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M E M O R A N D U M

TO: John Mitnik, Chief, Acting Assistant Director, Executive Office Staff

FROM: SFWMD Staff Environmental Advisory Team

DATE: June 14, 2019

SUBJECT: Weekly Environmental Conditions for Systems Operations

Summary from June 11, 2019 Meeting

Weather Conditions and Forecast

An unusually deep trough of low pressure moving through the eastern United States is expected to greatly enhance District rainfall today, possibly producing a wide coverage of heavy rains. Moisture levels increasing, enhanced instability, and very strong dynamical forcing associated with the trough should help to trigger numerous showers and thunderstorms by the middle or late afternoon into the evening, with a maximum of activity over the central interior to the east coast as a result of a deep-layered southwesterly steering flow. While the quicker northeasterly movement of rain areas would normally limit local maxima, the possible training of thunderstorms – repeated movement or reformation of rains over the same areas – could help to produce excessive rainfall in some locales. The very favorable upper-level forcing could also cause a few thunderstorms to become severe and produce high winds and/or hail. Overall, the model guidance today indicates a good chance of observing a half of an inch or total District rainfall, with the likely range from a little more than a third to about three quarters of an inch (i.e., above or even well above the climatological daily average of 0.28).

Kissimmee

Tuesday morning stages were 55.0 feet NGVD (1.5 feet below schedule) in East Lake Toho, 52.1 feet NGVD (1.4 feet below schedule) in Toho, and 49.0 feet NGVD (2.0 feet below schedule) in Kissimmee-Cypress-Hatchineha; headwater stages were 46.2 feet NGVD at S-65A and 25.9 feet NGVD at S-65D. Tuesday morning discharges were 256 cfs at S-65, 219 cfs at S-65A, 231 cfs at S-65D and 0 cfs at S-65E. Dissolved oxygen concentration in the Kissimmee River averaged 4.8 mg/L for the week. Kissimmee River mean floodplain depth on Sunday was 0.06 feet. Recommendations this week (6/1/2019): Begin implementation of the 2019 Wet Season Discharge Plan for S-65/S-65A. The purpose is to provide variable flow from S-65/S-65A to balance Kissimmee River and Headwaters Lakes objectives, including Kissimmee River floodplain inundation, moderate rates of change in discharge, and controlled rate of stage rise in the lakes.

Lake Okeechobee

Lake Okeechobee stage is 10.99 feet NGVD, increasing 0.17 feet from the previous week but remaining 0.30 ft lower than the previous month, and 3.19 ft below the stage one year ago. The Lake dropped into the Beneficial Use sub-band on March 7, 2019 and has been staying roughly parallel with the Water Shortage sub-band, currently 0.28 feet above. The lake remains below the bottom of the ecological envelope (currently 1.01 feet below), which varies seasonally from 12.5 – 15.5 feet NGVD (+/- 0.5 ft). With the onset of the wet season, lake stage ascension rates will become important in the recovery of SAV and EAV (Submerged and Emergent Aquatic Vegetation) in the nearshore zone; high ascension rates will stress newly established plants and could dramatically reduce the beneficial effects of low lake stages experienced throughout the dry season. The latest satellite image estimating cyanobacteria bloom potential on the lake was June 3 and suggests there is a medium-to medium-high bloom risk in the north and northeast portions of the lake, respectively.

Estuaries

Total inflow to the St. Lucie Estuary averaged 627 cfs over the past week with no flow coming from Lake Okeechobee. Over the past week, seven-day average salinities changed little, but daily salinity started to decrease in the end of the period. The seven-day average salinity at the US1 Bridge is within the good range for adult eastern oysters. Total inflow to the Caloosahatchee Estuary average 838 cfs over the past week with only 26 cfs coming from the Lake. Over the past week, salinity decreased slightly in the estuary. The 30-day moving average surface salinity is 2.2 at Val I-75 and 7.6 at Ft. Myers. Salinity conditions between Val I-75 and Ft. Myers are good for tape grass. Salinity conditions are in the good range for adult eastern at Cape Coral and in the fair range at Shell Point and Sanibel.

Stormwater Treatment Areas

Over the past week, approximately 1,300 acre-feet of Lake water was delivered to the STAs. The total amount of Lake releases sent to the STAs/FEBs in WY2020 (since May 1, 2019) is approximately 7,000 acre-feet. The total amount of inflows to the STAs in WY2020 is approximately 88,000 acre-feet. Most STA cells are at or above target depths. STA-1W Northern Flow-way is offline for STA-1W Expansion project construction activities, STA-1E Western Flow-way is offline for levee repairs in the West Distribution Cell, and STA-5/6 Flow-ways 2 and 3 are offline for the Restoration Strategies project to grade non-effective treatment areas. Operational restrictions are in place in STA-5/6 Flow-ways 1 and 4 to facilitate the Restoration Strategies grading project in Flow-ways 2 and 3. The nest of an Endangered Species Act (ESA) protected species has been observed in STA-1E and the nests of Migratory Bird Treaty Act (MBTA) protected species have been observed in STA-2 and STA-3/4. It is recommended that no Lake regulatory releases be sent to the STAs this week.

Everglades

Seasonal rains brought the wet season home to the Everglades last week, with stages rising in all the WCAs. Ecological areas of concern remain the foraging conditions in WCA-1A, WCA-2A and WCA-3A South and peat soils / fire risk in northern WCA-3A. Water depths in Taylor Slough and the ENP panhandle increased on average this week. Florida Bay salinities near the shoreline remained elevated this week, and there has been a steady climb in nearshore salinities over the past months and the mangrove zone (Florida Bay MFL) increased on average last week. These trends are making an exceedance of the MFL more likely until wet season water volumes return. Wading bird foraging in western WCA-2A remains diminished this week, conditions look good in the region to the south of that previous foraging location however birds weren't noted there. Instead, wading birds are now (as of last week) foraging and initiating nesting in the Refuge. Conditions remain good for Cape Sable Seaside Sparrow nesting, sub pop "D" breeding/nesting success remains above average.

