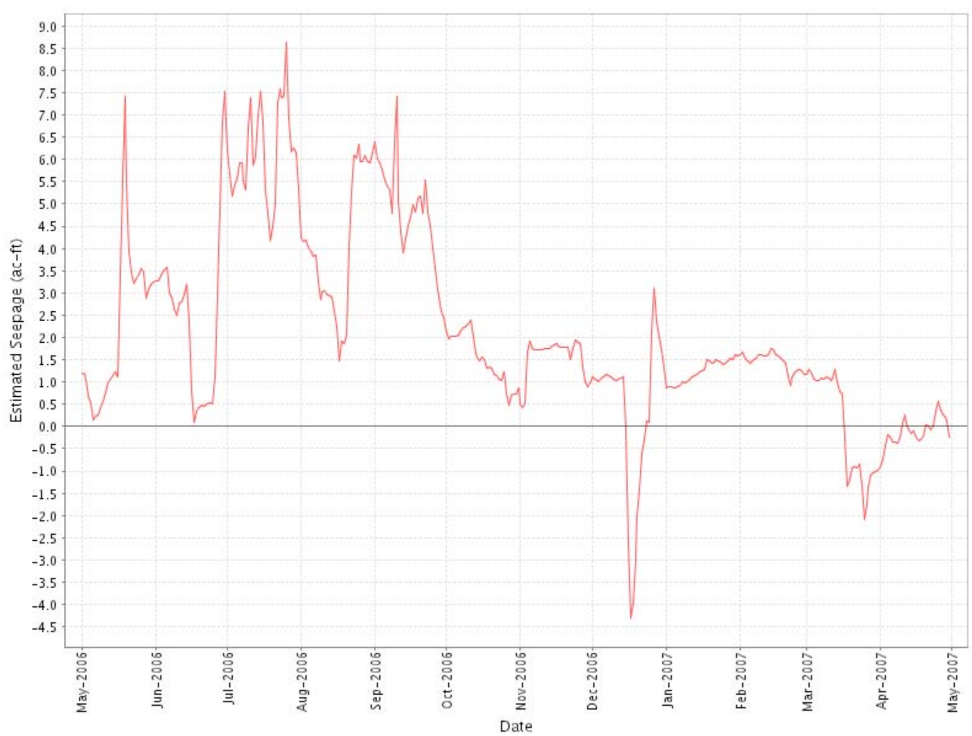

Figure 10. Estimated seepage for STA-2, Cell 2.

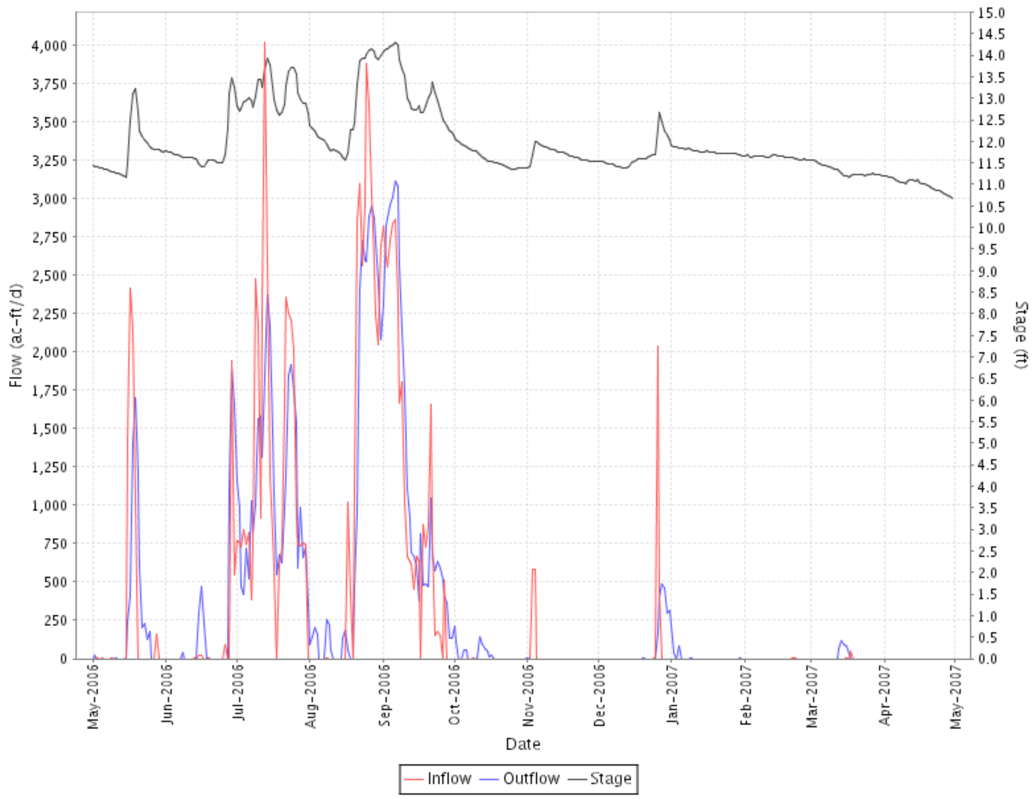

Figure 11. Inflow, outflow, and stage for STA-2, Cell 2.

Table 4. Monthly water budgets for STA-2, Cell 2.

Month-Year	INFLOW	OUTFLOW	CHANGE IN STORAGE	ET	RAIN	SEEPAGE	REMAINDER
May-2006	7,188	6,306	692	1,092	635	71	339
Jun-2006	2,632	5,660	3,313	914	1,100	74	6,229
Jul-2006	38,465	34,869	-1,356	941	1,346	191	-5,167
Aug-2006	34,072	29,186	2,977	937	1,804	125	-2,652
Sep-2006	32,807	38,338	-3,966	812	1,246	144	1,276
Oct-2006	1	814	-1,843	795	157	47	-345
Nov-2006	1,161	1	386	571	336	46	-491
Dec-2006	2,478	2,121	1,071	477	503	10	697
Jan-2007	0	344	-805	576	105	38	47
Feb-2007	0	1	-222	584	353	41	51
Mar-2007	49	386	-789	892	88	0	353
Apr-2007	0	0	-1,187	1,003	317	-3	-505

Note: all units in ac-ft.

Cell 3

Table 5 presents the water budget for Cell 3 at STA-2. The properties (width, length, and surface area) of Cell 3 are listed in **Table A-1** in Appendix A. Inflow was measured at G-333A-G and outflow at G-334.

Error in the water budget was 23 percent. The percentage of days where the daily water budget did not balance within a 0.25 ft (3 in.) depth was 4 percent. Daily water budget residuals are presented in **Figure 12**.

Figure 13 shows the estimated seepage for Cell 1 over the period of study. **Figure 7** displays the water levels in treatment cells versus the water levels in the surroundings. Inflow, outflow, and stage for Cell 3 are displayed in **Figure 14**. **Table 6** presents the monthly results of the water budget analysis for Cell 3.

Table 5. Annual water budget summaries for STA-2, Cell 3.

Cell 3	WY 2007	% Inflow
INFLOW	61,105	89
SEEPAGE IN	0	0
RAIN	7,990	11
TOTAL INFLOW	69,094	% Outflow
OUTFLOW	69,881	80
SEEPAGE OUT	7,465	9
ET	9,593	11
TOTAL OUTFLOW	86,940	
CHANGE IN STORAGE	-58	ERROR %
REMAINDER	17,788	23

Note: all units in ac-ft except for percentages.

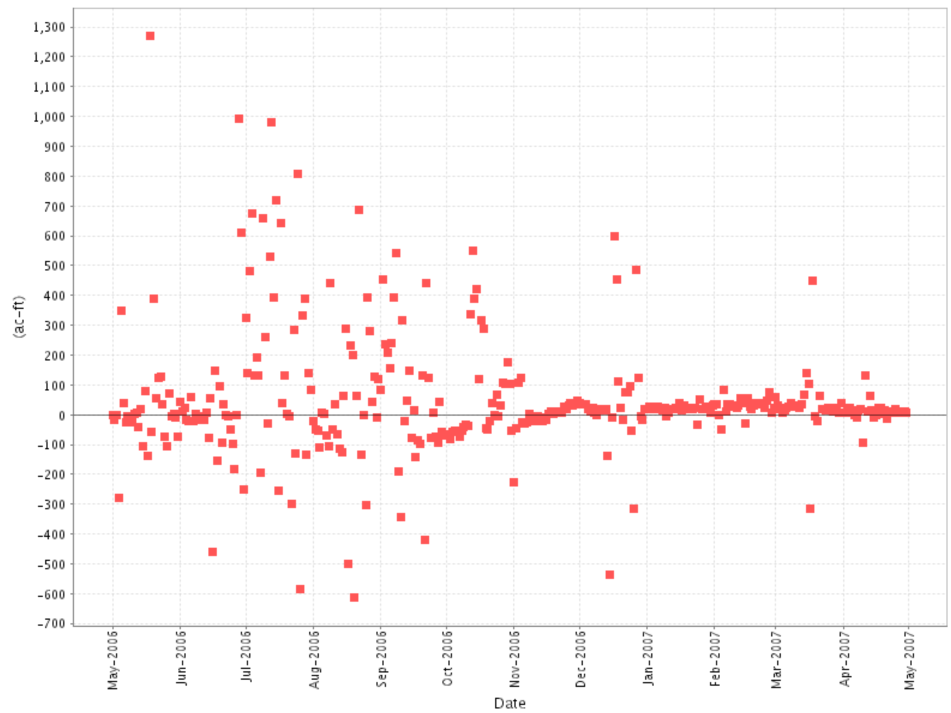

Figure 12. Daily water budget residuals for STA-2, Cell 3.

