Technical Publication
ERA # 420

Water Budget Analysis for Stormwater Treatment Area 1 West (May 1, 2003 to April 30, 2004)

November 2004

by

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EXECUTIVE SUMMARY

Stormwater Treatment Area 1 West (STA-1W) is a constructed wetland that is part of the Everglades Construction Project mandated by Florida's Everglades Forever Act [Section 373.4592, Florida Statutes (F.S.)]. STA-1W was built as an expansion of the Everglades Nutrient Removal (ENR) Project, a constructed wetland built to demonstrate the effectiveness of phosphorus (P) removal from agricultural runoff/drainage. The ENR project operated for five years (1994 to 1999) and STA-1W started inflow operation on July 1, 1999. STA-1W covers 2,700 hectares (ha) [6,699 acres (ac)] and is located in South Florida (26° 38' N, 80° 25' W) at the eastern edge of the Everglades Agricultural Area (EAA). The EAA with an approximate area of 223,855 ha (552,922 ac) under agriculture (Redfield et al., 1999), is a highly productive irrigation drainage basin with a major production of sugarcane. Ecological changes in the Everglades have been partially attributed to an increase in P concentrations in the inflow waters. Local, state, and federal initiatives have been taken to reduce P loads from agricultural runoff/drainage. Water from the agricultural area flows to the south and southeast through four primary canals: Miami, North New River, Hillsboro, and West Palm Beach. The West Palm Beach Canal, which carries runoff/drainage from the agricultural area and Lake Okeechobee releases, is the inflow source for STA-1W.

A minimum of 25 percent of the P load from the EAA is required to be removed at the basin level through the application of various agricultural Best Management Practices (BMPs) (Whalen and Whalen, 1994). Further P removal is to be achieved through constructed wetland systems, known as Stormwater Treatment Areas (STAs), to an initial outflow total phosphorus (TP) concentration of 0.05 milligrams per liter (mg L^{-1}). STA-1W is one of the large-scale constructed wetlands that followed the successful operation of the ENR Project. This report presents the fifth annual water budget for STA-1W. Water budget analyses for five years of the ENR Project and four years of STA-1W operation were reported in the South Florida Water Management District's (SFWMD's) technical publications (Guardo et al., 1996; Abtew and Mullen, 1997; Abtew and Downey, 1998; Abtew et al., 2000; Abtew et al., 2001; Abtew et al., 2002; Abtew and Reardon, 2003; Abtew et al., 2004).

The total inflow into STA-1W through the inflow spillway for the study period (May 2003 to April 2004) was 36,104 hectare-meters (ha-m) [292,688 acre-feet (ac-ft)], and the total outflow through the outflow pumps was 36,710 ha-m (297,601 ac-ft). Estimated seepage inflow from the L-7 levee through the roadside culverts was 429 ha-m (3,478 ac-ft). The seepage recirculation pump had a total flow of 1,294 ha-m (10,490 ac-ft). The areal average rainfall for the study period was 86.6 centimeters (cm), or 34.1 inches (in), and the total areal average evapotranspiration (ET) was 129.9 cm (51.1 in). A comparison with the previous four years of water budget shows that the surface water inflow for this period was close to the average for the past five years. The sum of the errors and unknowns (remainders) was 562 ha-m, which represents 1 percent of the total inflow into the system. Rainfall (6 percent) and ET (9 percent) comprise a small fraction of the current water balance.

The mean hydraulic loading rate for the study period, based on the daily average inflow, was 3.7 centimeters per day (cm d^{-1}), [1.46 inches per day (in d^{-1})]. The mean hydraulic retention time was 16 days and was computed as the ratio of the mean estimated volume of STA-1W and the average of inflow and outflow. The mean estimated volume was computed using the area-weighted (by cell) mean depth of 59 cm (23.2 in) and total area of 2,700 ha (6,669 ac).

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LIST OF ABBREVIATIONS AND ACRONYMS

ac	acre
ac-ft	acre-foot
BMP	Best Management Practice
cm	centimeter
cm d^{-1}	centimeter per day
cfs	cubic foot per second
EAA	Everglades Agricultural Area
ENR	Everglades Nutrient Removal
ET	evapotranspiration
ft	foot
ha	hectare
ha-m	hectare-meter
HW	headwater
in	inch
in d^{-1}	inch per day
m	meter
m^3s^{-1}	cubic meter per second
MAX	maximum
MIN	minimum
mm	millimeter
NGVD	National Geodetic Vertical Datum
P	phosphorus
Q	discharge
rpm	revolution per minute
SFWMD	South Florida Water Management District
STA	Stormwater Treatment Area
TW	tailwater
UVM	ultrasonic velocity meter
WCA	Water Conservation Area
WY	Water Year

CONVERSION FACTORS

Metric	English
mm	0.03937 in
cm	0.3937 in
m	3.2808 ft
ha	2.47 ac
m^3s^{-1}	35.33 cfs
ha-m	8.1068 ac-ft

ACKNOWLEDGMENTS

The author would like to acknowledge Mike Chimney, Scott Huebner, Julianne LaRock, Martha Nungesser and Garth Redfield for reviewing the draft; Stacey Efron and Hedy Marshall for editing the draft.

INTRODUCTION

Background

Stormwater Treatment Area 1 West (STA-1W) is a constructed wetland that is part of the Everglades Construction Project (ECP) mandated by Florida's Everglades Forever Act (EFA) [Section 373.4592, Florida Statutes (F.S.)]. STA-1W was built as an expansion of the Everglades Nutrient Removal (ENR) Project, a constructed wetland built to demonstrate the effectiveness of phosphorus (P) removal from agricultural runoff/drainage by a managed wetland. The ENR project operated for five years (1994 to 1999), and STA-1W started operation on July 1, 1999. STA-1W covers 2,700 hectares (ha) [6,669 acres (ac)] and is located in South Florida (26^{o} 38' N, 80^{o} 25' W) at the eastern edge of the Everglades Agricultural Area (EAA) as in depicted in Figure 1. The EAA is approximately a 223,855 ha (552,922 ac) (Redfield et al., 1999), highly productive irrigation drainage basin with a major production of sugarcane. Ecological changes in the Everglades have been partially attributed to an increase in P concentrations in the inflow waters. Local, state, and federal initiatives have been taken to reduce P loads from agricultural runoff/drainage. Water from the agricultural area flows to the south and southeast through four primary canals: Miami, North New River, Hillsboro, and West Palm Beach.

A minimum P load reduction of 25 percent from the EAA is required at the basin level through the application of various agricultural Best Management Practices (BMPs) (Whalen and Whalen, 1994). Further P removal is to be achieved through constructed wetland systems, known as Stormwater Treatment Areas (STAs), to an initial outflow total phosphorus (TP) concentration of 0.05 milligrams per liter (mg L^{-1}). STA-1W is one of the large-scale constructed wetlands that followed the successful operation of the ENR Project. This report presents the fifth annual water budget for STA-1W (May 1, 2003 to April 30, 2004). Water budget analyses for five years of the ENR Project and four years of STA-1W operation were reported in the South Florida Water Management District's (SFWMD's) technical publications (Guardo et al., 1996; Abtew and Mullen, 1997; Abtew and Downey, 1998; Abtew et al., 2000; Abtew et al., 2001; Abtew et al., 2002; Abtew and Reardon, 2003; Abtew et al., 2004).

Site Description

A survey of the ENR Project site indicated that the area is primarily covered by Okeechobee muck soils where one to two meters of peat overlies several meters of carbonate rock (Jammal and Associates, Inc., 1991). The topography of STA-1W is relatively flat, with an average elevation of 2.99 meters (m) [9.8 feet (ft)] National Geodetic Vertical Datum (NGVD). To the east, the L-7 levee separates STA-1W from the Arthur R. Marshall Loxahatchee National Wildlife Refuge [comprising Water Conservation Area 1 (WCA-1)] as depicted in Figure 2. A seepage canal runs along the northern perimeter, and a discharge canal on the west separates STA-1W from agricultural land. The narrow southern ENR levee separates STA-1W from the discharge area into WCA-1. STA-1W consists of five cells: Cells 1, 2, 3, 4, and 5. Cells 1 and 3, and Cells 2 and 4 (in series) comprise two parallel treatment trains of cells incorporated from the initial ENR project. The largest cell, Cell 5, has been added to the north and operates in parallel to the other cells. The area and average ground elevation for each cell are presented in Table 1.

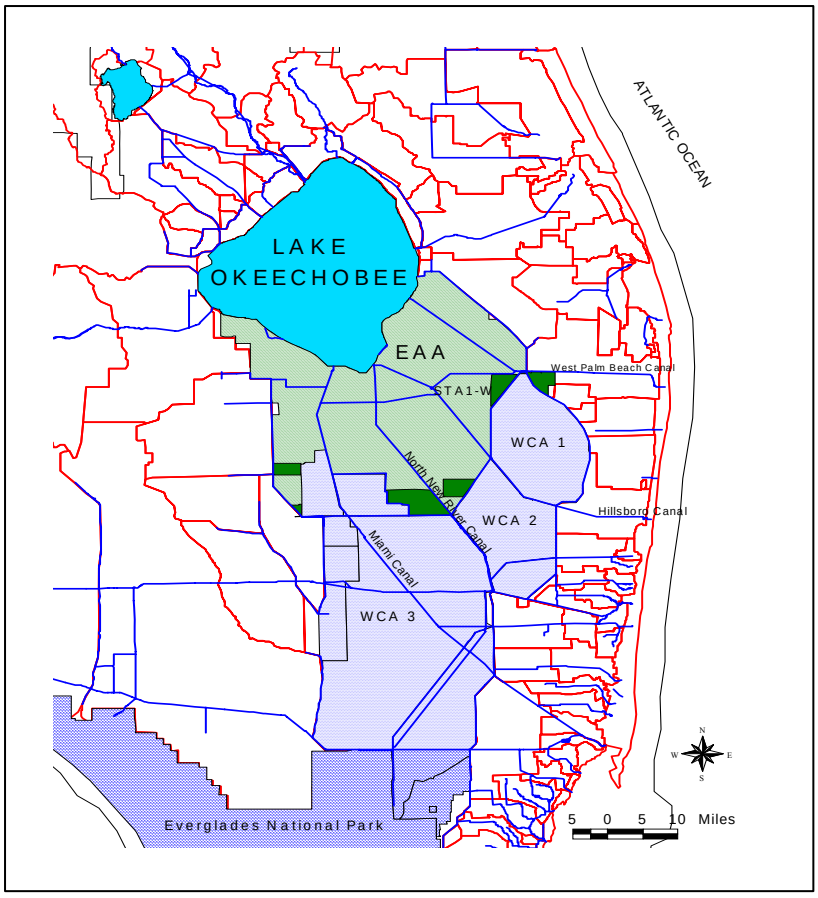

Figure 1. Location of Stormwater Treatment Area 1 West (STA-1W).

Table 1. Site characteristics of STA-1W.