KISSIMMEE BASIN

Kissimmee Basin Rainfall

The Upper Kissimmee Basin received 1.83 inches of rainfall in the past week and the Lower Basin received 1.74 inches (SFWMD Daily Rainfall Report 6/10/2019).

Upper Kissimmee Basin

Stages and departures in the Kissimmee Chain of Lakes (KCOL) are shown in **Table 1**. KCOL stage hydrographs with respective regulation schedules and rainfall are shown in Figures 1-7.

Table 1. Average discharge (cfs) for the preceding seven days, one-day stage (feet NGVD), and departures from KCOL flood regulation (R) or temporary schedules (T, A, or S). Provisional, real-time data are from SFWMD.
Report Date: 6/11/2019

Water Body	Structure	7-day Average Discharge (cfs) ¹	Stage Monitoring Site ²	Lake Stage (feet)	Schedule Type ³	Schedule Stage (feet)	Daily Departure (feet)						
							6/9/19	6/2/19	5/26/19	5/19/19	5/12/19	5/5/19	4/28/19
Lakes Hart and Mary Jane	S-62	0	LKMJ	59.3	R	60.0	-0.7	-0.6	-0.1	-0.2	-0.2	0.0	-0.2
Lakes Myrtle, Preston, and Joel	S-57	0	S-57	59.7	R	61.0	-1.3	-1.2	-0.1	0.0	0.0	0.0	-0.1
Alligator Chain	S-60	0	ALLI	61.9	R	63.2	-1.3	-1.2	0.0	0.0	0.0	0.1	0.0
Lake Gentry	S-63	0	LKGT	59.4	R	61.0	-1.6	-1.5	0.0	0.0	0.0	0.1	0.0
East Lake Toho	S-59	0	TOHOE	54.9	R	56.5	-1.6	-1.5	-0.1	-0.3	-0.5	-0.4	-0.7
Lake Toho	S-61	0	TOHOW, S-61	52.1	R	53.5	-1.4	-1.5	-0.1	-0.3	-0.4	-0.5	-0.7
Lakes Kissimmee, Cypress, and Hatchineha	S-65	284	KUB011, LKISSB	48.9	R	51.0	-2.1	-2.0	-0.1	-0.1	-0.4	-0.5	-0.6

¹ Seven-day average of weighted daily means through midnight.

² Names of in-lake monitoring sites and structures used to determine lake stage; if more than one site is listed, an average is reported.

³ A = projected ascension line, R = USACE regulation schedule, S = temporary recession target line, T = temporary schedule, N/A= not applicable or data not available.
DATA ARE PROVISIONAL

Lower Kissimmee Basin

Discharges at Lower Basin structures are shown in Table 2. SFWDAT depth maps for the Phase I restoration area are shown in Figure 8. Kissimmee River floodplain stages at selected stations are shown in Figure 9.

Table 2. One-day and seven-day averages of discharge at S-65x structures, of dissolved oxygen concentration in the Phase I area river channel, and water depth in the Phase I area floodplain. Data are provisional real-time data from SFWMD.

Report Date: 6/11/2019

Metric	Location	1-Day Average	Average for the Preceding 7-Days ¹									
		6/9/2019	6/9/19	6/2/19	5/26/19	5/19/19	5/12/19	5/5/19	4/28/19	4/21/19	4/14/19	4/7/19
Discharge (cfs)	S-65	279	284	319	596	984	1,014	428	438	525	710	434
Discharge (cfs)	S-65A ²	217	215	244	456	815	823	314	314	400	559	334
Discharge (cfs)	S-65D ²	199	222	329	706	920	795	403	466	584	703	367
Headwater Stage (feet NGVD)	S-65D ²	25.72	25.78	25.79	25.80	25.82	25.78	25.81	25.76	25.78	25.77	25.73
Discharge (cfs)	S-65E ²	113	208	313	591	810	703	351	441	563	679	330
Discharge (cfs)	S-67	0	0	0	0	79	102	68	107	110	106	0
DO (mg/L) ³	Phase I river channel	5.3	4.8	5.4	6.1	5.1	5.4	6.7	6.7	6.7	6.3	6.9
Mean depth (feet) ⁴	Phase I floodplain	0.06	0.06	0.07	0.11	0.16	0.15	0.10	0.12	0.16	0.18	0.16

¹ Seven-day average of weighted daily means through Sunday midnight.

² S-65A discharge combines S-65A with auxiliary structures; S-65D discharge combines discharge at S-65D, S-65DX1, and S-65DX2; S-65D stage averages stage at S-65D and S-65DX1; S-65E discharge combines S-65E and S-65EX1.

³ DO is the average for sondes at PC62 and PC33.

⁴ 1-day spatial average from South Florida Water Depth Assessment Tool (SFWDAT).

DATA ARE PROVISIONAL; N/A indicates that data were not available.

KCOL Hydrographs (through Sunday midnight)

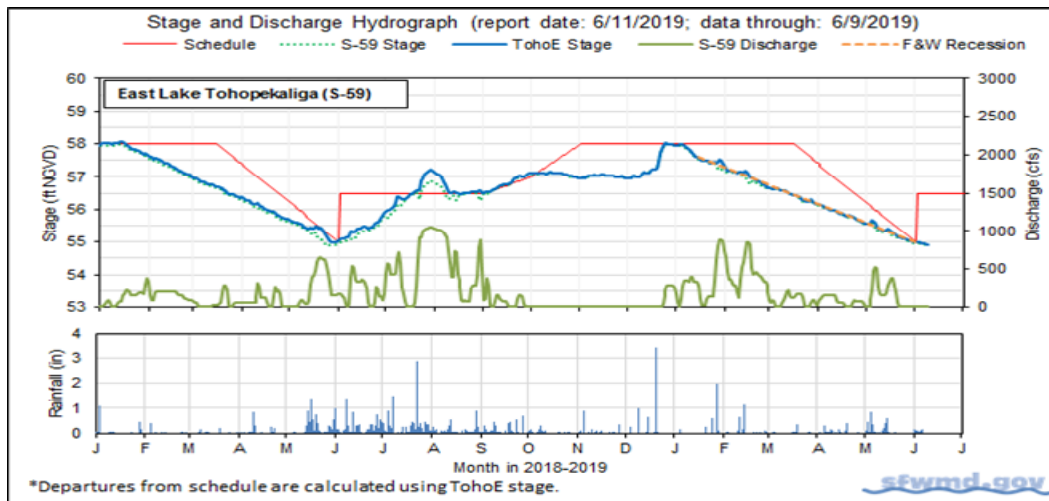


Figure 1.