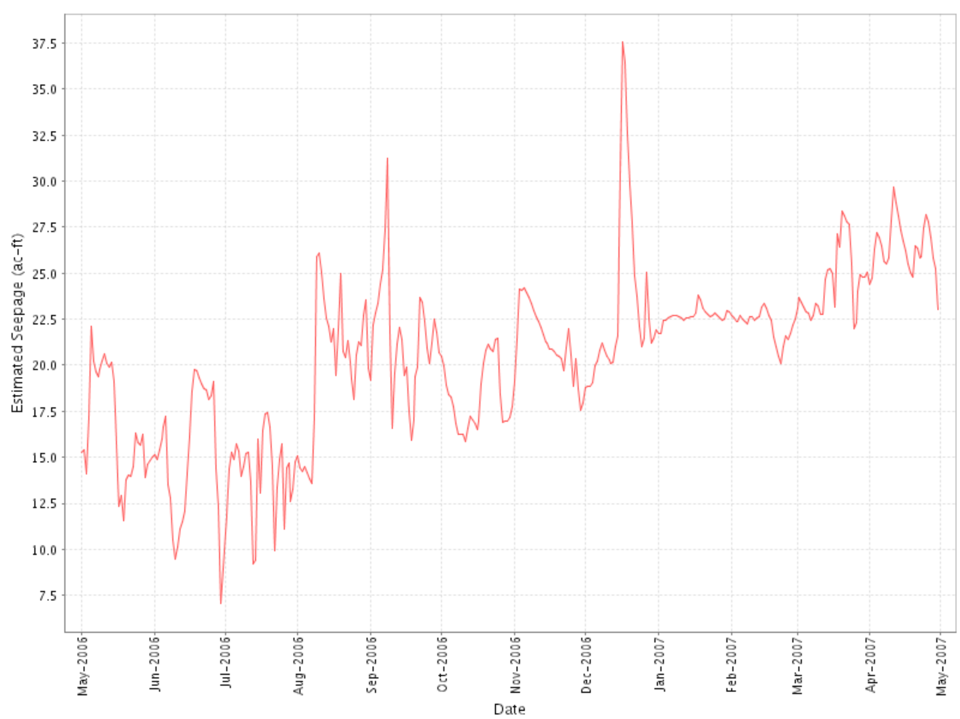

Figure 13. Estimated seepage for STA-2, Cell 3.

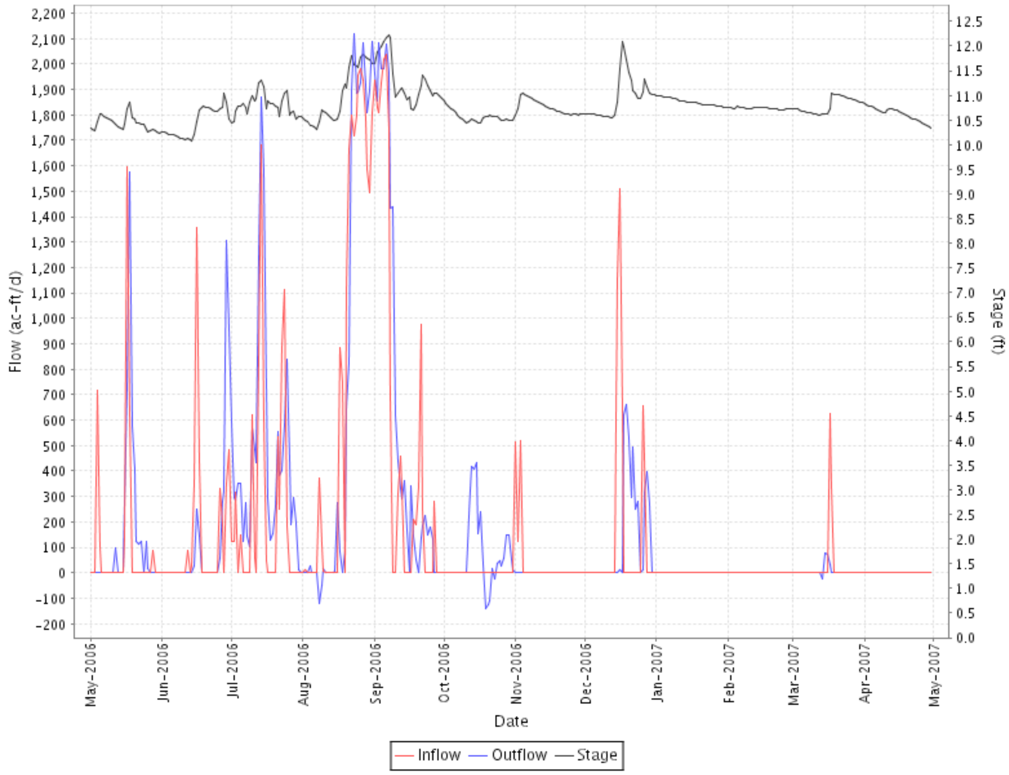

Figure 14. Inflow, outflow, and stage for STA-2, Cell 3.

Table 6. Monthly water budgets for STA-2, Cell 3.

Month-Year	INFLOW	OUTFLOW	CHANGE IN STORAGE	ET	RAIN	SEEPAGE	REMAINDER
May-2006	3,277	4,163	-285	1,092	635	515	1,572
Jun-2006	3,619	3,349	595	914	1,100	449	589
Jul-2006	7,530	14,182	148	941	1,346	436	6,830
Aug-2006	22,782	21,299	2,374	937	1,804	621	644
Sep-2006	17,331	20,534	-1,575	812	1,246	644	1,839
Oct-2006	0	2,049	-1,003	795	157	566	2,249
Nov-2006	1,153	0	307	571	336	639	28
Dec-2006	4,444	4,143	854	477	503	722	1,247
Jan-2007	0	2	-565	576	105	703	610
Feb-2007	0	0	-43	584	353	621	809
Mar-2007	968	160	274	892	88	758	1,029
Apr-2007	0	0	-1,138	1,003	317	792	340

Note: all units in ac-ft.

STA-2

Table 7 presents the overall water budget for STA-2. The properties (width, length, and surface area) of the STA are listed in **Table A-1** in Appendix A. **Table 7** also provides summary information for the daily water budget analysis. Inflow was measured at S-6 and G-328 and outflow at G-335.

Error in the water budget ranged from approximately -12.3 to 1.0 percent. The percentage of days where the daily water budget did not balance within a 0.25 ft (3 in.) depth was less than 3.0 percent. Daily water budget residuals are presented in **Figure 15**.

Figure 16 shows the estimated seepage for the STA over the period of study. **Figure 7** displays the water levels in treatment cells versus the water levels in the surrounding canals. Inflow, outflow, and stage for the STA are presented in **Figure 17**. **Table 8** presents the monthly results of the water budget analysis for the STA.

Table 7. Annual water budget summaries for STA-2.

STA	WY2007	% Inflow
INFLOW	252,336	92
SEEPAGE IN	4	0
RAIN	23,526	8
TOTAL INFLOW	275,866	% Outflow
OUTFLOW	217,572	87
SEEPAGE OUT	4,169	2
ET	28,249	11
TOTAL OUTFLOW	249,990	
CHANGE IN STORAGE	-3,870	ERROR %
REMAINDER	-29,747	-11

Note: all units in ac-ft except for percentages.