Cell	Area		Average ground elev.	
	ha	ac	m NGVD	ft NGVD
Cell 1	603	1,489	3.13	10.27
Cell 2	381	941	2.94	9.65
Cell 3	415	1,025	3.10	10.17
Cell 4	145	358	3.00	9.84
Cell 5	1,156	2,855	2.90	9.51
Total	**2,700**	**6,669**		
Average			**2.99**	**9.82**

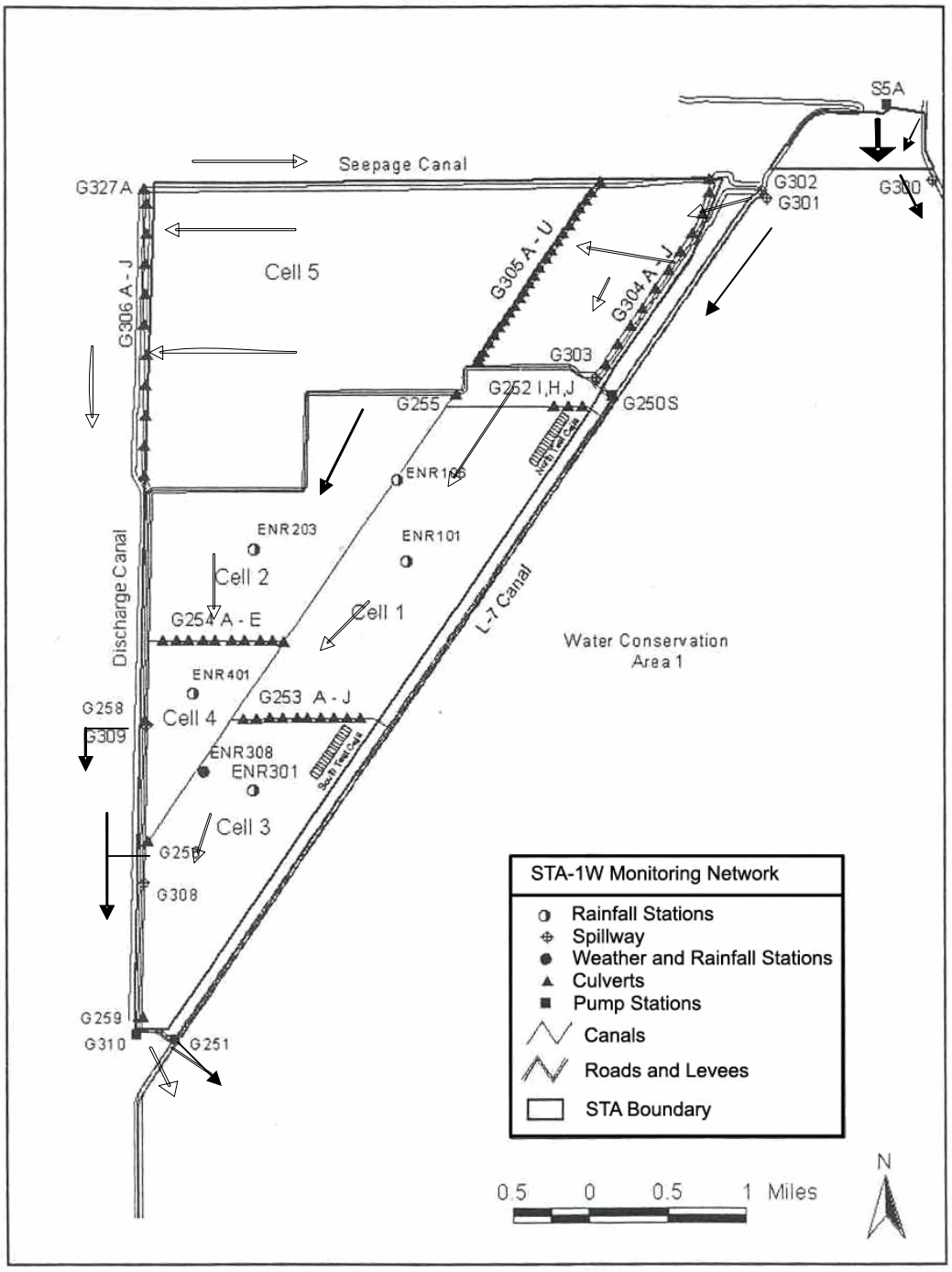

Figure 2. STA-1W structures and monitoring network.

Vegetation Cover

At STA-1W, vegetation cover generally varies from cell to cell and coverage has changed with time. Cell 1 is covered mostly with emergent vegetation dominated by cattail (*Typha* spp.), but Cell 1 also contains minimal coverage of submerged aquatic vegetation (SAV). A portion of Cell 1 contains the floating aquatics water hyacinth (*Eichhorina crassipes*) and water lettuce (*Pistia stratiotes*) as well as leather fern (*Acrostichum* spp.), carolina willow (*Salix caroliniana*) and primrose willow (*Ludwigia* sp.). Cell 1 also contains tussocks. Cell 2 is mostly covered with floating islands that contain leather fern, carolina willow, primrose willow and cattail, but this cell also contains some coverage of SAV and periphyton. Cell 2 contains the floating aquatics water hyacinth and water lettuce. Cell 3 is mostly covered with emergent vegetation dominated by cattail, but also contains significant coverage of pickerelweed (*Pontederia cordata*), arrowhead (*Sagittaria latifolia*), duck potato (*Sagittaria lancifolia*), spikerush (*Eleocharis* sp.) and carolina willow. Cell 4 is covered with SAV dominated by southern naiad (*Najas guadalupensis*), coontail (*Ceratophyllum demersum*), pondweed (*Potamogeton illinoensis*), naturally occurring periphyton and hydrilla. Cell 5A (eastern) is covered with sparse cattail, smartweed, and other emergent/floating vegetation. Cell 5B (western) is dominated by hydrilla and some floating aquatics. Also found are coontail and southern naiad mixed with hydrilla (Christy Combs, SFWMD, personal communication, 2004).

SYSTEM HYDRAULICS AND OPERATION

System Hydraulics

STA-1W Inflow and Distribution

Water from the West Palm Beach canal (C-51) that previously was pumped into the Refuge (WCA-1) via the S5A pump station and flowed through the Refuge is presently diverted to STA-1W. A small portion of the area of WCA-1 near the S5A pump station is levied and forms the STA-1W inflow and distribution basin (STA-1 inflow basin) that serves as a storage area to divert water into both STA-1W and STA-1E (upon completion). There are two former and four new water control structures in the STA-1W inflow basin. The S5A pump station delivers water from C-51 (West Palm Beach Canal); the S5AS spillway controls WCA-1 inflow and outflow at the junction of L-8 and C-51. The junction has two culvert structures, S5AW and S5AE. The four new spillway structures are G300, G301, G302, and G311.

G300 is a two-bay, reinforced concrete, U-shaped spillway with vertical lift gates installed on the crest of ogee-shaped weirs. The purpose of this structure is to bypass flows from the STA-1 inflow basin area into the L-40 borrow canal that runs along the eastern edges of WCA-1. G301 is a three-bay, reinforced concrete, U-shaped spillway with vertical lift gates on weirs. The purpose of this structure is to bypass flow from the STA-1 inflow basin area into WCA-1 along the L-7 borrow canal on the western edge of WCA-1. G302 is a fixed-crest, concrete ogee-shaped spillway equipped with two vertical lift gates each of which are 6 m (20 ft) wide. The purpose of this structure is to supply inflow to the five cells of STA-1W from the STA-1 inflow basin area. G302 has a capacity of 92 cubic meters per second ($m^3 s^{-1}$) [3,250 cubic feet per second (cfs)]. G311 is designed as a three-bay, reinforced concrete spillway with lift gates on weirs. The purpose of this structure is to supply water from the STA-1 inflow basin area to STA-1E, which is currently under construction. It also transfers water from STA-1E to STA-1W via the inflow basin when needed. Structure information for the STA-1W stations is provided in Table 2 and structure locations are shown in Figure 2.

Table 2. Structure information for STA 1-W stations.

Station	G300	G301	G302	G303	G304	G306	G308	G309	G327A	G310	G251
Type	spillway	spillway	spillway	spillway	culvert	culvert	spillway	spillway	culvert	pump	pump
Units	2	3	2	2	10	10	1	1	1	6	6
Max Q			92 m^3s^{-1} (3250 cfs)	50.4 m^3s^{-1} (1780 cfs)	41.6 m^3s^{-1} (1470 cfs)	41.6 m^3s^{-1} (1470 cfs)	28.3 m^3s^{-1} (1000 cfs)	28.3 m3s-1 (1000 cfs)	5.7 m^3s^{-1} (200 cfs)	86 m3s-1 (3,040) cfs)	12.7 m^3s^{-1} (450 cfs)
Min Q	-28.3 m^3s^{-1} (-1000 cfs)	-28.3 m^3s^{-1} (-1000 cfs)	0	0	0	0	0	0	0	0	0
Design Q			92 m^3s^{-1} (3250 cfs)	50.4 m^3s^{-1} (1780 cfs)	41.6 m^3s^{-1} (1470 cfs)	41.6 m^3s^{-1} (1470 cfs)	15.8 m^3s^{-1} (560 cfs)	15.8 m^3s^{-1} (560 cfs)	2.83 m^3s^{-1} (100 cfs)	86 m3s-1 (3040 cfs)	12.7 m^3s^{-1} (450 cfs)
Design HW	5.79 m (19 ft)	5.79 m (19 ft)	5.49 m (18 ft)	4.79 m (15.7ft)	4.79 m (15.7ft)	3.51 m (11.5 ft)	3.58 m (12.75 ft)	3.84 m (12.6 ft)	2.74 m (9 ft)	2.74 m (9 ft)	
Desigh TW			4.79 m (15.7ft)	4.41 m (14.46ft)		2.74 m (9 ft)	2.29 m (7.5 ft)	2.38 m (7.8 ft)	2.65 m (8.7 ft)		
Bypass stage	6.71 m (22 ft)	6.71 m (22 ft)			5.73 m (18.8 ft)	5.73 m (18.8 ft)	5.03 m (16.5 ft)	5.03 m (16.5 ft)	5.33 m (18.8 ft)		
Flow Min. Elevation	3.35 m (11 ft)	2.35 m (7.7ft)	2.87 m (9.4 ft)		3.43 m 1.52 m (11.24 ft) (5 ft inv.)	2.38 m (7.8 ft) inv.	2.26 m (7.4 ft)	2.32 m (7.6 ft)	0.15 m (0.5 ft)		
Flow Width	6.1 m (20 ft)	6.71 m (22 ft)	6.1 m (20 ft)	4.88 m (16 ft)	1.83 m (6 ft) dia.	1.83 m (6 ft) dia.	4.27 m (14 ft)	4.27 m (14 ft)	2.13 m (7 ft) dia.		0.91 m (3 ft) dia.
Flow Height	2.56 m (8.4 ft)	3.57 m (11.7 ft)					2.04 m (6.7 ft)	2.04 m (6.7 ft)			
RPM										720	720

STA-1W Inflow, Internal, and Discharge Structures

The supply canal to STA-1W is about 2.72 kilometers (km) [1.7 miles (mi)] long, extending between the inflow structure G302 and the flow control structures into Cells 1, 2, 3 and 4 (G303). The canal has a side slope of 2.5:1, with a bottom width of 18.3 m (60 ft) at an elevation of -1.52 m (-5 ft) NGVD. Expected velocities in the inflow canal vary between 0.232 m s^{-1} (0.76 ft s^{-1}) and 0.418 m s^{-1} (1.37 ft s^{-1}) (Hutcheon Engineers, 1996). G303 is a two-bay ogee spillway equipped with two lift gates, each 4.9 m (16 ft) wide, and with discharge capacity of 50.4 $m^3 s^{-1}$ (1780 cfs).

The perimeter and inter-cell levees facilitate vehicle transportation within the wetland. There are culverts situated below the levees for inflows, outflows, and inter-cell water delivery. Under each levee, the culverts are spread along the levee to facilitate distribution of flow over the downstream cell area. The evenness of flow distribution depends on the ground surface elevations and vegetation cover of the receiving cell.

Upstream of Cells 1 and 2, there was initially a buffer cell that received flow from G250S (seepage return pumps) and the inflow spillway G303. Also, there was a levee with ten culverts (G252A-J) between the Buffer Cell and Cell 1. However, the transition to STA-1W involved degrading about 70 percent of the levee and removing all but three of the culverts (G252H, I, and J). The number of culverts between the buffer cell and Cell 2 originally was five (G255A-E) but the number was increased to seven (G255A-G) during the transition from ENR project to STA-1W which made a direct connection between Cells 1 and 2. Similarly, there were initially five G254 culverts between Cells 2 and 4 under the ENR Project, but they were increased to nine as part of STA-1W (G254A, A1, B, B1, C, C1, D, D1 and E). The levee between Cells 1 and 3 has 10 culverts G253 (A-J), which did not change during the transition from the ENR project to STA-1W. Between Cells 4 and 3, there are five culverts (G256A-E), which were not affected by the transition from the ENR project to STA-1W.

The inflow to Cell 5 occurs through ten corrugated metal pipe culverts, which are 29.3 m (96 ft) long (G304A-J). The combined capacity of the inflow culverts (G304A-J) is 41.6 $m^3 s^{-1}$ (1,470 cfs). The Florida Power and Light (FPL) levee runs across Cell 5 dividing the cell into two parts. Twenty-two culverts (G305A-V) were constructed to deliver water from the eastern part to the western part of this cell. Each of the G305 culverts is 213 cm (84 inches) in diameter and 27.4 m (90 ft) long, with an invert elevation of 1.07 m (3.5 ft) NGVD. Seepage and recirculated water from the discharge canal is pumped through G250S to Cell 1 through the former ENR buffer cell, which is now part of Cell 1. G250S has three main pumps with a combined capacity of 5.66 $m^3 s^{-1}$ (200 cfs), and three supplemental pumps from the former ENR project inflow pump station G250, with a combined capacity of 8.49 $m^3 s^{-1}$ (300 cfs).

At the west end of Cell 3, there are two outflow structures, G308 and G259, releasing to the discharge canal. Similarly, G258 and G309 are the two outflow structures releasing to the discharge canal from Cell 4, located at the west end. Hydraulic information for STA-1W internal structures is shown in Table 3.