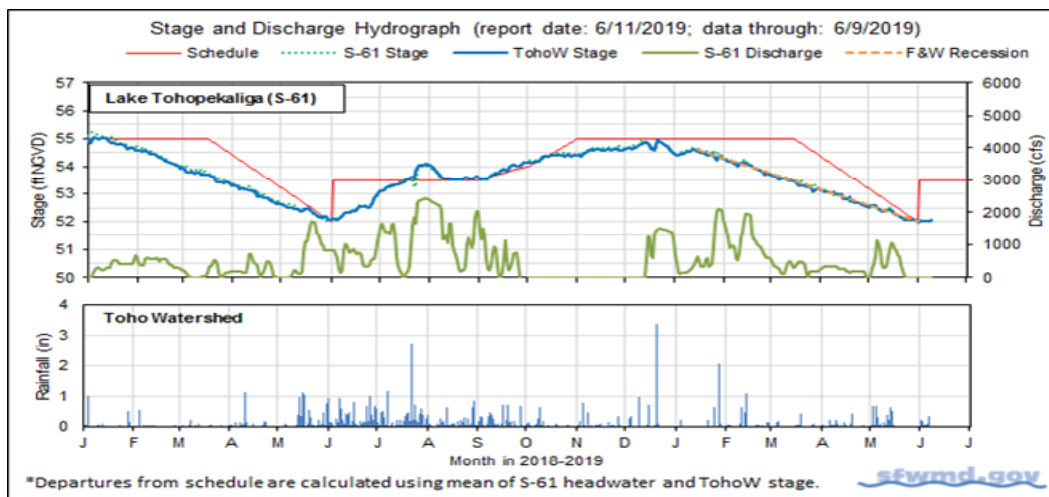


Figure 2.

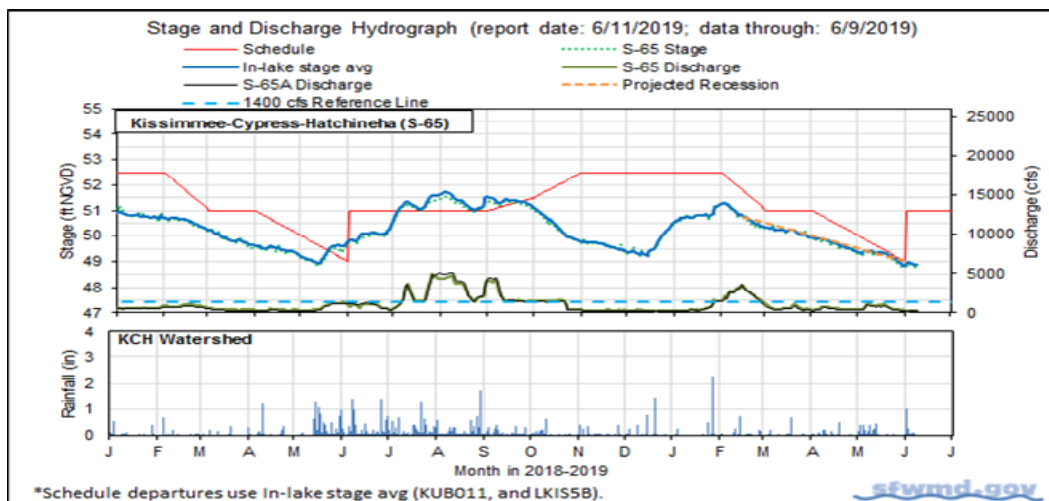


Figure 3.

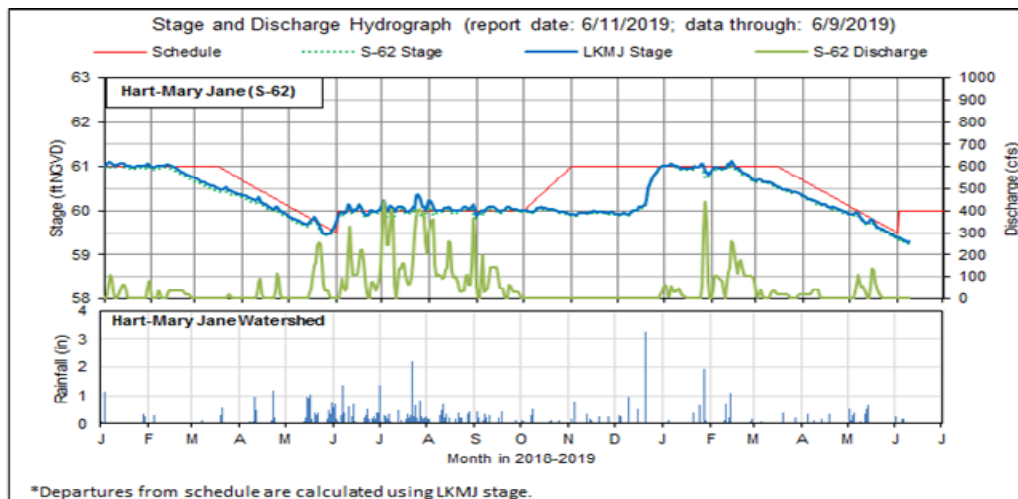


Figure 4.