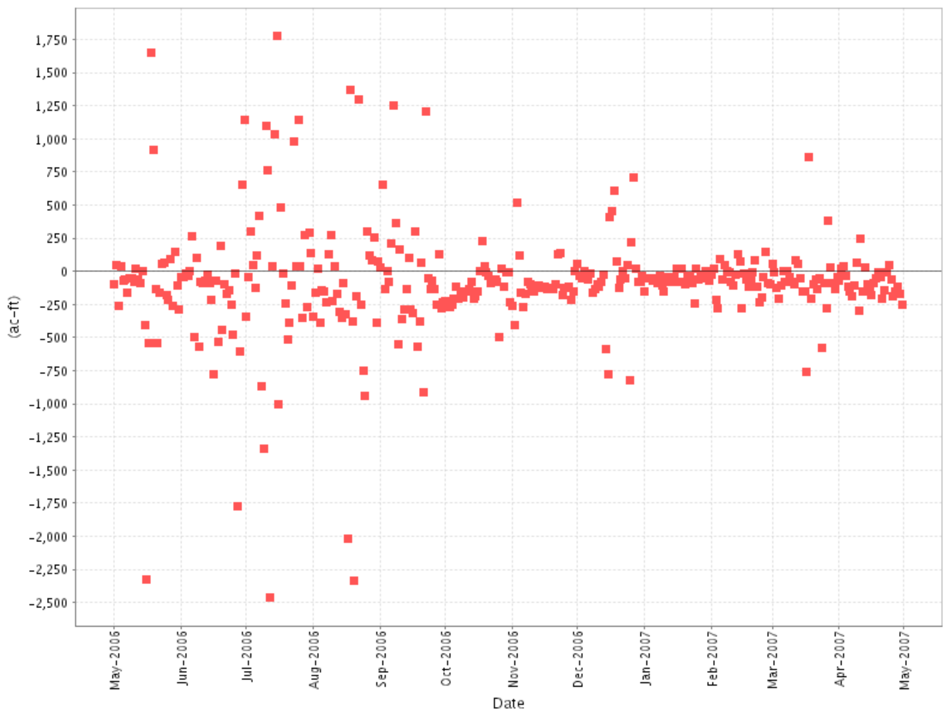

Figure 15. Daily water budget residuals for STA-2.

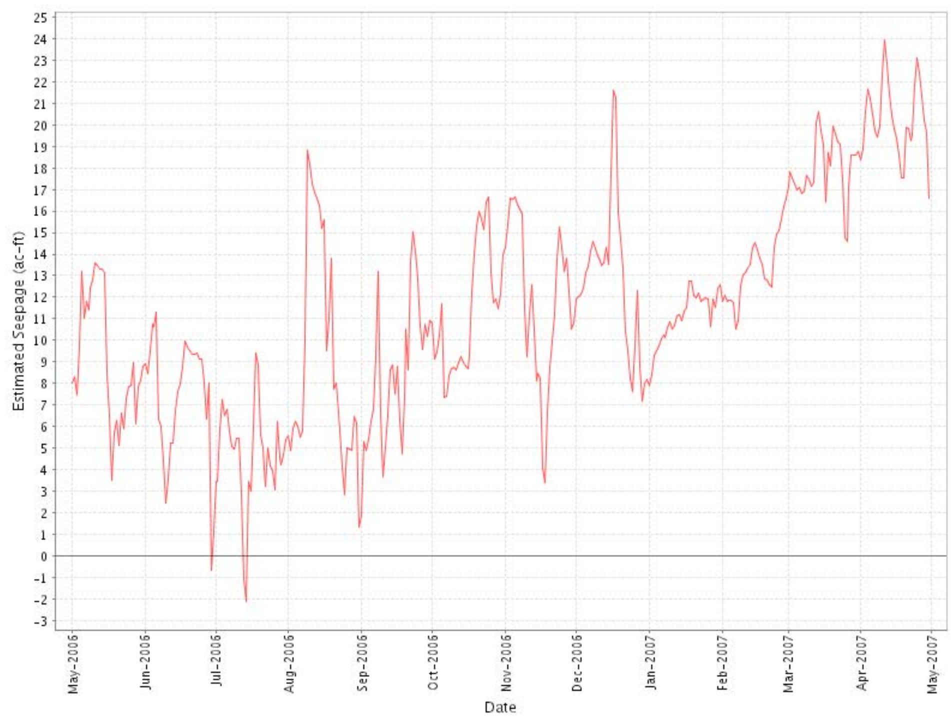

Figure 16. Estimated seepage for STA-2.

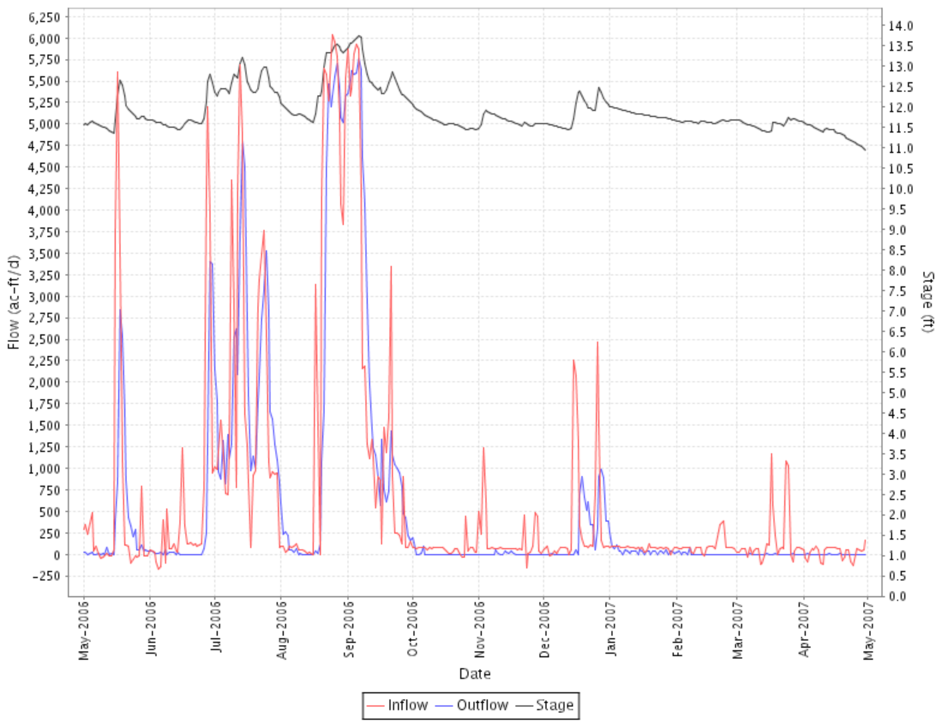

Figure 17. Inflow, outflow, and stage for STA-2.

Table 8. Monthly water budgets for STA-2.

Month-Year	INFLOW	OUTFLOW	CHANGE IN STORAGE	ET	RAIN	SEEPAGE	REMAINDER
May-2006	16,558	10,892	917	3,216	1,868	284	-3,118
Jun-2006	18,805	8,530	5,811	2,692	3,238	222	-4,787
Jul-2006	57,798	62,024	-2,270	2,771	3,964	145	908
Aug-2006	68,177	56,998	7,279	2,758	5,313	282	-6,173
Sep-2006	60,636	69,048	-8,082	2,392	3,668	254	-693
Oct-2006	2,107	439	-4,394	2,340	463	350	-3,834
Nov-2006	5,145	179	940	1,683	990	355	-2,978
Dec-2006	12,350	8,016	3,177	1,403	1,482	395	-840
Jan-2007	2,283	1,202	-2,605	1,695	311	342	-1,959
Feb-2007	2,859	202	61	1,721	1,039	372	-1,542
Mar-2007	4,896	28	-220	2,626	258	556	-2,163
Apr-2007	723	12	-4,483	2,952	933	608	-2,567

Note: all units in ac-ft.

Mean Hydraulic Retention Time

Mean hydraulic retention time (MHRT) measures how long water remains in each cell and estimates the treatment time. During this time, physical, chemical, and biological processes remove particulate and soluble phosphorus, other nutrients, and contaminants. The mean hydraulic retention time (also referred to as mean cell residence time) was determined using Equation 3:

$$t = \frac{V}{Q} \qquad (3)$$

where t = mean hydraulic retention time (d)
V = cell volume (ac-ft)
Q = flow rate (ac-ft/d)

MHRT was based upon the average stage during the study period and the average volume of total inflow and total outflow including rainfall, evapotranspiration, and seepage, which are significant percentages of the water budget. **Table 9** provides the mean hydraulic retention time (days) for Cells 1, 2, and 3 and the STA. Wet season values were based upon data from June through October; dry-season values were based upon values from November through May.

Table 9. Mean hydraulic retention time.

WY2007	ANNUAL AVG DEPTH	ANNUAL MHRT	WET AVG DEPTH	WET MHRT	DRY AVG DEPTH	DRY MHRT
Cell 1	1.77	18.2	2.17	12.3	1.48	37.0
Cell 2	1.30	8.2	1.84	5.5	0.91	30.6
Cell 3	0.86	8.9	0.90	4.9	0.82	25.3
STA	1.46	13.3	1.79	8.2	1.23	37.6

Note: MHRT in days, depth in feet.

Hydraulic Loading Rate

Hydraulic loading rate (HLR) is the rate at which water flowing into a system is distributed across the treatment area. It was calculated by dividing the total inflow by the treatment area of each cell and the STA. **Table 10** presents the HLR for WY2007 and for the wet and dry seasons that year. In WY2007, the highest HLR occurred in Cell 2.

Table 10. Hydraulic loading rate.