The outflow from Cell 5 to the discharge canal occurs through ten corrugated metal pipe culverts, which are 183 cm (72 in) in diameter and 39.6 m (130 ft) long and have a combined discharge capacity of 41.6 $m^3 s^{-1}$ (1,470 cfs). G327A is a gated culvert, which is 213 cm (84 in) in diameter, and 39.6 m (130 ft) long, with a 2.83 $m^3 s^{-1}$ (100 cfs) discharge capacity. G327C is a 39.3 m (129 ft) long culvert and has a discharge capacity of 2.83 $m^3 s^{-1}$ (100 cfs).

The discharge from Cell 1 into Cell 3 flows through ten culverts, which are 183 cm (72 in) in diameter and 17.7 m (58 ft) long (G253A-J). Discharge from Cell 2 into Cell 4 flows through nine culverts (G252A, A1, B, B1, C, C1, D, D1, and E), which are 183 cm (72 in) in diameter and 16.5 m (54 ft) long. Discharge from Cell 3 is to the discharge canal through G308 and G259 and to WCA-1 through the G251 pump station. G308 is a gated weir with a discharge capacity of 15.85 $m^3 s^{-1}$ (560 cfs). G259 is a gated culvert, which is 183 cm (72 in) in diameter and 23.9 m (78.5 ft) long. Discharge from Cell 4 is into the discharge canal through G309 and G258 and into Cell 3 through G256A through E. G309 is a gated weir with a discharge capacity of 15.85 $m^3 s^{-1}$ (560 cfs). G258 is a gated culvert which is 183 cm (72 in) in diameter and 23.5 m (77 ft) long. G256A-E are five culverts which are 183 cm (72 in) in diameter and 16.6 m (54.5 ft) long. The STA-1W outflow structures are composed of the G251 and G310 pump stations. G251 has six identical pumps with a combined capacity of 12.74 $m^3 s^{-1}$ (450 cfs). G310 is equipped with six pumps of three different capacities, with a total capacity of 86 $m^3 s^{-1}$ (3,040 cfs). G310 has two electric pumps with a combined discharge capacity of 5.66 $m^3 s^{-1}$ (200 cfs), two diesel pumps with a combined discharge capacity of 26.6 $m^3 s^{-1}$ (940 cfs), and two diesel pumps with a combined discharge capacity of 53.8 $m^3 s^{-1}$ (1,900 cfs).

The discharge canal extends between G327A at the northwest corner and the G310 pump station at the southwestern corner. The discharge canal is about 9.12 km (5.7 mi) long with bottom width varying from 15.2 m (50 ft) at G327A, to 24.4 m (80 ft) at G308, and to 30.5 m (100 ft) at G259, accounting for changes in flow magnitude and ground elevation.

Operation

S5A diverts water from the West Palm Beach Canal into the STA-1 inflow basin area. From the STA-1 inflow basin, water flows to STA-1W through spillway G302 or is bypassed to WCA-1 through G300 and G301, when needed. Water flows into Cell 5 via the inflow canal and through culverts G304 A-J, and into Treatment Cells 1, 2, 3, and 4 through the gated weir structure G303. The former ENR project seepage pumps (G250S) control stages in the seepage canal north of Treatment Cell 5 and redirect flow to the former ENR (Cells 1, 2, 3, and 4). Culverts installed beneath G302 deliver seepage return inflow to the G250S pumps. In return, the pumps convey the seepage return flow into Cell 1 that also receives inflow from G303. Thus, flow is primarily direct surface flow and partly through the remaining culverts G252 (H, I, and J). Cell 2 receives flow from Cell 1 through culverts G255 (A-G). Water flows from Cell 1 to Cell 3 through culverts G253 (A-J). Water delivery between Cells 2 and 4 occurs through nine culverts (G254A, A1, B, B1, C, C1, D, D1, and E). At the west end of Cell 3, there are two outflow structures releasing to the discharge canal, G309 spillway, and G258 culvert. Similarly, the G308 spillway and G259 culvert are the two outflow structures releasing to the discharge canal from Cell 4, located at the west end. Water delivery from Cell 4 to 3 is through culverts G256A-E as was during the former ENR project. Outflow from STA-1W is through pump stations G251 lifting water from Cell 3 to WCA-1 and through G310 lifting water from the discharge canal to WCA-1.

Table 3. Hydraulic information for STA-1W internal structures and seepage pump station.

Station	G250S	G252	G253	G254	G255	G256	G258	G259	G305
Type	pump	culvert	culvert	culvert	culvert	culvert	culvert	culvert	culvert
Units	6	3	10	9	7	5	1	1	22
DBKEY	JK278	16207, 16235, 16236	16237, 16238, 16208 to 16211, 16247 to 16450	16212 to 16215, 16251	16731 to 16735	16736 to 16740	15940	15939	staions not active
Bypass stage		15.5 ft.	15.5 ft.	15.5 ft.	15.5 ft.	15.5 ft.	15.5 ft.	15 ft.	18.8 ft.
Flow line Elevation		5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	2.5 ft.	1.5 ft.	3.5 ft.
Flow line Length		54.5 ft. barrel	54.5 ft. barrel	54.5 ft. barrel	54.5 ft. barrel	54.5 ft. barrel	78 ft. barrel	78.5 ft.	90 ft.
Cross Section Diameter	3@42 in. 3@36 in. propeller	72 inches	72 inches	72 inches	72 inches	72 inches	60 inches	72 inches	84 inches

HYDROLOGY AND HYDROLOGIC MONITORING

Rainfall

STA-1W has a six-gauge rainfall monitoring network. The rainfall gauging stations, along with their corresponding database keys and Theissen weights, are presented in Table 4. The gauge locations are depicted in Figure 2. The areal average rainfall on the project site was computed using a Theissen-weighted average of the six-gauge network. Minimal data gaps at a station are estimated using nearby station readings, while extended gaps result in areal rainfall computation using remaining stations with a new set of Theissen weights. The daily distribution of areal average rainfall for the study period is depicted in Figure 3. The monthly summary of areal average rainfall for STA-1W is shown in Table 5. The 12-month total areal average rainfall for STA-1W was 86.5 cm (34.1 in). The 10-year (May 1, 1994 to April 30, 2004) average areal rainfall for the previous ENR constructed wetland and the current STA-1W was 127.9 cm (50.34).

Table 4. Rainfall stations in STA-1W, database retrieval keys, and Theissen weights.

Stations	DBKEY	Theissen Weights
ENR101	15851	0.087
ENR106	DU515	0.441
ENR203	15874	0.222
ENR301	15877	0.126
ENR308	15888	0.049
ENR401	15862	0.075

Evapotranspiration

The daily evapotranspiration (ET) was computed from high-resolution weather data using a radiation-based ET estimation model that was developed based on lysimeter studies in the ENR Project area (Abtew, 1996a; 1996b). A complete weather station is located in Cell 3 (ENR 308). The daily distribution of ET for STA-1W for the study period is depicted in Figure 3. Monthly summary of ET for STA-1W is shown in Table 5. The 12-month total areal ET for STA-1W was 129.9 cm (51.1 in). The nine-year (May 1, 1995 to April 30, 2004) average areal ET for the previous ENR constructed wetland and current STA-1W was 132.5 cm (52.2 in).

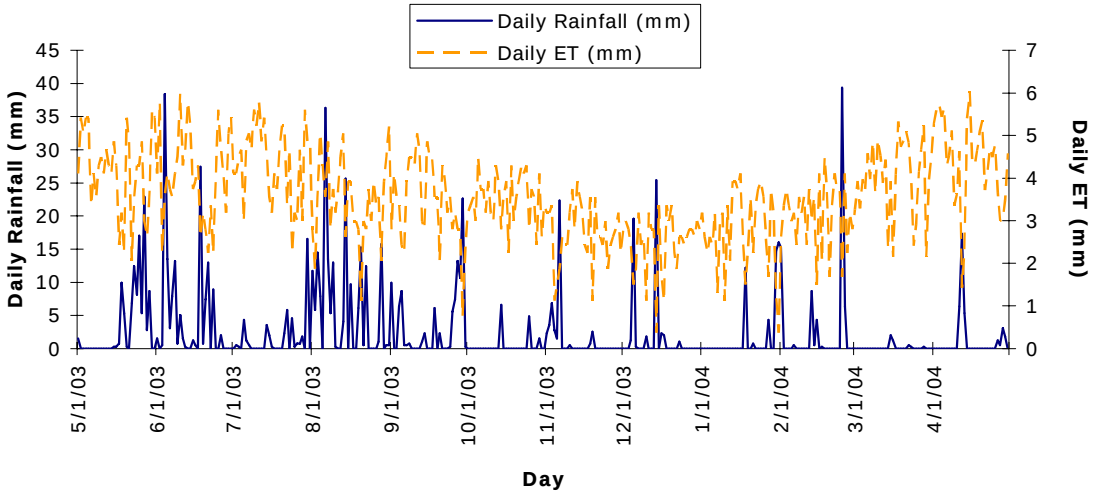

Figure 3. Daily distribution of areal average rainfall and evapotranspiration in STA-1W.

Table 5. STA-1W monthly flows, areal weighted rainfall, and ET (May 1, 2003 to April 30, 2004).

Year	Month	Inflow	Outflow	Rainfall		ET		Seepage	Seepage
		G302	G251+G 310					Pump	L7 Culverts
		ha-m	ha-m	cm	in	cm	in	ha-m	ha-m
2003	May	1015	1998	10.24	4.03	12.90	5.08	85	10
2003	Jun	4707	5234	14.68	5.78	12.22	4.81	94	9
2003	Jul	3278	2178	4.55	1.79	13.55	5.33	95	12
2003	Aug	11498	12617	19.96	7.86	10.84	4.27	141	40
2003	Sep	4561	3786	9.83	3.87	10.39	4.09	135	66
2003	Oct	1500	1585	1.30	0.51	10.92	4.30	130	60
2003	Nov	1964	1801	4.32	1.70	8.08	3.18	113	55
2003	Dec	1338	1045	5.36	2.11	7.72	3.04	123	52
2004	Jan	463	541	4.80	1.89	8.56	3.37	98	46
2004	Feb	2272	2810	7.52	2.96	9.12	3.59	89	44
2004	Mar	3124	3011	0.43	0.17	12.43	4.89	96	26
2004	Apr	384	104	3.56	1.40	13.17	5.19	95	9

1 ha-m = 8.1068 ac-ft

Flows

Database keys for STA-1W flow structures and stage gauges are listed in Table 6. The total inflow spillway discharge for the study period was 36,104 ha-m (292,690 ac-ft), and the total outflow through the outflow pump stations was 36,710 ha-m (297,603 ac-ft). In the past, inflows through G302 were underestimated. In July 2003, new flow data for the period of record was loaded into the database after recalibration of the flow computation equations for G302 spillway. The daily discharge rates of the inflow spillway and outflow pumps are shown in Figure 4. The estimated seepage from L-7 levee flowing through the roadside culverts and the daily seepage recycling pumping is presented in Figure 5. The total seepage and recirculation pumping during the current reporting period was 1,294 ha-m (10,494 ac-ft). The L-7 seepage through the roadside culverts was estimated using a regression equation developed from 42 data points. Guardo (1996) developed relationship between the seepage from L-7 through the roadside culverts, the stage rise in WCA-1 above 4.57 m (15 ft) NGVD, and the difference in stages between WCA-1 and the eastern cells of the ENR (Equation 1). The regression had a coefficient of determination (R^2) of 0.93 and a standard error of 0.30 $m^3 s^{-1}$. The total estimated seepage from L-7 through roadside culverts during the current reporting period was 429 ha-m (3,481 ac-ft). The monthly flow data for the study period are presented in Table 5.

$$\mathbf{L7a = 0.217 * \Delta WCA^{1.311} * \Delta h^{2.025}} \qquad \mathbf{(1)}$$

Where L7a is seepage in $m^3 s^{-1}$, ΔWCA is rise in stage in WCA-1 above 4.57 m (15 ft) NGVD and Δh is the difference in stage between WCA-1 and the eastern cells of ENR.

Water Levels

Daily water levels or water surface elevations (stages) in each cell of STA-1W are dependent upon rainfall, evapotranspiration, seepage, and daily operational decisions. Water levels have been regulated based on water depth, operation status of the S5A pump station, tests, maintenance, and other operational decisions. The minimum, maximum and mean of the daily average stage observations for the study period are shown in Table 7. The mean observed stage in Cell 1 was 3.78 m (12.40 ft) NGVD as observed at center of Cell 1 (ENR101). The mean stage in Cell 2 was 3.68 m (12.06 ft) as observed at center of cell (ENR203) and the mean stage in Cell 3 was 3.69 m (12.10 ft) as observed at center of cell (ENR301). The mean stage in Cell 4 was 3.63 m (11.91 ft) NGVD as observed at center of cell (ENR401). The mean stage in Cell 5 was 3.41 m (11.18 ft) NGVD as computed as average of three gages (G304E_T, G306H_H and G306J_H). The average daily stages for Cell 5 were computed from the stage readings for G304 tailwater and G306 headwater. The average daily water level observations in Cell 1 and 3 of STA-1W and WCA-1 are shown in Figure 6. Water levels for cells 2 and 4 are shown in Figure 7, and the daily water levels for Cell 5 are shown in Figure 8. The mean water depths for Cells 1, 2, 3, 4, and 5 were 65 cm (25.5 in), 74 cm (29 in), 59 cm (23.1 in), 63 cm (24.8 in), and 51 cm (20 in) respectively.