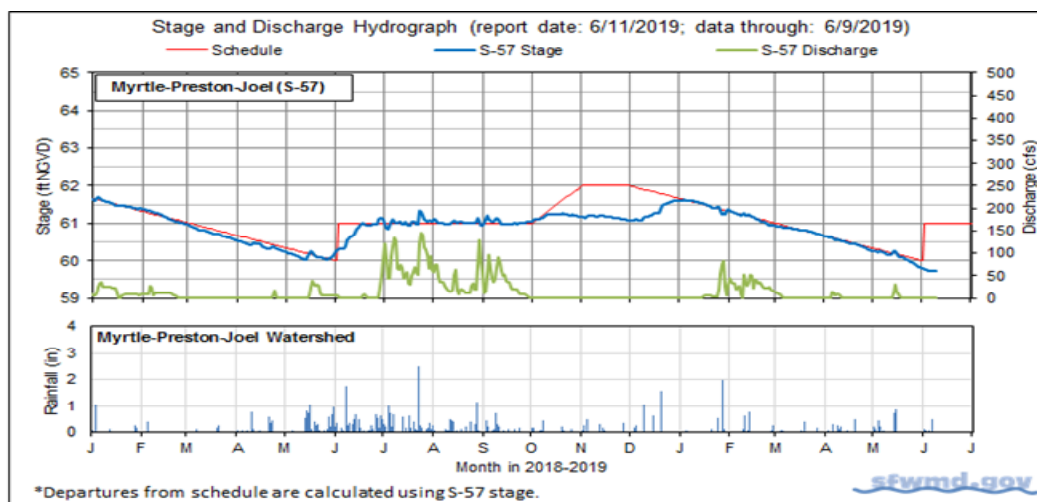


Figure 5.

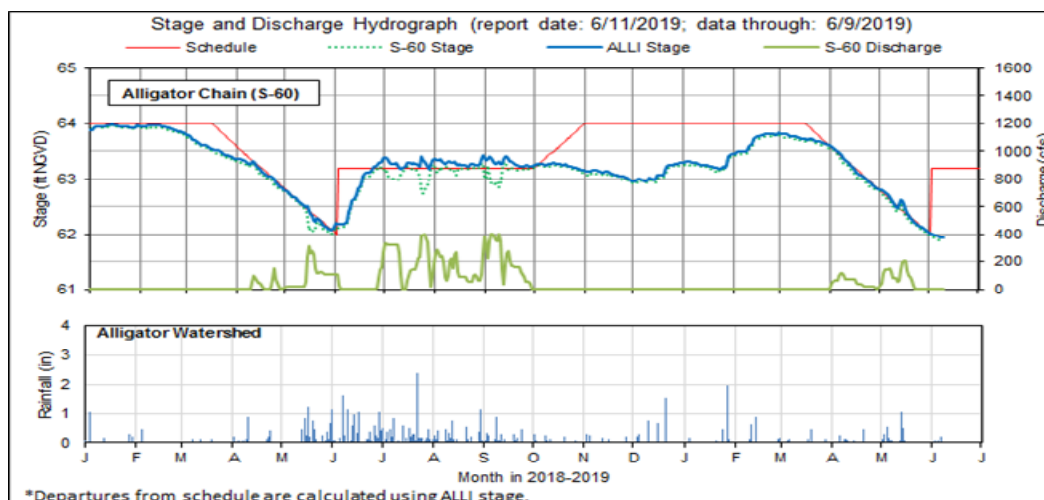


Figure 6.

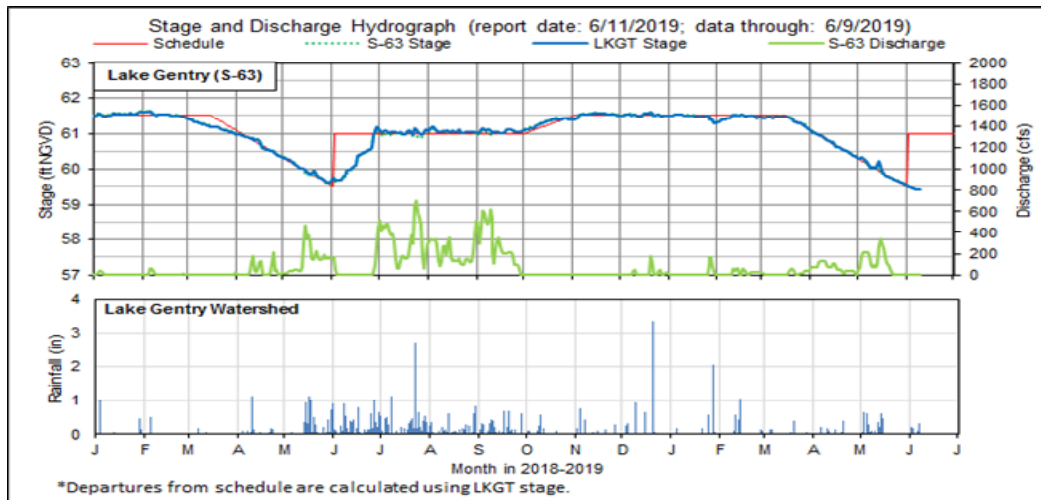


Figure 7.