WY2007	ANNUAL INFLOW (ac-ft)	ANNUAL	WET SEASON	DRY SEASON
Cell 1	65,842	2.46	4.59	0.93
Cell 2	126,884	4.47	9.69	0.71
Cell 3	69,094	2.30	4.60	0.64
STA	275,866	3.22	6.33	0.99

Note: HLR in cm/day.

SUMMARY AND DISCUSSION

During WY2007, STA-2 received 252,336 ac-ft of water. This flow constituted 92 percent of the total inflow to STA-2. Rainfall accounted for 23,526 ac-ft or 8 percent of the total inflow. Through evapotranspiration, 28,249 ac-ft were lost. Estimated net seepage was 2 percent of the water budget during the study period, losing 4,165 ac-ft to surrounding water bodies and the surficial aquifer. The volume of seepage was based upon head differences between the treatment cells and the water levels in the areas surrounding STA-2 and the estimated seepage coefficients for Cells 1, 2, and 3 that were estimated as 0.1, 0.1, and 1.0 cfs/mi/ft, respectively. Outflow from STA-2 was 87 percent of the total outflow accounting for 217,572 ac-ft. This volume was pumped into the L-6 Canal from the discharge canal at STA-2. The amount of water stored in the STA decreased by 3,870 ac-ft in WY2007. The error in the water budget was 29,747 ac-ft or 11 percent of the water budget. The average retention time in Cells 1, 2, and 3 was 18, 8, and 9 days, respectively. All the values above were in line with those from water budgets from WY2001–WY2006.

Cell 1 received 58,671 ac-ft of water during the study period through structures G-329A-D. Rain into this cell accounted for 7,162 ac-ft of inflow. The volume of water stored in Cell 1 decreased by 2,084 ac-ft during the period. Structures G-330A-E discharged 66,356 ac-ft of water from Cell 1 and the cell lost 8,600 ac-ft of water through evapotranspiration. Net seepage for Cell 1 was estimated at 452 ac-ft. Water budget error was about 11 percent.

Cell 2 received 118,854 ac-ft of water during the study period through structures G-331A-G. Rain into this cell accounted for 7,990 ac-ft of inflow. The volume of water stored in Cell 2 decreased by 1,729 ac-ft during the period. Structure G-332 discharged 118,026 ac-ft of water from Cell 2 and the cell lost 9,593 ac-ft of water through evapotranspiration. Net seepage for Cell 2 was estimated as 784 ac-ft. The water budget error was negligible.

Cell 3 received 61,105 ac-ft of water during the study period through structures G-333A-E. Rain into this cell accounted for 7,990 ac-ft of inflow. The volume of water stored in Cell 3 decreased by 58 ac-ft during the period. Structure G-334 discharged

69,881 ac-ft of water from Cell 3 and the cell lost 9.593 ac-ft of water through evapotranspiration. Net seepage for Cell 3 was estimated as 7,465 ac-ft. Water budget error was 23 percent. This relatively large error is possibly associated with construction activities for Cell 4 during this period.

Residual Analysis

The water budget residuals for STA-2 are displayed in **Figure 5**, **Figure 9**, **Figure 12,** and **Figure 15** (residuals for Cell 1, Cell 2, Cell 3, and the entire STA, respectively) are not random. Generally, the residuals increase when flow increases as shown in **Figure 18** for the entire STA, which shows daily budget error versus daily inflow for WY2007. Although seepage also increases during these periods (in response to increased stages in STA-2), the volume of outflow from STA-2, plus the increased seepage and the increase in storage, do not equal the daily volume of water entering STA-2. This was expected because the mean retention times for the cells are more than one day. Flow measurement error may also account for this, but it may also indicate a response to inflow that is not adequately represented by the traditional equations for levee seepage and storage used in this and other studies.

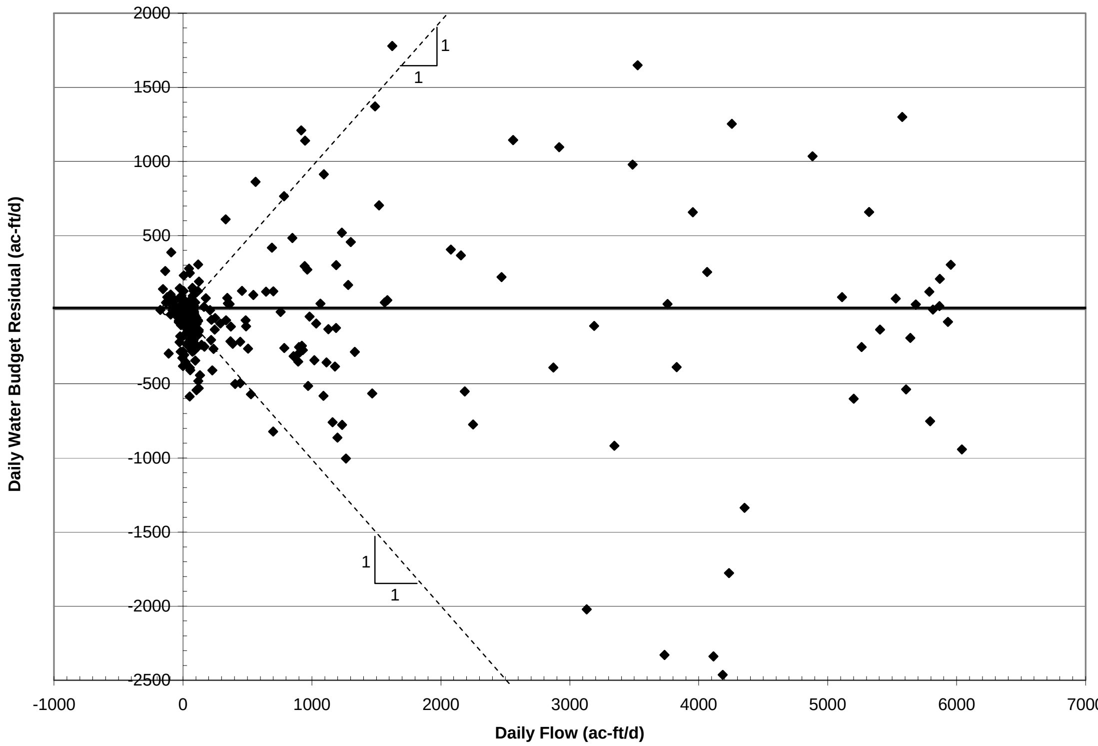

Figure 18. STA-2 water budget residual versus flow.

Appendix E presents correlation coefficient matrices of the principal terms in the water budget equation (**Eqn. 1**) for each of the treatment cells. There are no discernibly significant relationships shown except for the obvious relationship between inflow and outflow.

RECOMMENDATIONS

The residual error for individual cells varied dramatically. One source of error is the linear assumption used for the calculation of daily change in storage values. Recent detailed stage-storage information has shown that, due to the individual topographic variation of each cell, the vertical assumptions are not accurate at low stages, which is most of the time for which water budgets are computed. Modifications to the water budget program to incorporate a non-linear stage-storage relationship are expected to significantly improve cell water budgets.

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APPENDIX A

Site Properties and Monitoring Stations

Table A-1. STA-2 site properties.

Surface Area		
Cell 1	**1990**	**ac**
Cell 2	**2220**	**ac**
Cell 3	**2220**	**ac**
Total	**6430**	**ac**
Cell 1 Average Ground Elevation	**11.82**	**ft NGVD**
Cell 2 Average Ground Elevation	**10.33**	**ft NGVD**
Cell 3 Average Ground Elevation	**9.61**	**ft NGVD**
Levee Length		
Along Northern Boundary		
Supply Canal	**3000**	**ft**
Inflow Canal	**23400**	**ft**
Discharge Canal	**6000**	**ft**

Table A-2. STA-2 stage monitoring stations.

STATION	STATION DESCRIPTION	DBKEY
S6_T	S6 STA-2 Inflow Structure Supply Canal (Tailwater)	06685
G328_T	G-328 STA-2 Inflow Structure Supply Canal (Tailwater)	MQ898
G329B_H	G-329B STA-2 Inflow Structure Cell 1/Inflow Canal (Headwater)	MT237
G330A_H	G-330A STA-2 Outflow Structure Cell 1 (Headwater)	MQ893
G330D_H	G-330D STA-2 Outflow Structure Cell 1 (Headwater)	MQ894
G331B_T	G-331B STA-2 Inflow Structure Cell 2 (Tailwater)	MT241
G331D_H	G-331D STA-2 Inflow Structure Cell 2/Inflow Canal (Headwater)	MT248
G331E_T	G-331E STA-2 Inflow Structure Cell 2 (Tailwater)	MT244
G332_H	G-332 STA-2 Outflow Structure Cell 2 (Headwater)	N3458
G332_T	G-332 STA-2 Outflow Structure Cell 2/Discharge Canal (Tailwater)	N3459
G333C_H	G-333C STA-2 Inflow Structure Cell3/Inflow Canal (Headwater)	N0750
G333C_T	G-333C STA-2 Inflow Structure Cell 3 (Tailwater)	N0751
G335_H	G-335 STA-2 Outflow Structure Discharge Canal (Headwater)	MR463
G335_T	G-335 STA-2 Outflow Structure L6 Canal (Tailwater)	MR464
G337_H	G-337 STA-2 Inflow Structure Seepage Canal (Headwater)	LG727
G337_T	G-337 STA-2 Inflow Structure Supply Canal/Inflow Canal (Tailwater)	LG728
G339_T	G-339 STA-2 Inflow Structure L6 Canal (Tailwater)	MS576

Table A-3. STA-2 flow monitoring stations.