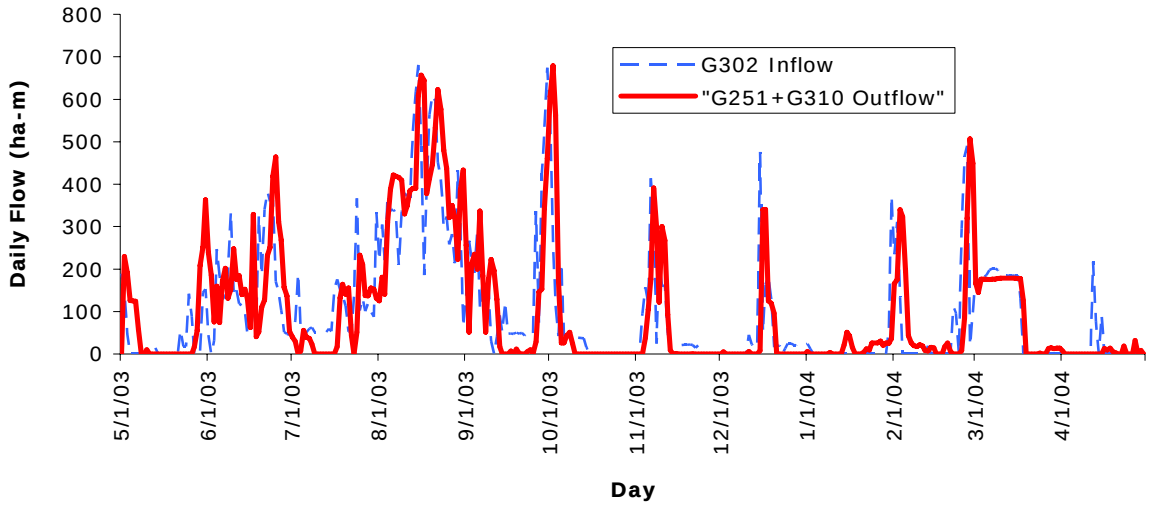

Figure 4. Daily STA-1W inflows and outflows.

Table 6. Flow control structures, stage recorders and database retrieval keys used in the water budget analysis for STA-1W.

Station	Description	Location	DBKEY	Remark
G302	spillway	I & D / Supply canal	JW221	inflow
G250S	pump	Seepage canal/cell1	JK278	seepage return, recirculation
G251	pump	Cell 3/WCA1	JW222	outflow
G310	pump	Discharge canal/WCA-1	M2901	outflow
ENR101	stage	Cell 1	15850	center of cell
ENR203	stage	Cell 2	15873	center
ENR301	stage	Cell 3	15876	center
ENR401	stage	Cell 4	15727	center of cell
G304E_H	stage	Supply Canal/Cell 5	OH559	Cell 5 stage close to WCA-1
G304E_T	stage	Supply Canal/Cell 5	OH560	tailwater
G306A_H	stage	Cell 5/Discharge Canal	L9951	headwater
G306J_H	stage	Cell 5/Discharge Canal	L9954	headwater
G251_T	stage	G251 tailwater	16219	WCA-1
G301_T	stage	Inflow and Distribution/WCA-1	KS686	tailwater

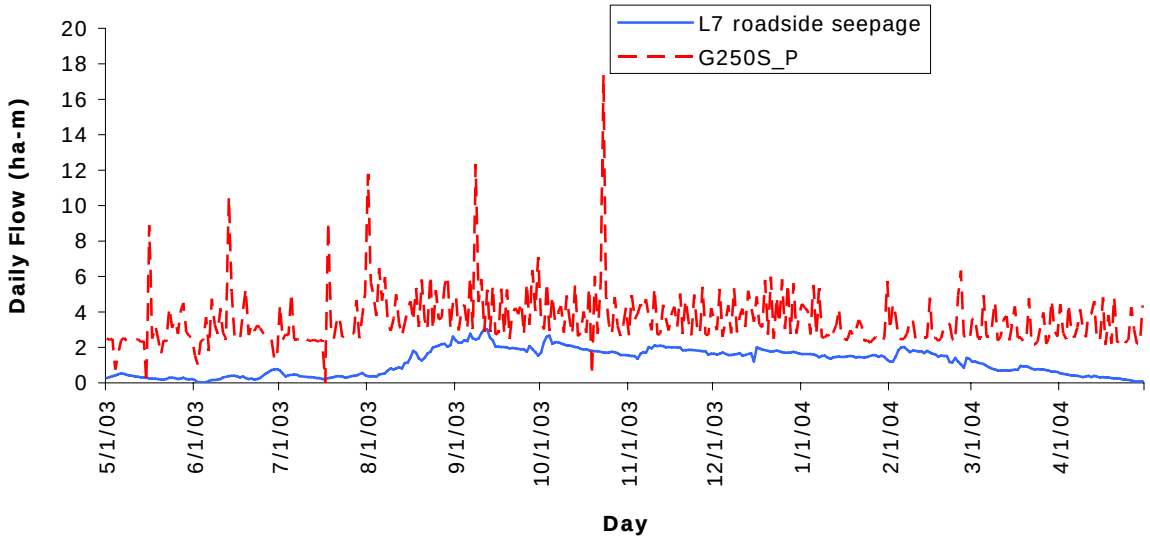

Figure 5. Daily pumping rates of the seepage/recirculation pump and seepage flow through L-7 levee roadside seepage collection culverts in STA-1W.

Table 7. Observed water surface elevations (stages) and depths in STA-1W (May 1, 2003 to April 30, 2004).

Cell	Water Surface Elevation						Depth	
	Min		Max		Mean		Mean	
	m	ft	m	ft	m	ft	cm	in
Cell 1	3.39	11.13	4.33	14.21	3.78	12.40	65	25.5
Cell 2	3.24	10.62	4.11	13.49	3.68	12.06	74	29.0
Cell 3	3.33	10.93	4.09	13.42	3.69	12.10	59	23.1
Cell 4	3.15	10.34	3.98	13.07	3.63	11.91	63	24.8
Cell 5	3.08	10.12	3.88	12.74	3.41	11.18	51	20.0

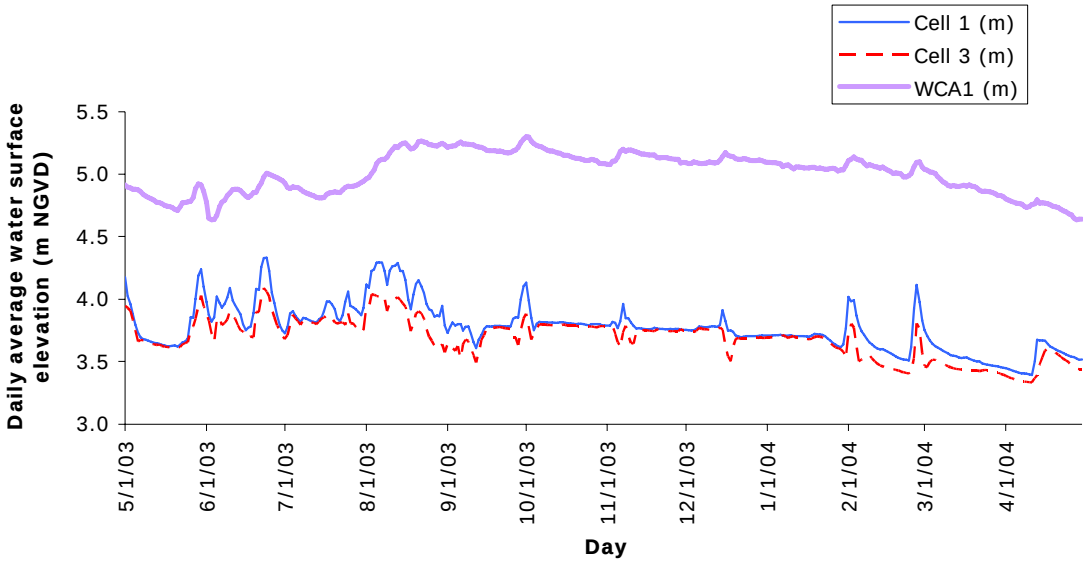

Figure 6. Daily mean water levels in Cells 1 and 3 of STA-1W and Water Conservation Area 1.

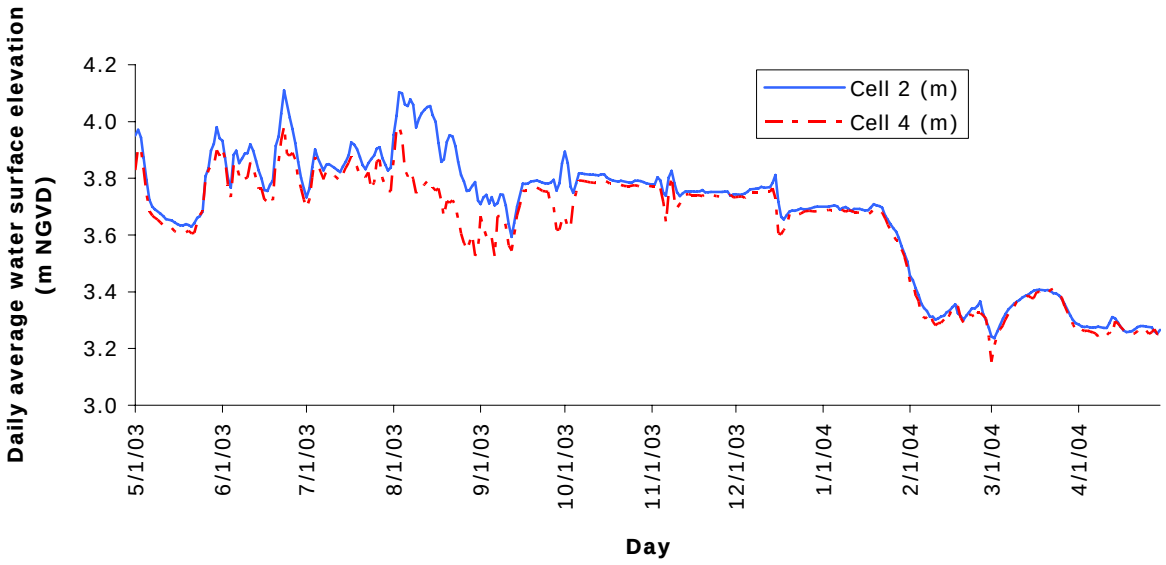

Figure 7. Daily mean water level in Cells 2 and 4 of STA-1W.

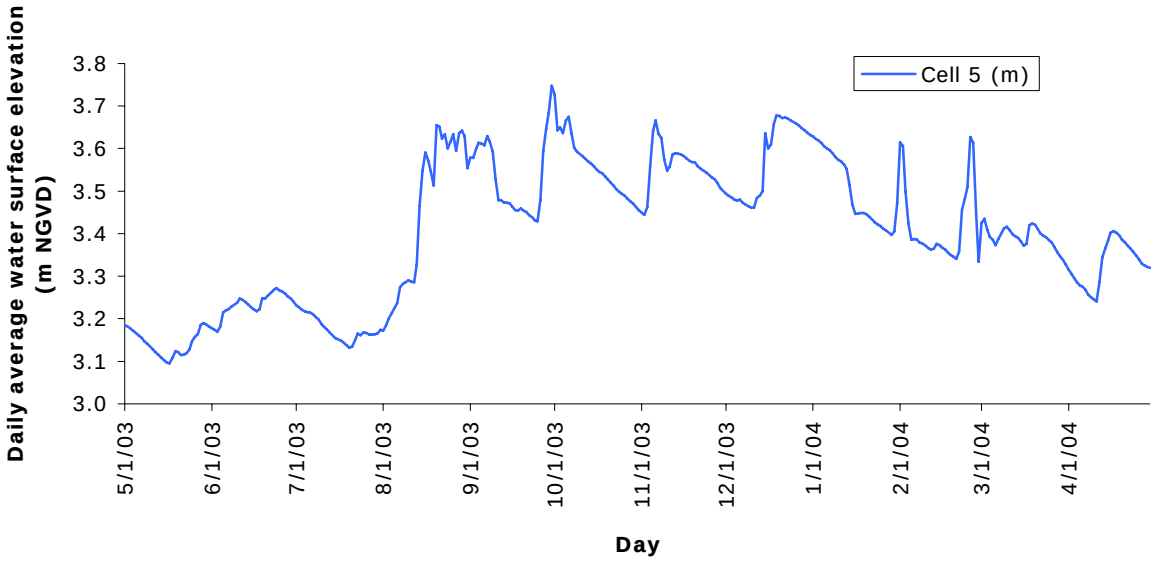

Figure 8. Daily mean water level in Cell 5 of STA-1W.