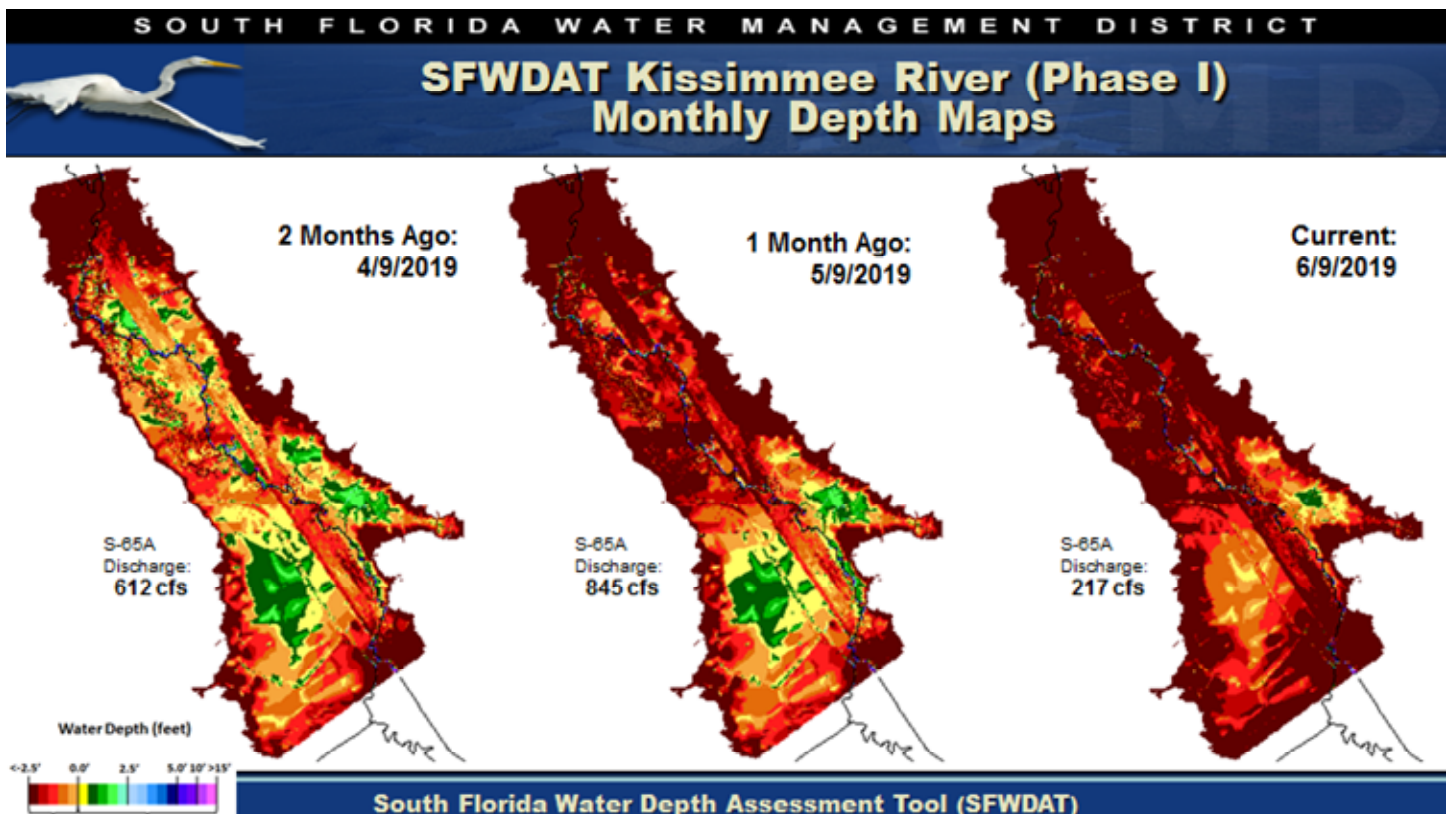


Figure 8. Phase I area floodplain water depths for this week, one month ago, and two months ago. Note that the WDAT color-coding has been modified to accommodate greater water depths; these maps are not directly comparable to Kissimmee Basin WDAT maps published prior to January 16, 2012.