STATION	STATION DESCRIPTION	DBKEY
G328	Flow from Florida Crystals Inc. at the inflow of STA-2	J0718
G328I_C	Irrigation flow to Florida Crystals Inc. (culvert)	TA607
G328I_P	Irrigation flow to Florida Crystals Inc. (pump)	TA605
G329A_C	G-329A STA-2 Inflow Structure Cell 1	N0748
G329B_C	G-329B STA-2 Inflow Structure Cell 1	LG703
G329C_C	G-329C STA-2 Inflow Structure Cell 1	LG704
G329D_C	G-329D STA-2 Inflow Structure Cell 1	LG705
G330A_C	G-330A STA-2 Outflow Structure Cell 1	LG706
G330B_C	G-330B STA-2 Outflow Structure Cell 1	LG707
G330C_C	G-330C STA-2 Outflow Structure Cell 1	LG708
G330D_C	G-330D STA-2 Outflow Structure Cell 1	LG709
G330E_C	G-330E STA-2 Outflow Structure Cell 1	LG710
G331A_C	G-331A STA-2 Inflow Structure Cell 2	LG711
G331B_C	G-331B STA-2 Inflow Structure Cell 2	LG712
G331C_C	G-331C STA-2 Inflow Structure Cell 2	LG713
G331D_C	G-331D STA-2 Inflow Structure Cell 2	LG714
G331E_C	G-331E STA-2 Inflow Structure Cell 2	LG715
G331F_C	G-331F STA-2 Inflow Structure Cell 2	LG716
G331G_C	G-331G STA-2 Inflow Structure Cell 2	LG718
G332_S	G-332 STA-2 Outflow Structure Cell 2	LG719
G333A_C	G-333A STA-2 Inflow Structure Cell 3	LG720
G333B_C	G-333B STA-2 Inflow Structure Cell 3	LG721
G333C_C	G-333C STA-2 Inflow Structure Cell 3	LG722
G333D_C	G-333D STA-2 Inflow Structure Cell 3	LG723
G333E_C	G-333E STA-2 Inflow Structure Cell 3	LG724
G334_S	G-334 STA-2 Outflow Structure Cell 3	LG725
G335_P	STA-2 Primary Outflow Pump Station	N0659
G337_P	STA-2 Seepage Return Pump Station	LG701
G338_C	STA-2 Culvert Flow on Hillsboro Canal 400 ft Downstream of S6	MC705
S6_P	Hillsboro Canal at S-6 Near Shawano	15034

Table A-4. STA-2 rainfall monitoring stations.

STATION	STATION DESCRIPTION	DBKEY
EAA5	EAA5 Everglades Agricultural Area	JW233
S6_R	S6 STA-2 S6 Pump Station	15203
S7_R	S7 Pump Station	15204

Table A-5. STA-2 evapotranspiration stations.

STATION	STATION DESCRIPTION	DBKEY
STA1W	Areal Computed Parameter for STA-1W Project	KN810

APPENDIX B

Rainfall Data

Table B-1. Rainfall for WY2007.

Day	May-2006	Jun-2006	Jul-2006	Aug-2006	Sep-2006	Oct-2006	Nov-2006	Dec-2006	Jan-2007	Feb-2007	Mar-2007	Apr-2007
1	0.00	0.18	0.04	0.00	0.01	0.00	0.17	0.00	0.00	0.00	0.00	0.00
2	0.00	0.05	0.78	0.00	0.42	0.01	1.27	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.01	0.00	0.92	0.01	0.04	0.00	0.00	0.00	0.00	0.00
4	0.00	0.14	0.00	0.26	0.42	0.00	0.02	0.00	0.00	0.40	0.00	0.00
5	0.00	0.38	0.64	0.05	0.31	0.00	0.00	0.00	0.00	0.20	0.00	0.00
6	0.00	0.01	0.21	0.05	0.33	0.00	0.00	0.00	0.00	0.02	0.00	0.02
7	0.00	0.00	0.04	0.01	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.01
8	0.00	0.01	0.74	0.00	0.66	0.00	0.00	0.02	0.00	0.00	0.00	0.00
9	0.03	0.02	0.06	0.03	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.01
10	0.11	0.02	0.01	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66
11	0.00	0.00	1.39	0.00	0.21	0.00	0.00	0.01	0.00	0.01	0.00	0.37
12	0.09	0.03	0.37	0.00	0.44	0.10	0.00	0.00	0.00	0.48	0.00	0.40
13	0.00	0.00	0.67	0.25	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.01	0.32	0.29	0.00	0.00	1.49	0.01	0.00	0.00	0.00
15	0.49	0.00	0.00	0.01	0.07	0.00	0.00	0.02	0.04	0.20	0.00	0.19
16	1.75	0.02	0.00	0.52	0.85	0.00	0.08	0.36	0.00	0.01	0.23	0.00
17	0.00	0.69	0.36	0.55	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.00
18	0.00	1.59	0.09	0.04	0.00	0.00	0.00	0.00	0.01	0.10	0.00	0.00
19	0.00	0.00	0.25	1.20	1.07	0.00	0.00	0.01	0.00	0.00	0.00	0.00
20	0.00	0.55	1.31	0.08	0.49	0.00	0.00	0.01	0.00	0.00	0.20	0.00
21	0.00	0.00	0.03	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.10	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.97	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00
24	0.00	0.14	0.02	0.30	0.00	0.00	0.00	0.01	0.37	0.00	0.00	0.01
25	0.03	0.83	0.00	1.23	0.00	0.00	0.05	0.37	0.05	0.04	0.00	0.00
26	0.28	0.40	0.00	0.33	0.00	0.00	0.05	0.03	0.01	0.02	0.00	0.00
27	0.07	0.83	0.00	0.22	0.00	0.00	0.01	0.00	0.00	0.24	0.00	0.00
28	0.00	0.01	0.10	0.00	0.00	0.40	0.00	0.00	0.03	0.17	0.00	0.00
29	0.12	0.01	0.05	0.51	0.00	0.00	0.09	0.00	0.00		0.00	0.00
30	0.00	0.00	0.00	2.11	0.00	0.00	0.02	0.01	0.01		0.01	0.00
31	0.45		0.00	0.20		0.30		0.00	0.01		0.00	
MAX	1.75	1.59	1.39	2.11	1.07	0.40	1.27	1.49	0.37	0.48	0.23	0.66
MEAN	0.11	0.20	0.24	0.32	0.22	0.03	0.06	0.09	0.02	0.07	0.02	0.06
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUM	3.43	5.94	7.28	9.75	6.73	0.85	1.82	2.72	0.57	1.91	0.47	1.71

Note: Rainfall in inches.