WATER BUDGET COMPUTATIONS

STA-1W Water Balance Model

A schematic hydrologic model for STA-1W is depicted in Figure 9. The inflow supplied through the G302 spillway accounts for about 92 percent of the inflow to the system. The known inflows to the system are G302 spillway inflows, rainfall, and seepage through the roadside L-7 levee culverts (L-7a). Rainfall accounts for 6 percent and seepage through the roadside culverts (L-7a) accounts for 1 percent. Outflow pumping (G251 and G310) accounts for 91 percent of the outflows, with evapotranspiration constituting 9 percent of the total outflows. The unknowns in the system are ungaged subsurface inflows, outflows, and errors that account for 1 percent of the total inflows. The schematic model (Figure 9) and the following set of water balance equations (Equations 2-5) represent the hydrologic system of STA-1W for water budget analysis purposes.

$$\mathbf{INFLOW - OUTFLOW = \Delta S + \varepsilon_T} \quad (2)$$

Where, INFLOW is the amount of water that enters the system from external sources, and OUTFLOW is water that leaves the system boundary and is not recirculated. ΔS is the change in storage in the system during the time interval of interest. The sum of all errors is represented by ε_T. Because all inflows and outflows cannot be entirely quantified, the following equation is introduced to represent the remainders, errors, and unknowns:

$$\mathbf{REMAINDERS = \varepsilon_T + UNKNOWNS} \quad (3)$$

Figure 9 shows the possible inflows and outflows to and from the STA-1W system. The seepage canal, which encompasses the northern side of STA-1W, is designed to capture seepage from STA-1W to the neighboring area and to recirculate discharge from the discharge canal when needed. Seepage through the former ENR supply canal is represented as SEEP1, and seepage in and out of the seepage canal to the north is represented as SEEP2. SEEP3 represents the two seepage possibilities into or out of the discharge canal to the west, regardless of the magnitude. SEEP4 represents the possible seepage loss or gain through the southern levee from WCA-1. The unmeasured subsurface inflow from WCA-1 into STA-1W from the east is represented by L-7b.

In computing the water balance for STA-1W, it is essential to identify quantifiable variables from unquantifiable variables, making reasonable assumptions to reduce the quantity of unknowns as much as possible. Because the purpose of the seepage canal is to recirculate seepage and recycle water, it is assumed that the seepage return pump flows are recirculation in the system. This assumption does not exclude the possibility of external seepage inflow being part of recirculation flow or seepage loss out of the seepage canal. The change in storage is represented as follows:

$$\mathbf{\Delta S = G302+R+L7a+L7b-G251-G310-ET+SEEP1+SEEP2+SEEP3+SEEP4+\varepsilon_T} \quad (4)$$

Where, ΔS is change in storage in the system; G302 is inflow; R is rainfall; L-7a is seepage flow from WCA-1 through the roadside culverts; L-7b is unknown subsurface seepage flow from WCA-1 into STA-

1W; ET is evapotranspiration losses. G310 and G251 represent outflow pumping; ε_T represents total error in inflow and outflow terms.

The daily change in storage for STA-1W was computed as the sum of storage changes in each of the five cells (Cells 1, 2, 3, 4, and 5). The change in storage volume in each cell was computed based on the area of the cell and change in stage in the cell. The remainders in the computation of daily water balances are the sum of all errors and unknowns in the system. Daily remainders were computed for the one-year study period based on the following equation:

$$\textbf{REMAINDERS} = \Delta S - \textbf{INFLOWS} + \textbf{OUTFLOWS} \quad (5)$$

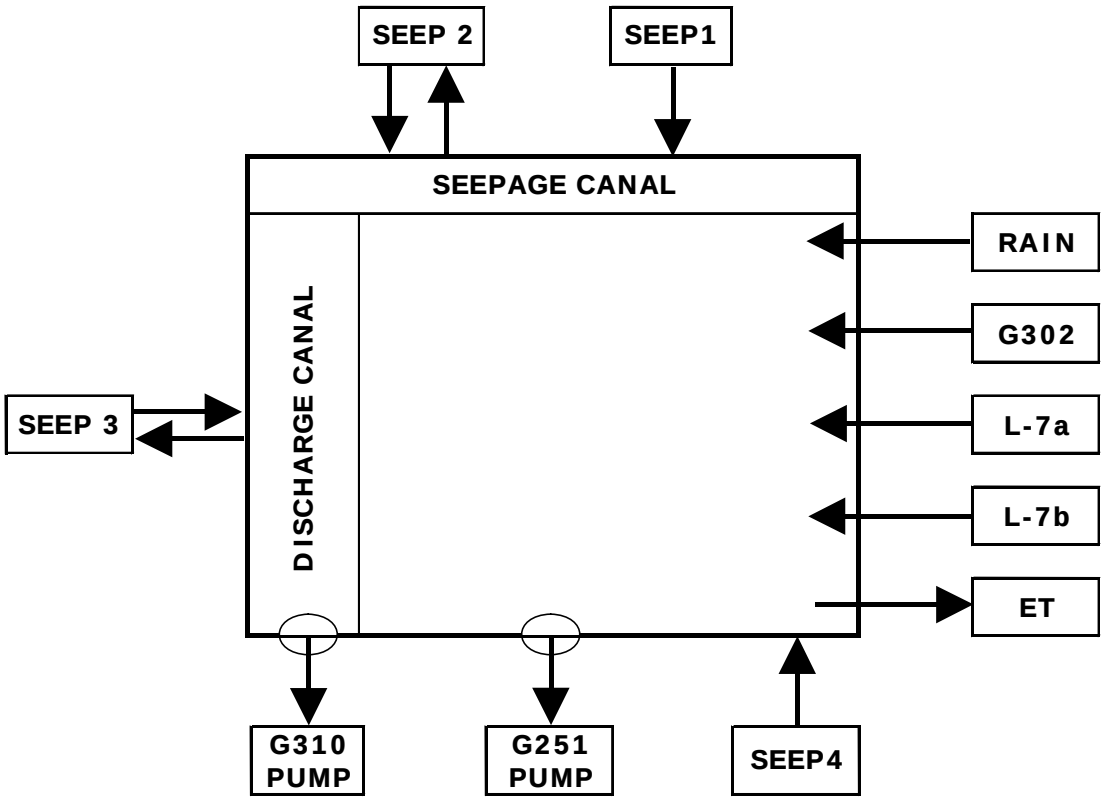

Figure 9. Schematic hydrologic model for STA 1-W.

Discussion

The total inflow through the inflow spillway was 36,104 ha-m (292,690 ac-ft) and total outflow through the outflow pumps was 36,710 ha-m (297,603 ac-ft). Seepage inflow from L-7 levee through the roadside culverts was a total of 429 ha-m (3,481 ac-ft). The seepage and recirculation pump had a total flow of 1,294 ha-m (10,494 ac-ft). Total average areal rainfall for the study period was 86.5 cm (34.1 inches) and the total average areal evapotranspiration was 129.9 cm (51.1 inches). For the study period, the mean daily remainders (errors and unknowns) was 1.54 ha-m d^{-1} (12.48 ac-ft d^{-1}), with a total remainder of 562 ha-m d^{-1} (4,560 ac-ft d^{-1}). The standard deviation of the remainders is 73.1 ha-m d^{-1} (592.7 ac-ft d^{-1}), which signifies high variation. Figure 10 depicts the daily remainder distribution. The remainder is 1.4

percent of the total inflows. The known outflow from the system is higher than the known inflow and the remainder is accounted as inflow.

A summary of the one-year water budget is shown in Table 8. Details of the daily water balances terms and calculations results are shown in Appendix I. The mean hydraulic loading rate for the study period, based on the average inflow, was 3.7 centimeters per day (cm d^{-1}), or 1.4 inches per day (in d^{-1}). The mean retention time was computed as the ratio of the mean estimated water volume of STA-1W and the average daily flow rate, inflow and outflow. The estimated mean volume was computed from the area-weighted (by cell) mean depth of 59 cm (23.2 inches) and a total area of 2,700 ha (6,669 ac). The estimated mean hydraulic retention time was 16 days.

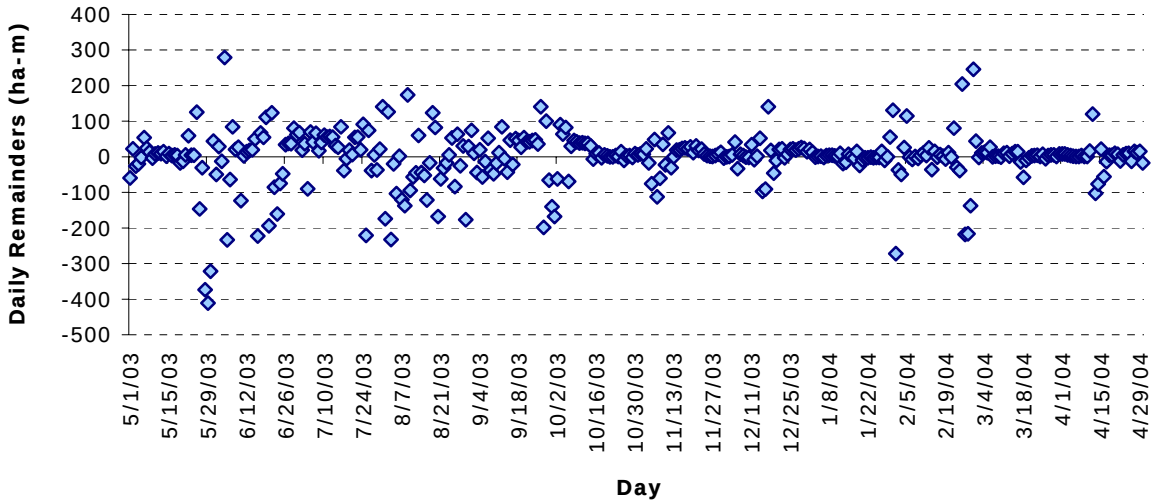

Figure 10. Distribution of daily remainders (errors and unknowns) for STA-1W water balance.

Table 8. Summary of water budget for STA-1W (May 1, 2003 to April 30, 2004).

Inflows	ha-m	Percent of total	Outflows	ha-m	Percent of total
Spillway inflow	36,104	92%	Outflow pump	36,710	91%
Rain	2,337	6%	ET	3,507	9%
L- 7 Culverts (L7a)	429	1%			
Remainders	562	1%			
Total	39,433	100%	Total	40,218	100%

Change in storage	(785)
Seepage/recirculation seepage pump (ha-m)	1,294
Loading rate (cm/d)	3.65
Average depth (cm)	59
Retention time (days)	16.0

1 ha-m = 8.1068 ac-ft

WATER BUDGET SUMMARY

This water budget study covers the fifth year of operation of STA-1W. The period of analysis was changed to May 1, 2003 to April 30, 2004 in order to coincide with the reporting period for the 2005 South Florida Environmental Report. For the period of analysis, the total inflow through the spillway (G302) was 36,104 ha-m, or 292,690 ac-ft. The total outflow through the outflow pump stations (G251 and G310) was 36,710 ha-m (297,603 ac-ft). Seepage inflow from L-7 levee through the roadside culverts was 429 ha-m (3,481 ac-ft). The seepage and recirculation pump had a total flow of 1,294 ha-m (10,494 ac-ft). Total areal average rainfall for the study period was 86.5 cm (34.1 in), and the total areal average evapotranspiration was 129.9 cm (51.1 in). The sum of the errors and unknowns was 562 ha-m (560 ac-ft), which represents 1.4 percent of the total inflows to the system.

The mean hydraulic loading rate for the one-year period, based on the average flow, was 3.7 cm d^{-1} (1.4 in d^{-1}). The mean hydraulic retention time was computed as the ratio of the estimated mean volume of STA-1W and the average daily flow rate. The estimated mean volume was computed using the area-weighted (by cell) mean depth of 59 cm (23.2 inches) and a total area of 2,700 ha (6,669 ac). The estimated mean hydraulic retention time was 16 days and the change in storage was -785 ha-m (-6,363 ac-ft). A comparison with the previous four years of water budget shows that the surface water inflow for this period was close to the average for the past five years.