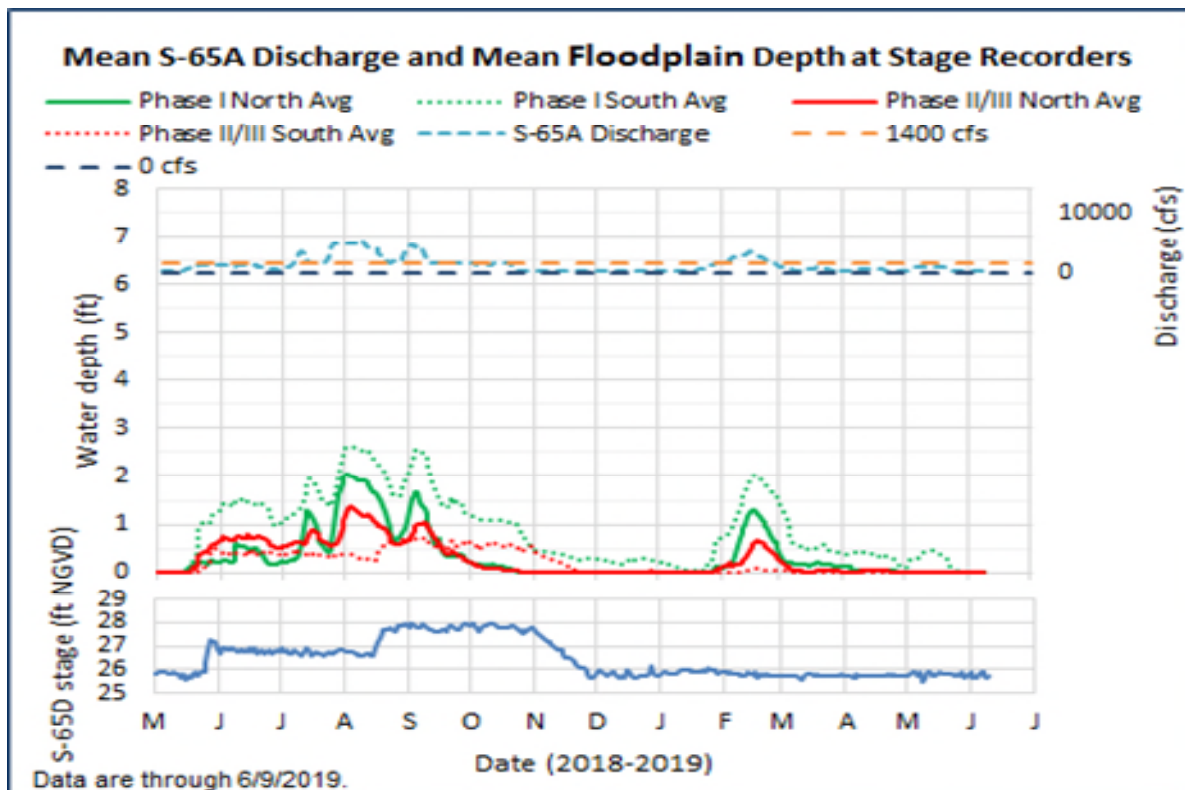
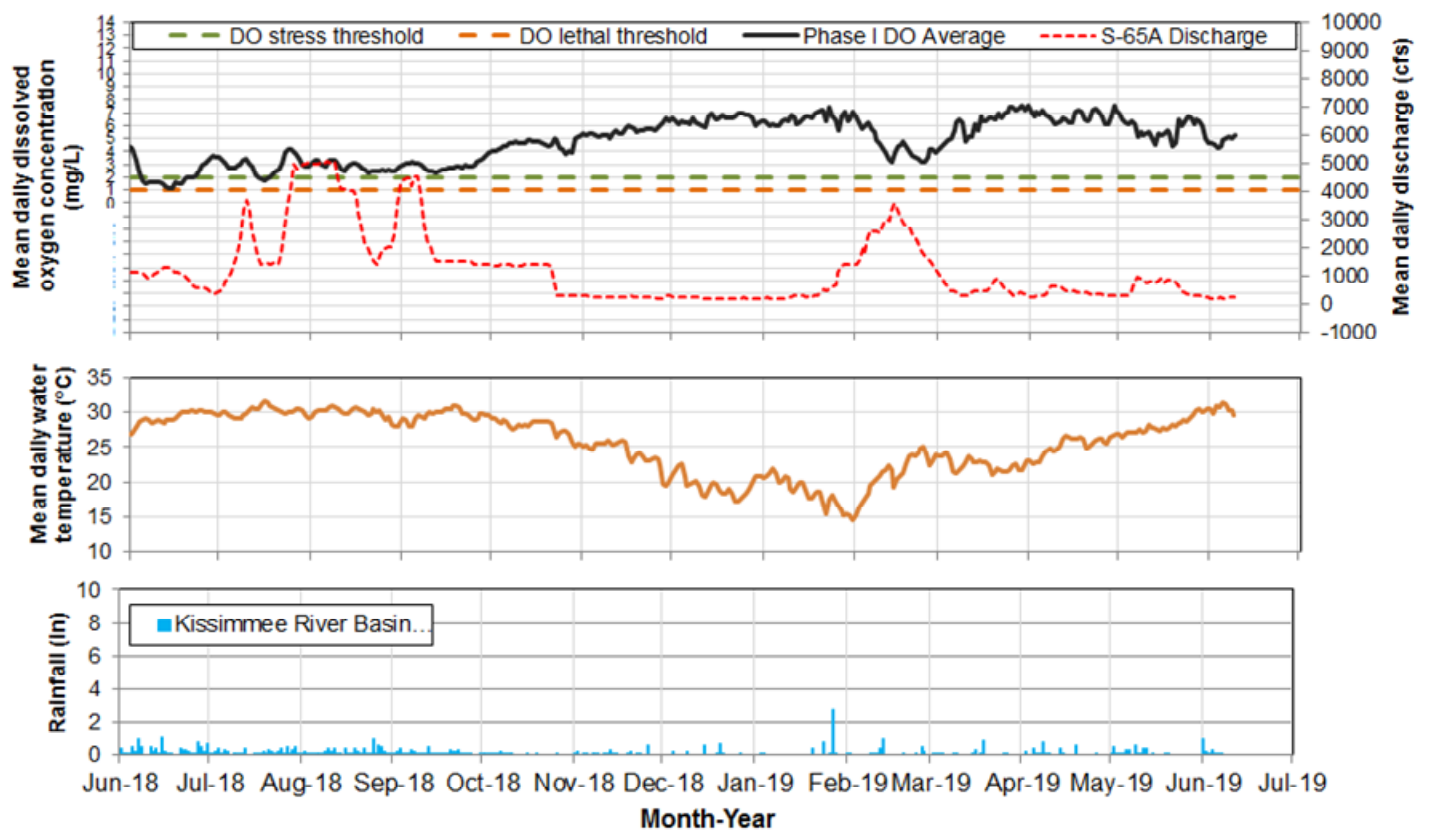


Figure 9. Mean water depth at stage recorders in the northern Phase I, southern Phase I, northern Phase II/III, and southern Phase II/III areas in relation to the S-65A discharge and S-65D headwater stage.



Report Date: 6/11/2019; data are through: 6/9/2019.

Figure 10. Mean daily dissolved oxygen, discharge, temperature and rainfall in the Phase I river channel.