APPENDIX C

Evapotranspiration Data

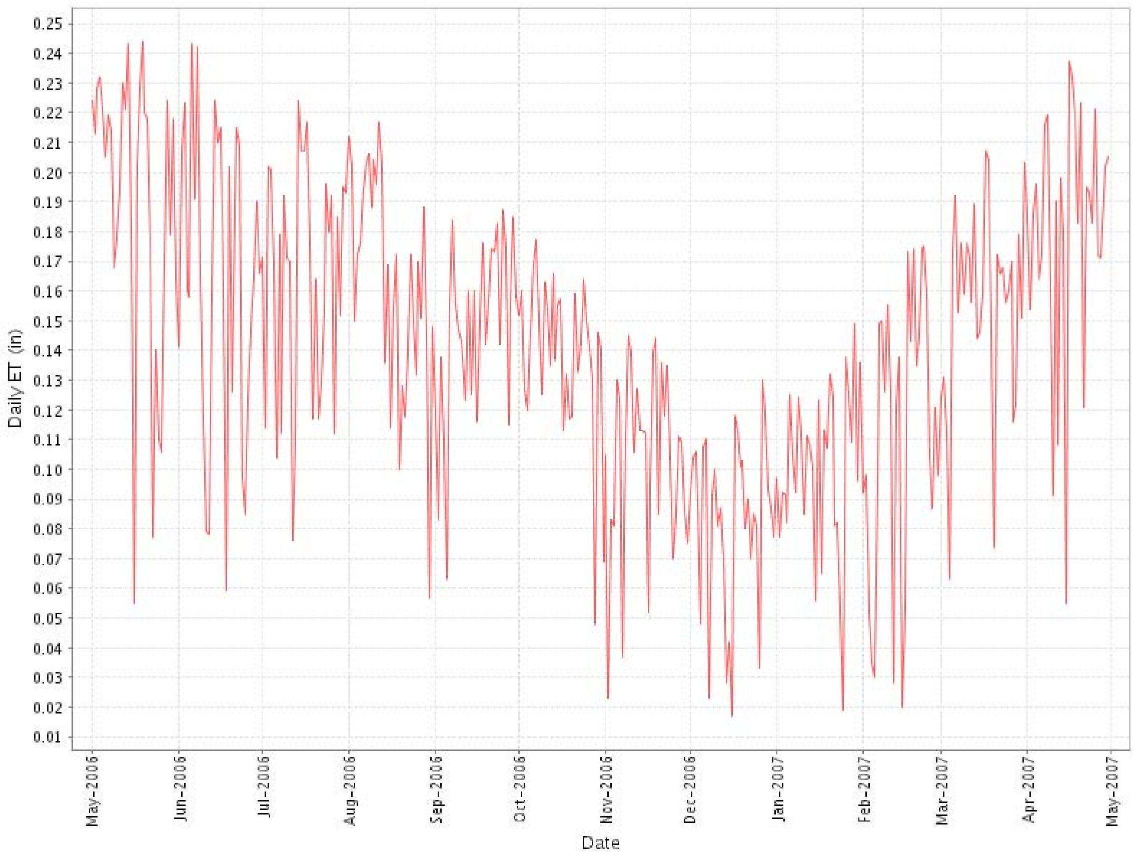

Figure C-1. Daily evapotranspiration at STA-2.

Table C-1. Evapotranspiration for WY2007.

Day	May-2006	Jun-2006	Jul-2006	Aug-2006	Sep-2006	Oct-2006	Nov-2006	Dec-2006	Jan-2007	Feb-2007	Mar-2007	Apr-2007
1	0.22	0.14	0.17	0.21	0.12	0.15	0.11	0.09	0.10	0.09	0.12	0.19
2	0.21	0.21	0.11	0.20	0.08	0.16	0.02	0.10	0.08	0.10	0.13	0.15
3	0.23	0.22	0.20	0.15	0.14	0.13	0.08	0.11	0.09	0.05	0.11	0.19
4	0.23	0.16	0.20	0.17	0.11	0.12	0.08	0.09	0.09	0.04	0.06	0.20
5	0.22	0.16	0.17	0.18	0.06	0.15	0.13	0.05	0.08	0.03	0.17	0.16
6	0.21	0.24	0.10	0.19	0.16	0.17	0.12	0.11	0.13	0.09	0.19	0.17
7	0.22	0.19	0.18	0.20	0.18	0.18	0.04	0.11	0.11	0.15	0.15	0.22
8	0.21	0.24	0.11	0.21	0.16	0.15	0.11	0.02	0.09	0.15	0.18	0.22
9	0.17	0.17	0.19	0.19	0.15	0.13	0.15	0.09	0.12	0.13	0.16	0.16
10	0.18	0.12	0.17	0.20	0.14	0.16	0.14	0.10	0.11	0.16	0.18	0.09
11	0.19	0.08	0.17	0.20	0.14	0.15	0.11	0.08	0.09	0.13	0.17	0.19
12	0.23	0.08	0.08	0.22	0.12	0.14	0.13	0.09	0.11	0.03	0.16	0.11
13	0.22	0.16	0.11	0.20	0.16	0.17	0.11	0.07	0.11	0.12	0.19	0.20
14	0.24	0.22	0.22	0.14	0.13	0.14	0.11	0.03	0.10	0.14	0.14	0.18
15	0.18	0.21	0.21	0.17	0.16	0.16	0.11	0.04	0.06	0.02	0.15	0.06
16	0.06	0.22	0.21	0.11	0.12	0.16	0.05	0.02	0.12	0.05	0.16	0.24
17	0.20	0.16	0.22	0.15	0.15	0.11	0.09	0.12	0.07	0.17	0.21	0.23
18	0.23	0.06	0.18	0.17	0.18	0.13	0.14	0.11	0.11	0.14	0.20	0.22
19	0.24	0.20	0.12	0.10	0.14	0.12	0.14	0.10	0.11	0.17	0.15	0.18
20	0.22	0.13	0.16	0.13	0.16	0.12	0.09	0.10	0.13	0.14	0.07	0.22
21	0.22	0.19	0.12	0.12	0.17	0.16	0.14	0.08	0.12	0.15	0.17	0.12
22	0.18	0.22	0.13	0.14	0.17	0.13	0.12	0.09	0.08	0.17	0.17	0.20
23	0.08	0.21	0.15	0.17	0.18	0.14	0.14	0.07	0.08	0.18	0.17	0.19
24	0.14	0.10	0.20	0.15	0.14	0.16	0.10	0.09	0.05	0.16	0.16	0.18
25	0.11	0.09	0.18	0.13	0.19	0.15	0.07	0.08	0.02	0.11	0.16	0.22
26	0.11	0.12	0.19	0.17	0.17	0.14	0.09	0.03	0.14	0.09	0.17	0.17
27	0.17	0.15	0.11	0.15	0.12	0.13	0.11	0.13	0.13	0.12	0.12	0.17
28	0.22	0.17	0.19	0.19	0.16	0.05	0.11	0.12	0.11	0.10	0.12	0.19
29	0.18	0.19	0.15	0.14	0.19	0.15	0.09	0.09	0.15		0.18	0.20
30	0.22	0.17	0.20	0.06	0.16	0.14	0.08	0.09	0.10		0.15	0.21
31	0.17		0.19	0.15		0.07		0.08	0.14		0.20	
MAX	0.24	0.24	0.22	0.22	0.19	0.18	0.15	0.13	0.15	0.18	0.21	0.24
MEAN	0.19	0.17	0.16	0.16	0.15	0.14	0.10	0.08	0.10	0.11	0.16	0.18
MIN	0.06	0.06	0.08	0.06	0.06	0.05	0.02	0.02	0.02	0.02	0.06	0.06
SUM	5.90	4.94	5.09	5.06	4.39	4.30	3.09	2.58	3.11	3.16	4.82	5.42

Note: Evapotranspiration in inches.

APPENDIX D

Average Daily Stage for STA-2 Treatment Cells

Table D-1. Cell 1 average daily stage for WY2007.

Day	May-2006	Jun-2006	Jul-2006	Aug-2006	Sep-2006	Oct-2006	Nov-2006	Dec-2006	Jan-2007	Feb-2007	Mar-2007	Apr-2007
1	13.06	13.22	13.99	13.55	14.75	13.31	12.57	12.72	13.29	12.69	12.87	12.99
2	13.25	13.18	13.85	13.45	14.78	13.27	12.62	12.73	13.26	12.68	12.84	12.95
3	13.21	13.15	13.78	13.40	14.76	13.24	12.86	12.72	13.23	12.65	12.81	12.92
4	13.15	13.11	13.78	13.35	14.82	13.21	12.85	12.71	13.21	12.64	12.78	12.88
5	13.10	13.10	13.74	13.31	14.86	13.18	12.79	12.69	13.19	12.67	12.75	12.85
6	13.06	13.09	13.65	13.26	14.90	13.16	12.76	12.67	13.17	12.66	12.72	12.81
7	13.02	13.05	13.65	13.23	14.80	13.13	12.75	12.65	13.14	12.64	12.69	12.77
8	12.99	13.02	13.71	13.19	14.34	13.10	12.74	12.62	13.12	12.62	12.66	12.72
9	12.95	12.99	13.99	13.15	14.20	13.08	12.72	12.60	13.10	12.60	12.63	12.69
10	12.92	12.96	14.12	13.12	14.06	13.06	12.69	12.57	13.07	12.57	12.60	12.66
11	12.89	12.94	14.03	13.10	13.95	13.03	12.67	12.55	13.05	12.55	12.56	12.70
12	12.86	12.92	14.09	13.06	13.89	13.01	12.65	12.52	13.03	12.60	12.53	12.70
13	12.82	12.90	14.45	13.03	13.84	12.99	12.62	12.50	13.01	12.60	12.50	12.69
14	12.78	12.87	14.58	13.00	13.76	12.96	12.60	12.53	12.99	12.58	12.46	12.66
15	12.74	12.84	14.29	12.97	13.75	12.93	12.58	12.86	12.98	12.56	12.43	12.64
16	13.25	12.80	14.08	12.95	13.77	12.91	12.56	13.37	12.97	12.57	12.41	12.60
17	13.87	12.79	13.97	13.24	13.68	12.88	12.54	13.57	12.94	12.55	12.48	12.57
18	14.15	12.84	13.81	13.57	13.75	12.86	12.51	13.75	12.93	12.53	12.73	12.53
19	14.05	12.86	13.76	13.45	13.84	12.83	12.48	13.68	12.91	12.51	12.70	12.48
20	13.79	12.83	13.78	13.71	13.89	12.81	12.46	13.57	12.89	12.58	12.67	12.44
21	13.60	12.81	13.94	14.18	14.03	12.78	12.43	13.46	12.87	12.75	12.62	12.39
22	13.47	12.77	14.18	14.46	13.97	12.75	12.72	13.39	12.86	12.85	12.57	12.34
23	13.38	12.74	14.27	14.59	13.83	12.73	12.72	13.35	12.84	12.90	12.54	12.29
24	13.31	12.73	14.31	14.61	13.68	12.69	12.63	13.31	12.83	12.82	12.78	12.25
25	13.26	12.73	14.28	14.71	13.58	12.66	12.58	13.29	12.83	12.81	13.20	12.20
26	13.22	12.87	14.09	14.78	13.49	12.63	12.56	13.66	12.82	12.85	13.00	12.14
27	13.21	13.46	13.93	14.80	13.54	12.60	12.72	13.57	12.79	12.87	13.11	12.09
28	13.35	13.91	13.86	14.76	13.48	12.62	12.81	13.54	12.78	12.87	13.13	12.04
29	13.37	14.26	13.82	14.62	13.41	12.62	12.74	13.45	12.76		13.09	11.99
30	13.29	14.20	13.79	14.50	13.36	12.60	12.70	13.38	12.73		13.05	11.94
31	13.24		13.67	14.63		12.58		13.33	12.71		13.02	
MAX	14.15	14.26	14.58	14.80	14.90	13.31	12.86	13.75	13.29	12.90	13.20	12.99
MEAN	13.25	13.06	13.97	13.73	14.02	12.91	12.65	13.07	12.98	12.67	12.74	12.53
MIN	12.74	12.73	13.65	12.95	13.36	12.58	12.43	12.50	12.71	12.51	12.41	11.94