Inflow through the G302 spillway that was used for the previous three water budgets for STA-1W was underestimated by the flow computation equations. In July 2003, after recalibration of the flow equations, new flow data for the G302 spillway was loaded into the database for the period of record. Comparison of previous years and current year water budgets are shown in Table 9. Inflows into STA-1W through the G302 spillway were updated based on the new dataset in DBHYDRO.

Figure 9. Comparison of current water year (WY2004) to previous reporting years of STA-1W water budget parameters.

Year	(7/1/1999 - 4/30/2000*)	(5/1/2000 - 4/30/2001)	(5/1/2001 - 4/30/2002)	(5/1/2002 - 4/30/2003)	(5/1/2003 - 4/30/2004)
Inflows (ha-m)					
Spillway inflow	14,296	11,573	34,398	73,006	36,104
Rainfall	2,623	2,467	3,704	2,978	2,337
L-7 Culverts (L7a)	541	288	440	396	429
Remainders				1,378	562
Total	17,460	14,328	38,542	77,758	39,433
Outflows (ha-m)					
Outflow pump	13,379	11,166	33,012	73,518	36,710
ET	2,955	3,946	3,715	3,595	3,495
Remainders	1,410	331	1,313		
Total	17,744	15,443	38,040	77,113	40,205
Change in storage (ha-m)	(284)	(1,113)	503	645	(785)
Seepage/Recirculation Seepage Pump (ha-m)	5,475	3,386	1,449	1,431	1,294
Loading rate (cm/d)	1.70	1.14	3.40	7.41	3.65
Average depth (cm)	54.3	53.4	57.5	61.0	59.0
Retention time (days)	38.7	46.3	16.8	8.2	16.0

1 ha-m = 8.1068 ac-ft
* 10-month period

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APPENDIX I: WATER BALANCE TERMS WITH CALCULATED REMAINDERS

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
5/1/2003	12.080	189.040	2.498	229.948	0.263	4.115	11.097	-59.707
5/2/2003	-82.031	146.155	2.416	191.939	0.320	0.000	14.634	21.933
5/3/2003	-66.530	46.905	2.479	126.077	0.373	0.000	13.635	-25.904
5/4/2003	-119.689	0.000	0.741	125.495	0.418	0.000	14.634	-20.022
5/5/2003	-136.384	0.000	1.617	124.076	0.486	0.000	14.634	-1.840
5/6/2003	-119.287	0.000	2.391	56.875	0.539	0.000	9.072	53.879
5/7/2003	-34.773	0.000	2.547	0.000	0.508	0.000	11.097	24.184
5/8/2003	-22.230	0.000	2.346	0.000	0.451	0.000	9.585	13.096
5/9/2003	-17.482	0.000	2.348	10.073	0.415	0.000	11.610	-3.786
5/10/2003	-19.653	0.000	2.349	0.000	0.395	0.000	12.123	7.925
5/11/2003	-21.203	0.000	2.389	0.000	0.367	0.000	11.097	10.473
5/12/2003	-20.990	0.000	2.460	0.000	0.343	0.000	12.609	8.724
5/13/2003	-10.875	14.281	2.291	0.000	0.309	0.000	11.610	13.855
5/14/2003	-12.214	0.000	2.361	0.039	0.299	0.000	11.097	1.377
5/15/2003	-20.843	0.000	0.000	0.000	0.283	0.686	13.122	8.690
5/16/2003	-14.107	0.000	8.897	0.000	0.259	0.686	11.610	3.442
5/17/2003	-9.018	0.000	2.505	0.000	0.241	2.057	6.561	4.755
5/18/2003	14.959	0.000	3.241	0.000	0.231	26.746	8.586	3.432
5/19/2003	25.765	0.000	2.501	0.000	0.212	14.402	6.048	-17.199
5/20/2003	-0.631	0.000	1.581	0.000	0.189	0.686	14.634	-13.128
5/21/2003	-18.191	0.000	2.401	0.000	0.173	0.000	13.122	5.242
5/22/2003	9.803	55.794	2.333	0.000	0.220	18.517	5.562	59.166
5/23/2003	38.134	17.680	4.229	0.000	0.289	33.604	9.585	3.854
5/24/2003	23.773	17.415	3.101	0.000	0.290	21.946	11.610	4.268
5/25/2003	51.037	142.037	3.505	0.000	0.263	45.949	11.610	125.602
5/26/2003	220.573	89.301	2.754	16.349	0.209	14.402	13.122	-146.132
5/27/2003	29.329	0.000	4.059	55.566	0.256	61.722	8.073	-30.990
5/28/2003	166.460	0.000	4.496	208.166	0.290	7.544	7.074	-373.866
5/29/2003	173.332	0.000	2.869	251.628	0.216	23.317	9.585	-411.012
5/30/2003	87.585	144.302	2.656	362.969	0.196	0.000	15.147	-321.203
5/31/2003	-144.247	152.408	2.525	238.436	0.220	0.000	14.634	43.805
6/1/2003	-99.091	44.018	1.552	186.119	0.154	4.115	11.097	-49.838
6/2/2003	-119.593	0.000	1.005	75.526	0.042	0.000	15.633	28.476
6/3/2003	-119.356	31.976	2.327	159.697	0.034	1.372	6.048	-13.007
6/4/2003	-12.091	246.711	2.427	73.860	0.027	103.556	9.585	278.940
6/5/2003	269.322	183.006	3.701	172.026	0.036	36.347	11.097	-233.056
6/6/2003	-11.014	128.634	1.845	201.824	0.111	8.230	10.098	-63.933
6/7/2003	-67.086	136.001	4.730	131.034	0.170	21.260	9.585	83.898
6/8/2003	41.148	188.284	3.291	151.699	0.165	35.662	11.097	20.167
6/9/2003	49.297	333.824	2.800	247.927	0.173	2.057	12.123	26.707
6/10/2003	81.078	134.966	4.207	174.810	0.219	13.716	16.146	-123.133
6/11/2003	-44.085	149.553	2.819	184.220	0.302	4.115	11.610	2.225
6/12/2003	-47.460	117.981	2.469	139.810	0.346	0.686	12.609	14.054
6/13/2003	-71.410	113.795	10.508	152.301	0.376	0.000	15.633	17.647
6/14/2003	-61.689	100.754	5.169	129.561	0.388	0.000	14.121	19.149
6/15/2003	-70.393	48.385	2.540	62.544	0.399	3.429	10.098	49.964
6/16/2003	-69.402	45.229	2.590	328.897	0.369	1.372	10.611	-223.136
6/17/2003	-4.786	114.783	2.463	40.835	0.309	0.000	11.610	67.433
6/18/2003	29.120	68.426	3.980	51.962	0.354	74.067	7.074	54.691
6/19/2003	98.463	325.655	5.315	109.729	0.267	2.057	8.586	111.201

“ 1 ha-m = 8.1068 ac-ft”

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
6/20/2003	264.767	186.219	2.710	127.572	0.215	19.888	7.560	-193.577
6/21/2003	14.375	340.805	3.328	231.999	0.239	34.976	6.048	123.598
6/22/2003	207.642	382.156	2.937	251.095	0.182	0.000	9.072	-85.471
6/23/2003	120.411	359.654	3.247	418.604	0.208	24.003	6.048	-161.198
6/24/2003	-37.377	362.573	3.082	464.056	0.266	0.000	11.097	-74.937
6/25/2003	-107.545	170.683	2.825	311.533	0.391	0.000	15.147	-48.061
6/26/2003	-161.928	146.482	2.643	268.209	0.529	5.486	12.609	33.607
6/27/2003	-101.935	102.800	2.492	156.634	0.608	0.000	11.097	37.612
6/28/2003	-129.061	51.591	2.493	136.488	0.722	0.000	8.586	36.300
6/29/2003	-100.130	46.761	1.286	53.658	0.762	0.000	13.635	80.360
6/30/2003	-69.529	45.525	1.511	39.509	0.776	0.000	14.634	61.687
7/1/2003	-50.062	58.050	4.400	29.441	0.703	0.000	11.097	68.277
7/2/2003	50.819	78.431	2.390	0.000	0.531	1.372	11.097	18.418
7/3/2003	133.783	189.052	2.739	7.421	0.362	0.686	12.123	36.773
7/4/2003	74.929	52.777	2.688	55.571	0.433	0.000	12.609	-89.899
7/5/2003	-53.204	51.392	5.085	39.049	0.454	11.659	8.073	69.587
7/6/2003	-36.055	50.981	2.460	36.982	0.477	3.429	13.122	40.838
7/7/2003	-41.587	58.962	2.465	22.911	0.454	1.372	13.635	65.829
7/8/2003	33.702	62.547	2.418	0.000	0.379	0.000	12.609	16.615
7/9/2003	-4.339	50.514	2.292	0.000	0.359	0.000	15.147	40.065
7/10/2003	-24.347	49.981	2.495	0.000	0.346	0.000	14.121	60.553
7/11/2003	-20.589	50.441	2.395	0.000	0.332	0.000	15.633	55.729
7/12/2003	-20.129	50.098	2.364	0.000	0.319	0.000	13.122	57.424
7/13/2003	-19.288	50.866	2.425	0.000	0.298	0.000	14.634	55.818
7/14/2003	26.176	59.476	2.345	0.000	0.269	9.601	12.123	31.047
7/15/2003	22.959	53.612	2.352	0.000	0.266	5.486	9.585	26.820
7/16/2003	40.617	149.612	2.440	17.342	0.219	0.686	8.586	83.972
7/17/2003	71.741	176.085	0.000	132.683	0.221	0.000	11.097	-39.215
7/18/2003	-17.023	151.765	9.098	164.422	0.262	0.000	10.098	-5.470
7/19/2003	-32.054	139.903	2.994	140.566	0.281	0.000	12.609	19.063
7/20/2003	-61.490	113.717	2.496	155.212	0.327	0.000	14.121	6.201
7/21/2003	-53.589	51.938	3.401	43.703	0.379	6.172	14.121	54.254
7/22/2003	0.727	49.521	3.766	0.000	0.380	15.773	9.072	55.875
7/23/2003	56.093	139.174	2.578	51.412	0.364	0.000	12.609	19.424
7/24/2003	49.605	366.830	2.737	232.696	0.287	12.344	6.048	91.112
7/25/2003	105.344	102.741	2.652	210.399	0.323	0.686	8.586	-220.579
7/26/2003	-86.348	130.870	2.700	137.205	0.384	2.057	8.073	74.381
7/27/2003	-8.179	100.304	2.786	136.757	0.404	2.057	12.609	-38.422
7/28/2003	-44.767	118.326	4.669	155.469	0.423	4.801	8.073	4.775
7/29/2003	-32.171	98.474	2.526	152.844	0.491	0.000	15.147	-36.855
7/30/2003	-33.164	87.300	3.753	130.936	0.556	44.577	13.122	21.539
7/31/2003	55.673	334.532	5.025	125.419	0.428	0.000	13.122	140.746
8/1/2003	238.444	220.397	11.795	180.733	0.371	31.547	7.560	-174.422
8/2/2003	49.287	304.459	5.657	140.246	0.362	15.773	5.049	126.012
8/3/2003	172.701	220.707	4.893	310.300	0.377	39.091	9.585	-232.411
8/4/2003	14.295	374.141	3.765	387.957	0.342	21.260	13.635	-20.144
8/5/2003	8.347	338.131	6.467	421.736	0.461	0.000	11.610	-103.101
8/6/2003	8.547	339.851	4.636	418.979	0.512	98.070	9.585	1.322
8/7/2003	60.600	331.943	5.971	415.945	0.540	36.347	13.122	-120.837
8/8/2003	-54.517	210.013	3.388	409.600	0.703	14.402	7.560	-137.525