Water Management Recommendations

Kissimmee Basin Adaptive Recommendations and Operational Actions

Recommendation Date	Recommendation	Purpose	Outcome	Source	Report Date
6/1/2019	Begin implementation of the 2019 Wet Season Discharge Plan for S-65/S-65A (see figure).	Provide variable flow from S-65/S-65A to balance Kissimmee River and Headwaters Lakes objectives, including Kissimmee River floodplain inundation, moderate rates of change in discharge, and controlled rate of stage rise in the lakes.	Planned	KB Ops	6/11/2019
5/31/2019	Reduce S-65 flow by 100 cfs over 2 days (5/31 and 6/1) to about 280 cfs.	Slow rate of stage decline in KCH while sustaining about 150 cfs at S-65A. (Note: Unexpected rainfall late on 6/1 allowed S-65A discharge to be returned to about 220 cfs on 6/2).	Implemented	KB Ops/SFWMD Water Management	6/4/2019
5/28/2019	No new recommendations.		N/A		5/28/2019
5/20/2019	No new recommendations.		N/A		5/21/2019
5/13/2019	No new recommendations.		N/A		5/14/2019
5/6/2019	Due to the rainfall, increase S65-A to 1000 cfs today in two increments and increase flow at S-65 accordingly. We will reassess the rise in KCH stage tomorrow 5/7.	Short-term goals: try to keep S65-A discharge at or below 1000 cfs for KR fish sampling this week and next, while keeping the reversal in KCH less than about 0.4 ft.	Implemented	KB Ops	5/7/2019
4/29/2019	No new recommendations.		N/A		4/30/2019
4/23/2019	No new recommendations.		N/A		4/23/2019
4/15/2019	No new recommendations.		N/A		4/16/2019
4/8/2019	No new recommendations.		N/A		4/9/2019
4/1/2019	No new recommendations.		N/A		4/2/2019
3/25/2019	No new recommendations.		N/A		3/26/2019
3/18/2019	No new recommendations.		N/A		3/19/2019
3/11/2019	No new recommendations.		N/A		3/12/2019
3/4/2019	No new recommendations.		N/A		3/5/2019
2/26/2019	No new recommendations.		N/A		2/26/2019
2/19/2019	No new recommendations.		N/A		2/19/2019
2/10/2019	Increase discharge at S-65 by 600 cfs.	To compensate for increased inflow and rain forecast for Tuesday.	Implemented	KB Ops/SFWMD Water Mgt	2/12/2019
2/4/2019	Increase discharge at S-65/S-65A to begin reducing KCH stage to reach 50.75 ft on 2/15/2019.	Reduce to the stage at which the seasonal recession will begin.	Implemented	KB Ops/SFWMD Water Mgt	2/5/2019
1/26/2019	Increase S65A discharge by a total of 350 cfs today, which will put S65A at 1,400 cfs. Continue to increase discharge as needed.	Moderate or stop the rise in Lake KCH preemptively before forecast rainfall and provide capacity at S65A for S65A basin runoff.	Implemented	SFWMD Water Mgt/KB Ops	1/29/2019
1/22/2019	No new recommendations.		N/A		1/22/2019
	Begin recessions on Lake Toho and East Lake Toho on Jan 15, with a continuous recession to the regulation dry season low (52.0 ft on Toho; 55.0 ft on East Lake) on May 31. The lines are represented graphically in the Dry Season Operations slides.				
1/15/2019	Tentatively plan on a recession in Kissimmee-Cypress-Hatchineha starting on February 15 with a continuous recession to the dry season low (49 ft) on May 31. A provisional diagram is included in the Dry Season Operations slides; however, starting stage may change depending on conditions.	Slow recession rates in East Toho, Toho, and KCH to benefit fish and wildlife; as possible limit flow volume at S-65D to facilitate KRR construction.	N/A	KB Ops	1/15/2019
	Discharge and reversal guidelines are provided in the Dry Season Operations slides.				
1/4/2019	Discontinue 54 foot stage reduction target in Lake Toho.	Lake Kissimmee has already risen by ~1.5 ft.	Implemented	SFWMD Water Mgt/KB Ops	1/8/2019
12/14/2018	Manage S-61 discharge to reduce stage in Lake Toho to 54 ft over the next 7-9 days.	Move water to KCH to reduce the rate of stage decline in KCH; reduce the head difference between S-61 headwater and tailwater.	N/A	SFWMD Water Mgt/KB Ops	12/18/2018
12/10/2018	Reduce S-65A discharge to 180 cfs.	Reduce rate of stage decline in lakes Kissimmee-Cypress-Hatchineha	N/A	SFWMD Water Mgt/KB Ops	12/11/2018
12/3/2018	No new recommendations.		N/A		12/4/2018
11/26/2018	No new recommendations.		N/A		11/27/2018
11/19/2018	No new recommendations.		N/A		11/20/2018
11/12/2018	No new recommendations.		N/A		11/13/2018
11/2/2018	Reduce S-65/S-65A discharge to approximately 250 cfs.	To conserve stage in Lake Kissimmee.	Implemented	SFWMD Water Mgt/KB Ops	11/6/2018
10/30/2018	No new recommendations.		N/A		10/30/2018

Stage and Discharge Guidance for Wet Season 2019.		
Zone	KCH Stage (ft NGVD)	S-65/S-65A Discharge*
A	Above regulation schedule line.	Flood control releases as needed with no limits on the rate of discharge change.
B1	In flood control buffer zone (0.5 ft below the schedule line).	Adjust S-65 discharge so that S-65A discharge is between 1400 cfs at the buffer zone line and 3000 cfs at the schedule line.
B2	Between the Flood Control Buffer and the 50.0 ft line.	Adjust S-65 discharge to maintain at least 1400 cfs at S-65A. Use ± 0.2 ft buffer (gray band) above and below the 50.0 ft line to decide when to begin ramping up to 1400 cfs or down to 300 cfs; do not continue reducing discharge if stage rises back to or above the threshold stage line.
B3	Between the 50.0 ft line and 49 ft.	Adjust S-65 discharge to maintain at least 300 cfs at S-65A.
B4	Between 48.5 ft to 49 ft.	Adjust S-65 discharge to maintain S-65A discharge between 0 cfs at 48.5 ft and 300 cfs at 49 ft.
C	Below 48.5 ft.	0 cfs.

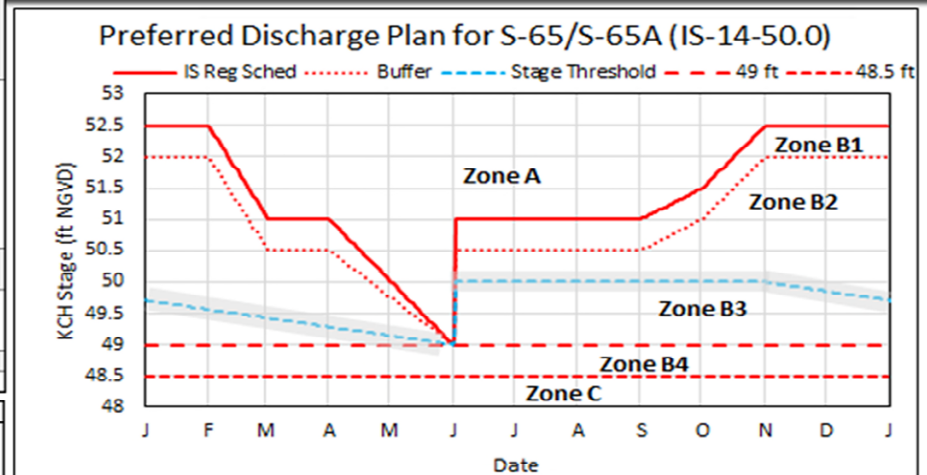
*Changes in discharge should not exceed limits in inset table below.

Discharge Rate of Change Limits for S65/S65A (revised 7/13/18).

Q (cfs)	Maximum rate of increase (cfs/day)	Maximum rate of decrease (cfs/day)
0-300	50	-50
301-650	75	-75
651-1400	150	-150
1401-3000	300	-600
>3000	1000	-2000

Revised 5/16/2019

Kissimmee Basin 2019 Wet Season



Other Considerations

- When possible, limit lake ascension rate in the Jun 1 - Aug 15 window to 0.5 ft per 14 days in Lakes Kissimmee, Cypress, Hatchineha (S-65), East Toho (S-59) and Toho (S-61).
- If outlook is for extreme dry conditions meet with KB staff to discuss modifications to this plan.