Note: Stage in ft NGVD

Table D-2. Cell 2 average daily stage for WY2007.

Day	May-2006	Jun-2006	Jul-2006	Aug-2006	Sep-2006	Oct-2006	Nov-2006	Dec-2006	Jan-2007	Feb-2007	Mar-2007	Apr-2007
1	11.43	11.77	12.83	12.35	14.09	12.10	11.37	11.55	11.90	11.67	11.56	11.20
2	11.41	11.75	12.71	12.29	14.15	12.02	11.42	11.53	11.89	11.68	11.56	11.19
3	11.40	11.74	12.75	12.24	14.15	11.98	11.70	11.52	11.88	11.64	11.54	11.17
4	11.39	11.71	12.91	12.12	14.20	11.94	12.00	11.50	11.85	11.63	11.50	11.16
5	11.38	11.70	12.94	12.09	14.25	11.91	12.00	11.48	11.84	11.65	11.48	11.14
6	11.36	11.69	13.02	12.05	14.30	11.87	11.93	11.47	11.83	11.66	11.45	11.10
7	11.34	11.66	12.93	12.01	14.24	11.84	11.90	11.46	11.82	11.66	11.44	11.07
8	11.32	11.63	12.78	11.92	13.89	11.82	11.89	11.43	11.83	11.65	11.43	11.05
9	11.30	11.62	13.04	11.80	13.67	11.79	11.86	11.42	11.80	11.65	11.41	11.03
10	11.28	11.62	13.44	11.79	13.54	11.77	11.84	11.41	11.78	11.63	11.39	11.02
11	11.27	11.62	13.45	11.81	13.02	11.75	11.82	11.39	11.77	11.62	11.37	11.09
12	11.26	11.61	13.24	11.77	12.89	11.70	11.80	11.39	11.77	11.67	11.34	11.09
13	11.23	11.61	13.67	11.74	12.77	11.63	11.78	11.38	11.76	11.68	11.31	11.09
14	11.21	11.58	13.92	11.70	12.74	11.59	11.76	11.42	11.76	11.69	11.25	11.08
15	11.18	11.49	13.78	11.64	12.73	11.55	11.75	11.51	11.76	11.66	11.21	11.10
16	11.50	11.41	13.24	11.57	12.82	11.53	11.74	11.54	11.77	11.66	11.21	11.05
17	12.50	11.43	12.97	11.73	12.68	11.52	11.72	11.57	11.75	11.65	11.18	11.03
18	13.11	11.52	12.74	12.26	12.67	11.52	11.69	11.59	11.75	11.64	11.21	11.03
19	13.21	11.57	12.61	12.28	12.81	11.51	11.67	11.60	11.74	11.62	11.22	11.00
20	12.66	11.57	12.66	12.42	13.02	11.49	11.65	11.61	11.73	11.62	11.24	10.96
21	12.25	11.56	12.84	13.33	13.13	11.47	11.64	11.61	11.73	11.61	11.24	10.93
22	12.11	11.54	13.29	13.88	13.37	11.45	11.62	11.62	11.73	11.60	11.22	10.90
23	12.02	11.51	13.62	13.94	13.13	11.42	11.60	11.65	11.72	11.59	11.22	10.88
24	11.96	11.50	13.71	13.92	12.94	11.38	11.57	11.68	11.71	11.56	11.21	10.85
25	11.86	11.50	13.72	14.01	12.73	11.36	11.56	11.70	11.72	11.57	11.22	10.82
26	11.84	11.68	13.56	14.10	12.52	11.34	11.55	12.30	11.71	11.59	11.24	10.79
27	11.82	12.31	13.12	14.13	12.46	11.35	11.54	12.68	11.71	11.58	11.25	10.76
28	11.81	13.11	12.98	14.08	12.37	11.39	11.54	12.45	11.71	11.56	11.24	10.73
29	11.82	13.47	12.87	13.97	12.26	11.39	11.54	12.25	11.69		11.23	10.70
30	11.79	13.26	12.87	13.89	12.20	11.38	11.54	12.14	11.68		11.22	10.67
31	11.76		12.65	13.99		11.37		12.03	11.66		11.21	
MAX	13.21	13.47	13.92	14.13	14.30	12.10	12.00	12.68	11.90	11.69	11.56	11.20
MEAN	11.74	11.79	13.12	12.67	13.19	11.62	11.70	11.67	11.77	11.63	11.32	10.99
MIN	11.18	11.41	12.61	11.57	12.20	11.34	11.37	11.38	11.66	11.56	11.18	10.67

Note: Stage in ft NGVD

Table D-3. Cell 3 average daily stage for WY2007.

Day	May-2006	Jun-2006	Jul-2006	Aug-2006	Sep-2006	Oct-2006	Nov-2006	Dec-2006	Jan-2007	Feb-2007	Mar-2007	Apr-2007
1	10.35	10.26	10.43	10.54	11.66	10.89	10.61	10.63	11.00	10.75	10.74	10.84
2	10.31	10.25	10.46	10.50	11.87	10.83	10.74	10.62	11.00	10.75	10.73	10.82
3	10.29	10.23	10.67	10.46	11.91	10.78	11.01	10.62	10.99	10.73	10.72	10.79
4	10.46	10.21	10.79	10.40	11.99	10.73	11.05	10.63	10.98	10.73	10.71	10.77
5	10.63	10.22	10.79	10.38	12.08	10.69	11.01	10.62	10.97	10.78	10.69	10.75
6	10.63	10.22	10.83	10.36	12.18	10.64	10.98	10.61	10.96	10.76	10.67	10.73
7	10.59	10.18	10.74	10.31	12.23	10.59	10.96	10.60	10.95	10.76	10.66	10.70
8	10.56	10.16	10.64	10.46	12.17	10.55	10.94	10.59	10.94	10.75	10.66	10.67
9	10.53	10.14	10.87	10.71	11.43	10.51	10.91	10.58	10.93	10.74	10.65	10.66
10	10.50	10.12	10.99	10.67	10.97	10.47	10.88	10.57	10.91	10.73	10.63	10.65
11	10.48	10.10	10.88	10.66	11.05	10.44	10.85	10.56	10.90	10.72	10.62	10.71
12	10.42	10.13	10.94	10.61	11.12	10.48	10.83	10.55	10.89	10.76	10.61	10.73
13	10.37	10.11	11.25	10.55	11.14	10.52	10.80	10.54	10.88	10.77	10.60	10.73
14	10.35	10.06	11.32	10.50	11.05	10.49	10.77	10.59	10.87	10.76	10.61	10.71
15	10.32	10.21	11.18	10.50	10.92	10.46	10.75	10.86	10.87	10.76	10.62	10.70
16	10.43	10.47	10.72	10.53	10.98	10.43	10.74	11.55	10.86	10.77	10.62	10.67
17	10.73	10.71	10.88	10.69	10.74	10.45	10.72	12.09	10.85	10.76	10.72	10.65
18	10.85	10.76	10.83	11.11	10.71	10.54	10.70	11.99	10.85	10.75	11.05	10.63
19	10.54	10.78	10.82	11.24	10.80	10.57	10.68	11.72	10.84	10.74	11.02	10.61
20	10.51	10.76	10.79	11.16	11.03	10.58	10.67	11.47	10.83	10.74	11.01	10.58
21	10.45	10.76	10.77	11.56	11.19	10.60	10.65	11.31	10.82	10.73	11.02	10.56
22	10.44	10.73	10.57	11.81	11.40	10.59	10.64	11.10	10.81	10.73	11.00	10.53
23	10.42	10.70	10.89	11.63	11.33	10.58	10.62	11.04	10.80	10.72	10.98	10.51
24	10.42	10.67	11.05	11.59	11.20	10.57	10.61	10.94	10.80	10.70	10.96	10.49
25	10.32	10.68	11.10	11.57	11.10	10.52	10.61	10.93	10.82	10.71	10.95	10.46
26	10.27	10.74	10.61	11.78	10.98	10.50	10.61	11.06	10.81	10.73	10.94	10.44
27	10.29	10.75	10.66	11.83	11.05	10.51	10.61	11.32	10.79	10.73	10.92	10.42
28	10.30	11.03	10.69	11.77	11.04	10.51	10.61	11.18	10.79	10.74	10.91	10.40
29	10.29	10.86	10.53	11.75	10.99	10.50	10.62	11.04	10.78		10.89	10.37
30	10.26	10.51	10.56	11.73	10.94	10.50	10.62	11.02	10.76		10.87	10.35
31	10.24		10.58	11.65		10.49		11.01	10.76		10.86	
MAX	10.85	11.03	11.32	11.83	12.23	10.89	11.05	12.09	11.00	10.78	11.05	10.84
MEAN	10.44	10.45	10.80	11.00	11.31	10.56	10.76	10.97	10.87	10.74	10.79	10.62
MIN	10.24	10.06	10.43	10.31	10.71	10.43	10.61	10.54	10.76	10.70	10.60	10.35