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Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
8/9/2003	-143.263	335.089	2.942	329.893	0.812	34.976	10.098	174.149
8/10/2003	116.873	378.019	3.630	348.348	0.753	0.686	8.586	-94.349
8/11/2003	34.137	371.946	4.997	385.070	0.812	0.000	10.098	-56.547
8/12/2003	12.100	367.581	3.372	389.604	0.887	0.000	12.123	-45.359
8/13/2003	69.081	521.426	2.658	390.176	0.819	10.973	13.635	60.326
8/14/2003	115.711	617.179	3.394	609.066	1.117	69.266	7.074	-44.289
8/15/2003	66.515	680.303	4.174	656.624	1.130	0.000	10.611	-52.317
8/16/2003	-16.117	490.399	4.595	644.579	1.417	26.060	10.611	-121.197
8/17/2003	-180.885	185.852	3.470	377.779	1.800	0.000	8.073	-17.315
8/18/2003	-149.370	394.306	5.358	413.393	1.697	0.000	8.073	123.907
8/19/2003	45.094	563.861	3.161	446.391	1.378	16.459	7.560	82.653
8/20/2003	284.647	609.176	5.820	532.250	1.269	41.148	3.024	-168.328
8/21/2003	29.811	595.342	3.544	622.755	1.406	1.372	8.073	-62.519
8/22/2003	-65.722	451.590	2.990	576.356	1.654	33.604	7.560	-31.346
8/23/2003	-56.300	415.414	6.081	480.495	1.748	0.000	10.098	-17.131
8/24/2003	-148.646	300.205	3.006	437.571	1.994	0.000	8.073	5.201
8/25/2003	-59.570	322.983	5.232	320.997	2.030	0.000	10.611	52.975
8/26/2003	-15.568	257.975	3.566	350.242	2.106	0.000	9.072	-83.665
8/27/2003	-106.407	282.204	3.670	320.625	2.175	2.743	9.585	63.319
8/28/2003	55.130	213.487	5.477	222.926	2.201	42.520	5.562	-25.410
8/29/2003	6.389	432.235	6.030	386.964	2.043	0.000	10.611	30.314
8/30/2003	43.937	308.333	3.038	433.167	2.126	1.372	12.123	-177.396
8/31/2003	-231.033	63.885	4.557	256.336	2.619	1.372	14.121	28.452
9/1/2003	31.725	135.717	4.904	51.258	2.398	26.746	7.560	74.318
9/2/2003	36.287	267.082	2.954	211.858	2.256	0.000	11.097	10.096
9/3/2003	27.652	225.997	4.171	235.069	2.273	0.000	9.585	-44.036
9/4/2003	-18.495	190.611	4.404	199.673	2.406	17.145	9.072	19.912
9/5/2003	29.445	291.213	3.051	337.362	2.358	23.317	6.561	-56.480
9/6/2003	-66.822	105.351	5.962	183.545	2.783	1.372	6.048	-13.265
9/7/2003	62.906	173.144	3.054	51.253	2.525	1.372	10.611	52.271
9/8/2003	30.386	175.948	12.353	176.075	2.449	2.057	12.123	-38.130
9/9/2003	-32.052	152.961	4.550	222.767	2.503	0.000	12.123	-47.374
9/10/2003	-156.746	30.375	5.854	196.678	2.819	0.000	11.610	-18.348
9/11/2003	-150.861	0.000	2.905	129.018	3.052	0.000	13.635	11.260
9/12/2003	-71.331	39.847	5.265	17.247	3.009	0.000	12.609	84.331
9/13/2003	93.602	90.368	2.878	0.000	2.548	2.743	8.073	-6.016
9/14/2003	94.979	51.116	5.475	0.000	2.421	6.172	7.560	-42.830
9/15/2003	65.011	122.165	2.716	0.000	2.044	0.000	13.122	46.076
9/16/2003	52.876	47.901	2.822	7.051	2.042	0.000	12.123	-22.107
9/17/2003	-12.347	48.513	5.296	0.000	2.022	0.000	12.123	50.759
9/18/2003	-1.419	46.837	2.783	11.866	2.018	16.459	9.585	45.282
9/19/2003	14.197	49.839	5.260	1.732	1.982	0.000	9.585	26.307
9/20/2003	-3.687	47.346	2.513	0.000	1.954	6.172	5.562	53.597
9/21/2003	-1.577	49.888	3.940	0.000	1.957	0.000	11.610	41.812
9/22/2003	-13.728	43.216	4.210	5.970	1.939	0.000	10.611	42.302
9/23/2003	-12.288	49.486	3.865	9.938	1.904	0.000	8.586	45.154
9/24/2003	-11.311	43.558	4.545	0.482	1.892	0.686	9.585	47.380
9/25/2003	-6.066	49.215	2.716	28.734	1.899	15.088	7.560	35.974
9/26/2003	62.074	336.320	5.625	146.353	1.746	19.888	8.586	140.941
9/27/2003	146.109	69.880	3.277	152.543	2.071	35.662	7.560	-198.599

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Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
9/28/2003	5.432	425.203	6.364	342.965	1.915	28.804	7.560	99.965
9/29/2003	194.941	528.020	4.073	459.911	1.726	61.036	2.025	-66.095
9/30/2003	203.265	674.047	7.108	606.761	1.534	0.686	6.561	-140.320
10/1/2003	25.622	543.563	3.360	679.253	1.716	0.000	8.586	-168.182
10/2/2003	-244.743	262.191	3.003	562.733	2.310	0.000	9.072	-62.561
10/3/2003	-153.147	116.202	5.673	172.268	2.618	0.000	9.585	90.114
10/4/2003	-52.351	42.007	2.932	25.697	2.663	0.000	8.073	63.251
10/5/2003	94.896	213.167	4.909	25.680	2.204	0.000	12.123	82.672
10/6/2003	59.732	41.704	3.458	43.304	2.291	0.000	10.098	-69.139
10/7/2003	-48.347	39.727	3.946	51.189	2.287	0.000	10.098	29.074
10/8/2003	-39.240	37.253	4.328	24.653	2.240	0.000	8.586	45.494
10/9/2003	-13.748	37.062	2.837	0.000	2.160	0.000	10.611	42.359
10/10/2003	-8.503	36.982	4.915	0.223	2.110	0.000	8.586	38.786
10/11/2003	-7.189	38.261	3.704	0.000	2.106	0.000	8.073	39.483
10/12/2003	-9.270	37.945	2.733	0.000	2.067	0.000	11.610	37.672
10/13/2003	-8.729	37.226	5.537	0.000	2.022	0.000	10.611	37.366
10/14/2003	-1.481	16.239	2.627	0.000	1.998	17.831	7.560	29.989
10/15/2003	-1.615	0.000	2.803	0.000	1.902	0.000	9.585	-6.068
10/16/2003	-17.586	0.000	4.015	0.000	1.895	0.000	10.611	8.870
10/17/2003	-14.661	0.000	2.809	0.000	1.892	0.000	6.048	10.505
10/18/2003	-6.798	0.000	5.350	0.000	1.836	0.000	11.610	-2.976
10/19/2003	-11.333	0.000	0.459	0.000	1.800	0.000	8.073	5.060
10/20/2003	-10.244	0.000	6.041	0.000	1.782	0.000	9.585	2.441
10/21/2003	-8.430	0.000	2.774	0.000	1.784	0.000	10.611	-0.397
10/22/2003	-10.023	0.000	5.581	0.000	1.750	0.000	11.610	0.163
10/23/2003	-12.749	0.000	17.409	0.000	1.704	0.000	11.097	3.356
10/24/2003	-10.313	0.000	4.784	0.000	1.688	0.000	11.610	0.391
10/25/2003	-6.577	0.000	3.272	0.000	1.714	13.030	7.560	13.761
10/26/2003	1.846	0.000	2.741	0.000	1.745	0.000	10.098	-10.199
10/27/2003	-10.040	0.000	4.822	0.000	1.728	0.000	9.585	2.183
10/28/2003	-8.460	0.000	3.230	0.000	1.675	0.000	6.561	3.574
10/29/2003	-3.191	0.000	2.641	0.000	1.565	4.115	11.097	-2.226
10/30/2003	-14.178	0.000	3.292	0.000	1.560	0.000	7.074	8.664
10/31/2003	-12.912	0.000	4.247	0.000	1.569	0.000	9.072	5.409
11/1/2003	-9.101	0.000	2.661	0.000	1.537	6.172	8.586	8.224
11/2/2003	-4.551	0.000	4.932	0.000	1.514	9.601	8.586	7.080
11/3/2003	46.990	95.467	3.533	37.358	1.516	18.517	9.072	22.080
11/4/2003	75.453	156.670	3.885	104.598	1.350	7.544	3.024	-17.511
11/5/2003	19.754	118.240	4.427	175.997	1.648	4.115	4.050	-75.798
11/6/2003	31.564	413.694	4.125	391.223	1.734	60.351	5.049	47.943
11/7/2003	135.695	327.299	4.723	298.827	1.688	0.000	7.074	-112.609
11/8/2003	-41.837	24.337	3.737	121.654	2.026	0.000	6.561	-60.015
11/9/2003	-121.799	217.531	2.974	300.249	1.938	0.000	6.561	34.458
11/10/2003	-88.863	161.483	5.358	267.642	2.113	1.372	8.586	-22.397
11/11/2003	-7.905	159.589	2.729	92.330	2.079	0.000	10.098	67.145
11/12/2003	64.829	48.618	2.782	8.676	2.090	0.000	7.560	-30.357
11/13/2003	15.080	23.559	4.402	0.000	2.068	0.000	10.611	-0.064
11/14/2003	-3.562	24.168	3.688	1.125	1.994	0.000	9.585	19.014
11/15/2003	-5.060	21.428	2.959	0.000	2.027	0.000	8.586	19.929
11/16/2003	-5.577	22.333	3.878	0.000	1.999	0.000	6.561	23.348

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Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
11/17/2003	-7.708	21.325	4.296	0.000	1.991	0.000	6.048	24.976
11/18/2003	-5.963	21.580	3.167	0.000	1.991	2.057	9.585	22.006
11/19/2003	-0.015	21.773	5.024	0.000	1.985	6.858	3.024	27.607
11/20/2003	2.137	22.142	2.793	0.947	1.829	0.000	9.585	11.302
11/21/2003	-15.354	20.740	4.681	0.340	1.833	0.000	7.074	30.513
11/22/2003	-8.400	14.460	3.476	0.000	1.849	0.000	7.074	17.635
11/23/2003	-5.160	20.628	2.690	0.000	1.854	0.000	6.561	21.081
11/24/2003	-7.118	6.704	4.981	0.000	1.842	0.000	8.073	7.591
11/25/2003	-6.638	0.000	3.083	0.000	1.822	0.000	5.049	3.411
11/26/2003	-6.156	0.000	2.754	0.000	1.804	0.000	6.561	1.399
11/27/2003	-5.801	0.000	5.421	0.000	1.790	0.000	7.074	0.517
11/28/2003	-9.101	0.000	2.717	0.000	1.783	0.000	7.560	3.324
11/29/2003	-14.052	0.000	2.699	0.000	1.592	0.000	8.586	7.058
11/30/2003	-16.850	0.000	4.218	0.000	1.647	0.000	6.048	12.449
12/1/2003	-6.963	0.000	3.491	5.114	1.639	0.000	7.560	-4.072
12/2/2003	-5.897	0.000	2.964	0.000	1.590	0.000	8.073	-0.586
12/3/2003	-7.025	0.000	5.254	0.000	1.639	0.000	7.560	1.104
12/4/2003	-6.924	0.000	2.586	0.000	1.703	3.429	6.561	5.495
12/5/2003	9.766	0.000	3.495	0.000	1.648	52.807	4.050	40.639
12/6/2003	30.871	0.000	4.383	0.000	1.574	0.686	5.049	-33.660
12/7/2003	-13.730	0.000	2.791	0.000	1.573	0.000	8.586	6.717
12/8/2003	-8.277	0.000	5.326	0.000	1.598	0.000	6.561	3.314
12/9/2003	-4.573	0.000	2.853	0.000	1.626	0.000	7.074	-0.875
12/10/2003	0.156	0.000	3.773	5.471	1.672	4.801	3.024	-2.178
12/11/2003	3.447	44.520	4.172	0.000	1.526	0.000	8.586	34.013
12/12/2003	24.976	22.270	3.158	0.000	1.559	0.000	7.560	-8.707
12/13/2003	5.769	13.029	5.187	0.000	1.621	0.000	7.560	1.321
12/14/2003	34.102	25.052	4.342	8.191	1.669	68.580	0.999	52.009
12/15/2003	225.896	476.152	3.449	339.760	1.205	0.000	9.072	-97.371
12/16/2003	-194.513	51.745	4.870	340.609	1.991	6.172	4.536	-90.724
12/17/2003	-97.905	163.509	3.277	125.040	1.951	5.486	3.024	140.787
12/18/2003	38.461	183.070	3.130	119.229	1.875	0.000	9.072	18.183
12/19/2003	71.327	127.063	5.799	95.518	1.835	0.000	8.073	-46.020
12/20/2003	19.792	15.903	2.725	0.000	1.795	0.000	9.072	-11.166
12/21/2003	-5.378	19.023	5.974	0.000	1.751	0.000	6.048	20.104
12/22/2003	-5.979	19.463	2.478	0.000	1.777	0.000	5.049	22.170
12/23/2003	0.871	0.825	4.860	0.000	1.811	2.743	7.074	-2.566
12/24/2003	0.775	13.261	3.347	0.000	1.792	0.000	7.074	7.204
12/25/2003	-0.700	24.861	5.845	0.000	1.722	0.000	6.561	20.722
12/26/2003	-3.495	24.533	3.020	0.000	1.689	0.000	7.074	22.643
12/27/2003	-3.408	21.235	5.597	0.000	1.685	0.000	7.560	18.768
12/28/2003	-6.944	21.276	2.783	0.000	1.707	0.000	7.560	22.367
12/29/2003	-6.045	24.724	5.628	0.000	1.742	0.000	7.074	25.437
12/30/2003	-5.147	24.046	2.766	0.000	1.701	0.000	8.073	22.821
12/31/2003	-3.390	22.612	3.841	5.811	1.650	0.000	7.560	14.281
1/1/2004	-3.154	24.034	4.442	0.000	1.630	0.000	8.586	20.232
1/2/2004	-6.099	11.634	4.238	0.000	1.628	0.000	7.074	12.287
1/3/2004	-3.550	0.000	4.079	0.000	1.617	0.000	6.048	-0.881
1/4/2004	-6.302	0.000	2.745	0.000	1.624	0.000	7.074	0.852
1/5/2004	-6.772	0.000	5.520	0.000	1.602	0.000	6.561	1.813

“ 1 ha-m = 8.1068 ac-ft”

Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
1/6/2004	-4.990	0.000	2.722	0.000	1.542	0.000	8.586	-2.054
1/7/2004	-5.376	0.000	5.359	0.076	1.433	0.000	3.537	3.196
1/8/2004	-14.634	0.000	2.556	3.807	1.514	0.000	8.073	4.268
1/9/2004	-11.520	0.000	2.575	0.000	1.535	0.000	8.586	4.469
1/10/2004	-4.325	0.000	2.744	0.000	1.430	0.000	3.024	2.731
1/11/2004	-9.518	0.000	2.442	0.000	1.343	0.000	9.072	1.789
1/12/2004	-13.400	0.000	2.850	0.000	1.450	0.000	5.562	9.288
1/13/2004	-11.179	0.000	3.256	21.279	1.462	0.000	10.611	-19.249
1/14/2004	-44.860	0.000	4.198	51.503	1.472	0.000	10.611	-15.782
1/15/2004	-58.199	0.000	2.547	42.518	1.454	0.000	10.098	7.037
1/16/2004	-27.073	0.000	2.477	15.436	1.461	0.000	11.097	2.001
1/17/2004	-1.667	0.000	2.475	0.000	1.490	0.000	7.074	-3.917
1/18/2004	15.223	0.000	2.967	0.000	1.519	32.918	4.050	15.164
1/19/2004	20.093	0.000	2.633	0.000	1.487	0.000	6.048	-24.654
1/20/2004	-2.599	0.000	2.950	3.621	1.424	0.000	9.585	-9.183
1/21/2004	-12.386	0.000	3.554	12.642	1.453	2.057	6.048	-2.794
1/22/2004	-13.720	0.203	3.207	9.107	1.440	0.000	9.072	-2.816
1/23/2004	-33.071	0.000	2.341	25.768	1.420	0.000	10.098	-1.375
1/24/2004	-31.929	0.000	2.415	25.761	1.458	0.000	10.611	-2.985
1/25/2004	-32.272	0.000	2.249	25.759	1.522	0.000	9.585	-1.550
1/26/2004	-34.276	0.000	2.453	30.527	1.566	0.000	7.074	-1.759
1/27/2004	-27.046	0.000	2.591	20.288	1.548	11.659	4.536	15.429
1/28/2004	-24.104	0.000	2.438	25.773	1.466	0.000	10.098	-10.301
1/29/2004	-31.754	0.000	2.296	25.333	1.535	0.000	8.586	-0.630
1/30/2004	0.849	54.925	2.537	36.509	1.451	39.776	3.537	55.257
1/31/2004	118.700	372.007	5.730	165.645	1.300	43.205	0.999	131.168
2/1/2004	366.524	234.154	2.989	174.866	1.197	41.148	7.074	-271.965
2/2/2004	0.386	311.227	4.442	339.926	1.212	0.000	9.072	-36.945
2/3/2004	-149.379	133.640	3.829	323.482	1.454	0.000	10.098	-49.107
2/4/2004	-229.277	0.000	2.481	196.534	1.843	0.000	9.072	25.514
2/5/2004	-163.745	0.000	2.471	43.326	1.997	0.000	8.073	114.343
2/6/2004	-29.658	0.000	2.487	25.766	2.022	1.372	8.586	-1.300
2/7/2004	-16.272	0.000	2.774	19.356	1.870	0.000	6.561	-7.775
2/8/2004	-25.958	0.000	3.608	17.068	1.734	0.000	9.585	1.039
2/9/2004	-23.623	0.000	3.470	21.800	1.815	0.000	8.586	-4.948
2/10/2004	-30.840	0.000	2.499	18.874	1.797	0.000	9.585	4.178
2/11/2004	-23.474	0.000	2.400	8.160	1.774	0.000	6.561	10.527
2/12/2004	-19.036	0.000	2.539	7.494	1.777	0.000	10.098	3.221
2/13/2004	-5.409	18.453	2.540	15.639	1.672	23.317	8.073	25.139
2/14/2004	14.745	0.000	2.542	14.712	1.795	1.372	9.585	-35.875
2/15/2004	-6.011	0.000	4.785	0.000	1.703	11.659	4.050	15.323
2/16/2004	-8.171	0.000	2.514	0.000	1.636	0.000	11.097	-1.290
2/17/2004	-9.381	0.000	2.555	0.000	1.600	0.686	5.562	6.105
2/18/2004	-29.302	0.000	2.359	17.310	1.482	0.000	12.123	1.351
2/19/2004	-27.897	0.000	2.496	25.771	1.523	0.000	10.098	-6.449
2/20/2004	-19.670	0.000	3.165	5.500	1.521	0.000	4.536	11.155
2/21/2004	-6.712	0.000	3.400	0.000	1.509	0.000	9.072	-0.851
2/22/2004	19.815	110.208	3.323	0.000	1.179	0.000	11.097	80.475
2/23/2004	116.225	95.699	2.463	0.000	1.161	0.000	10.098	-29.463
2/24/2004	22.214	0.000	2.304	7.856	1.398	0.000	10.098	-38.770

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Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
2/25/2004	109.197	295.815	4.940	84.887	1.181	106.299	4.536	204.675
2/26/2004	371.161	465.539	6.333	319.529	1.042	17.145	11.097	-218.061
2/27/2004	195.131	490.343	2.665	506.822	0.842	0.000	6.048	-216.816
2/28/2004	-298.120	20.415	2.436	449.202	1.410	0.000	8.586	-137.843
2/29/2004	-322.387	96.247	2.388	166.570	1.348	0.000	7.560	245.852
3/1/2004	-8.583	187.472	3.593	144.723	1.187	0.000	8.775	43.744
3/2/2004	-14.589	169.048	3.716	176.210	1.211	0.000	10.611	-1.973
3/3/2004	-21.074	173.291	2.520	176.153	1.142	0.000	8.883	10.471
3/4/2004	-15.706	181.744	2.524	175.708	1.107	0.000	10.746	12.103
3/5/2004	-9.484	186.180	4.932	175.199	1.066	0.000	9.990	11.541
3/6/2004	-17.518	197.603	2.608	176.750	0.952	0.000	12.366	26.957
3/7/2004	14.076	200.872	2.609	176.848	0.872	0.000	10.746	0.074
3/8/2004	8.824	200.855	3.209	178.118	0.789	0.000	13.068	1.634
3/9/2004	8.420	197.667	4.578	178.353	0.757	0.000	9.828	1.823
3/10/2004	-0.110	189.806	2.385	178.688	0.695	0.000	13.230	-1.307
3/11/2004	-16.715	183.378	2.594	178.786	0.692	0.000	12.204	9.795
3/12/2004	-14.252	185.299	3.539	178.615	0.709	0.000	10.503	11.142
3/13/2004	-6.352	184.492	3.767	178.426	0.694	0.000	11.961	1.151
3/14/2004	-8.235	184.237	2.392	178.309	0.690	0.000	6.318	8.535
3/15/2004	-12.088	184.819	3.258	177.959	0.712	5.486	10.611	14.535
3/16/2004	-7.647	185.431	4.313	177.624	0.732	3.429	5.805	13.810
3/17/2004	9.098	131.431	2.532	126.535	0.745	0.000	11.043	-14.500
3/18/2004	44.598	0.000	2.535	0.000	0.955	0.000	14.391	-58.034
3/19/2004	-2.013	0.000	2.328	0.000	0.923	0.000	12.771	-9.835
3/20/2004	-9.325	0.000	2.399	0.000	0.933	0.000	13.122	-2.864
3/21/2004	-15.227	0.000	4.769	0.000	0.884	0.000	13.770	2.341
3/22/2004	-14.497	0.000	2.160	0.000	0.795	1.372	13.068	3.596
3/23/2004	-16.043	0.000	2.159	2.530	0.758	0.686	10.746	4.211
3/24/2004	-6.724	0.000	2.323	0.000	0.770	0.000	6.507	0.987
3/25/2004	-14.318	0.000	3.134	0.494	0.753	0.000	7.884	6.693
3/26/2004	-17.403	0.000	3.962	12.801	0.751	0.000	11.205	-5.852
3/27/2004	-30.155	0.000	2.194	14.756	0.729	0.000	12.609	3.519
3/28/2004	-29.635	0.000	2.486	11.981	0.684	0.686	14.121	4.903
3/29/2004	-24.171	0.000	4.669	13.990	0.627	0.000	5.805	5.003
3/30/2004	-24.989	0.000	2.939	14.005	0.636	0.000	10.638	0.982
3/31/2004	-26.728	0.000	2.614	7.634	0.614	0.000	12.204	7.504
4/1/2004	-21.391	0.000	4.433	0.000	0.532	0.000	14.283	7.640
4/2/2004	-22.699	0.000	2.790	0.000	0.504	0.000	15.147	8.056
4/3/2004	-20.502	0.000	2.474	0.000	0.483	0.000	15.498	5.487
4/4/2004	-18.055	0.000	4.444	0.000	0.456	0.000	14.688	3.823
4/5/2004	-15.975	0.000	2.756	0.000	0.423	0.000	15.228	1.170
4/6/2004	-11.723	0.000	2.556	0.000	0.422	0.000	11.610	0.535
4/7/2004	-12.906	0.000	3.112	0.000	0.404	0.000	12.258	1.052
4/8/2004	-17.179	0.000	4.148	0.000	0.358	0.000	13.824	3.713
4/9/2004	-9.404	0.000	3.075	0.000	0.319	0.000	9.045	0.678
4/10/2004	-10.021	0.000	2.579	0.000	0.353	0.000	9.801	0.573
4/11/2004	-10.993	0.000	3.866	0.000	0.403	17.145	12.528	16.013
4/12/2004	140.521	217.319	3.892	0.000	0.321	46.634	3.834	119.919
4/13/2004	187.559	76.652	4.607	0.000	0.393	14.402	5.967	-102.079
4/14/2004	61.907	0.000	2.384	0.000	0.337	0.000	14.472	-76.042

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Date	Change in storage	Inflow Spillway G302	Seepage Pump G250S	Outflow Pump G251/G31	Seepage L7a	Rain	ET	Remainders
	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m	ha-m
4/15/2004	40.152	90.265	2.447	12.735	0.308	0.000	16.308	21.378
4/16/2004	34.365	0.000	4.805	9.704	0.325	0.000	11.853	-55.597
4/17/2004	-11.677	0.000	2.123	13.780	0.315	0.000	11.664	-13.452
4/18/2004	-21.475	0.000	3.814	5.214	0.298	0.000	12.555	4.004
4/19/2004	-20.586	0.000	2.194	3.095	0.279	0.000	13.770	4.000
4/20/2004	-24.032	0.000	4.849	0.000	0.261	0.000	14.445	9.848
4/21/2004	-16.719	0.000	2.271	0.000	0.254	0.000	10.044	6.929
4/22/2004	-18.446	0.000	2.443	19.101	0.228	0.000	11.205	-11.632
4/23/2004	-17.834	0.000	2.562	0.000	0.197	0.000	12.717	5.314
4/24/2004	-20.469	0.000	2.274	0.000	0.184	0.000	12.123	8.530
4/25/2004	-22.750	0.000	2.421	0.000	0.157	0.000	12.879	10.028
4/26/2004	-25.115	0.000	4.270	31.650	0.139	3.429	9.936	-12.903
4/27/2004	-21.467	0.000	3.008	0.000	0.093	1.372	8.073	14.859
4/28/2004	-19.574	0.000	2.193	8.333	0.070	8.230	8.127	11.414
4/29/2004	-19.406	0.000	2.223	0.000	0.083	4.801	9.396	14.894
4/30/2004	5.022	0.000	4.352	0.000	0.083	0.000	12.366	-17.305

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