Note: Stage in ft NGVD

Table D- 4. STA-2 average daily stage for WY2007.

Day	May-2006	Jun-2006	Jul-2006	Aug-2006	Sep-2006	Oct-2006	Nov-2006	Dec-2006	Jan-2007	Feb-2007	Mar-2007	Apr-2007
1	11.56	11.70	12.36	12.10	13.45	12.06	11.48	11.59	12.02	11.67	11.68	11.63
2	11.60	11.68	12.28	12.03	13.56	12.00	11.56	11.59	12.00	11.67	11.67	11.61
3	11.58	11.65	12.35	11.99	13.57	11.96	11.82	11.58	11.99	11.64	11.65	11.58
4	11.61	11.63	12.45	11.91	13.63	11.92	11.93	11.57	11.97	11.63	11.62	11.56
5	11.66	11.62	12.45	11.88	13.69	11.88	11.90	11.56	11.96	11.67	11.60	11.53
6	11.63	11.61	12.46	11.84	13.75	11.84	11.86	11.55	11.94	11.66	11.58	11.50
7	11.60	11.58	12.40	11.80	13.72	11.81	11.84	11.53	11.93	11.65	11.56	11.47
8	11.57	11.55	12.33	11.81	13.44	11.78	11.82	11.51	11.92	11.64	11.54	11.44
9	11.54	11.53	12.59	11.84	13.06	11.75	11.80	11.49	11.90	11.63	11.52	11.42
10	11.52	11.52	12.80	11.82	12.81	11.72	11.77	11.48	11.88	11.61	11.50	11.40
11	11.50	11.51	12.74	11.81	12.63	11.69	11.75	11.46	11.87	11.60	11.48	11.46
12	11.46	11.51	12.71	11.77	12.59	11.68	11.73	11.45	11.86	11.64	11.46	11.47
13	11.43	11.49	13.07	11.72	12.54	11.67	11.70	11.44	11.84	11.65	11.43	11.46
14	11.40	11.46	13.23	11.69	12.47	11.63	11.68	11.48	11.83	11.65	11.40	11.44
15	11.37	11.46	13.04	11.66	12.42	11.60	11.66	11.70	11.83	11.63	11.38	11.44
16	11.67	11.52	12.63	11.64	12.48	11.58	11.65	12.11	11.83	11.63	11.38	11.40
17	12.31	11.60	12.56	11.84	12.32	11.57	11.63	12.37	11.81	11.62	11.42	11.37
18	12.65	11.67	12.41	12.27	12.33	11.60	11.60	12.40	11.80	11.61	11.63	11.35
19	12.55	11.70	12.35	12.28	12.43	11.59	11.58	12.28	11.79	11.59	11.61	11.32
20	12.27	11.68	12.36	12.38	12.60	11.58	11.56	12.17	11.78	11.61	11.60	11.29
21	12.05	11.67	12.46	12.98	12.74	11.57	11.54	12.08	11.77	11.66	11.59	11.25
22	11.96	11.64	12.62	13.34	12.87	11.56	11.62	11.99	11.76	11.69	11.56	11.22
23	11.89	11.61	12.88	13.34	12.72	11.53	11.61	11.97	11.75	11.69	11.55	11.19
24	11.85	11.59	12.98	13.33	12.57	11.50	11.57	11.93	11.74	11.66	11.61	11.16
25	11.76	11.60	12.99	13.39	12.43	11.47	11.55	11.92	11.75	11.66	11.74	11.12
26	11.73	11.73	12.70	13.51	12.29	11.45	11.54	12.29	11.74	11.68	11.68	11.09
27	11.72	12.13	12.52	13.55	12.31	11.45	11.59	12.49	11.73	11.69	11.71	11.05
28	11.77	12.64	12.46	13.49	12.26	11.47	11.61	12.35	11.73	11.68	11.71	11.02
29	11.77	12.81	12.36	13.41	12.18	11.47	11.59	12.20	11.71		11.69	10.98
30	11.73	12.60	12.36	13.33	12.12	11.45	11.59	12.14	11.69		11.67	10.95
31	11.70		12.25	13.38		11.44		12.08	11.67		11.65	
MAX	12.65	12.81	13.23	13.55	13.75	12.06	11.93	12.49	12.02	11.69	11.74	11.63
MEAN	11.75	11.72	12.59	12.42	12.80	11.65	11.67	11.86	11.83	11.65	11.58	11.34
MIN	11.37	11.46	12.25	11.64	12.12	11.44	11.48	11.44	11.67	11.59	11.38	10.95

Note: Stage in ft NGVD

APPENDIX E

Correlation Coefficient Matrices for Major Water Budget Equation Terms

Table E- 1. STA-2 Correlation Matrices.

Cell 1

	CHANGE IN STORAGE	*INFLOW*	*OUTFLOW*	*SEEPAGE*	*RAIN*	*ET*	*REMAINDER*
CHANGE IN STORAGE	1						
INFLOW	0.612915815	1					
OUTFLOW	-0.071038224	0.635291462	1				
SEEPAGE	0.100251932	-0.463026978	-0.726343199	1			
RAIN	0.138951743	0.290898821	0.263359913	-0.222985043	1		
ET	-0.127684709	0.012651173	0.009623226	0.10830942	-0.246821391	1	
REMAINDER	-0.096100494	-0.205507303	0.31869213	-0.139797331	-0.254752543	-0.067967134	1

Cell 2

	CHANGE IN STORAGE	*INFLOW*	*OUTFLOW*	*SEEPAGE*	*RAIN*	*ET*	*REMAINDER*
CHANGE IN STORAGE	1						
INFLOW	0.36686179	1					
OUTFLOW	0.06897297	0.891349509	1				
SEEPAGE	0.012542772	0.662650849	0.743223094	1			
RAIN	0.112180691	0.307345866	0.294514362	0.211768055	1		
ET	-0.084064619	0.04300551	0.107738865	0.180597715	-0.246818881	1	
REMAINDER	0.349060721	-0.136785907	0.07195923	0.014695442	-0.168981247	0.126301924	1

Cell 3

	CHANGE IN STORAGE	*INFLOW*	*OUTFLOW*	*SEEPAGE*	*RAIN*	*ET*	*REMAINDER*
CHANGE IN STORAGE	1						
INFLOW	0.36365333	1					
OUTFLOW	-0.033264086	0.838901141	1				
SEEPAGE	0.090737079	-0.020098497	-0.099619743	1			
RAIN	0.115836706	0.259987358	0.292018754	-0.055622947	1		
ET	-0.082897227	0.009791748	0.05175664	-0.196076442	-0.246818881	1	
REMAINDER	0.363732082	0.119567008	0.337248904	-0.04251383	-0.027727198	0.09894368	1

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	CHANGE IN STORAGE	*INFLOW*	*OUTFLOW*	*SEEPAGE*	*RAIN*	*ET*	*REMAINDER*
CHANGE IN STORAGE	1						
INFLOW	0.487475095	1					
OUTFLOW	0.027527078	0.844800403	1				
SEEPAGE	-0.022302466	-0.478132534	-0.523246603	1			
RAIN	0.14231957	0.311708396	0.294760769	-0.169976945	1		
ET	-0.112895019	0.02283021	0.081668867	-0.022501072	-0.246818282	1	
REMAINDER	0.038075208	-0.039783119	0.218899944	0.010515908	-0.279447922	0.146840042	1