Figure 11. The 2019 Wet Season Discharge Plan for S-65/S-65A.

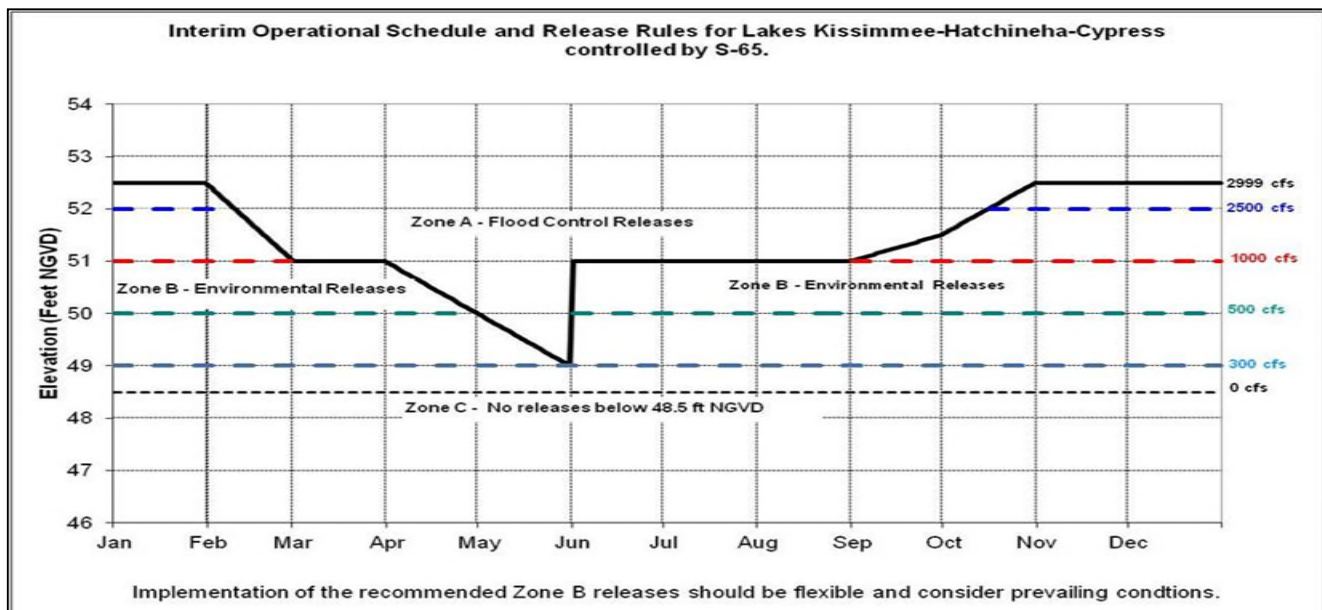


Figure 12. Interim operations schedule for S-65. The discharge schedule shown to the right has not been used in recent years.

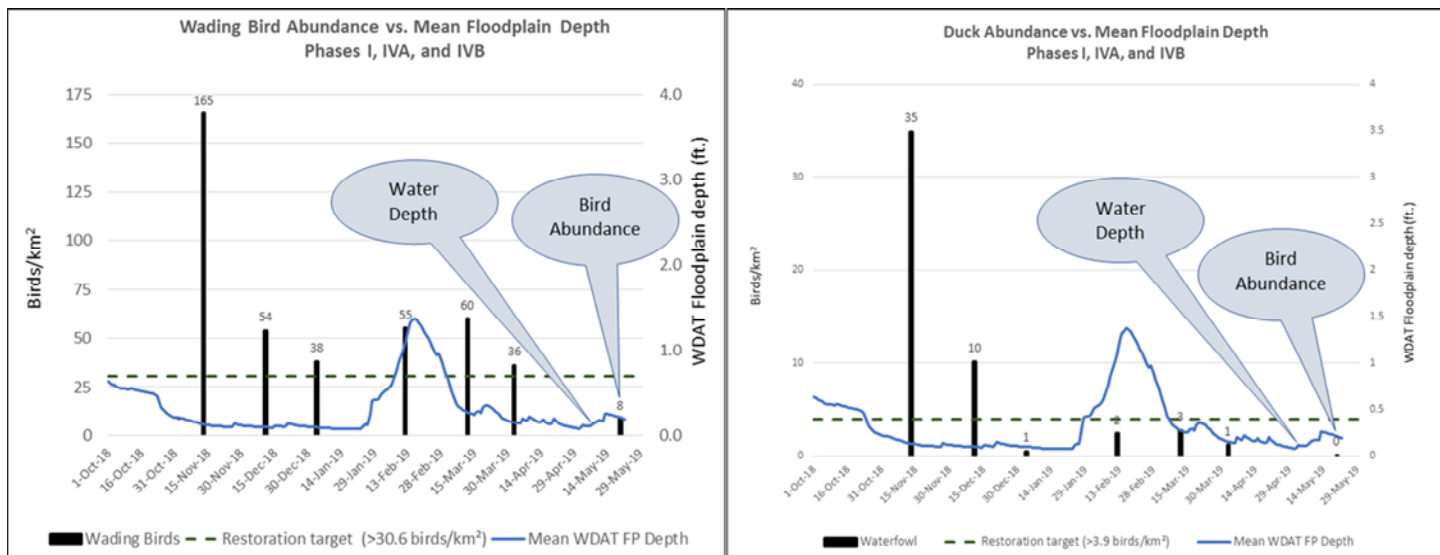


Figure 13. Kissimmee River Wading Bird and Waterfowl Surveys from November 2018 to May 2019.

Table 3. Upper Kissimmee Basin Snail Kite Survey Update
Survey 4: May 19-21 2019

WATERBODY	KITES	TOTAL NESTS	SUCCESSFUL	ACTIVE
East Toho	2	4	0	2
Toho	97	55	19	11
Kissimmee	225	55	7	30
KCOL Total	324	114	26	43

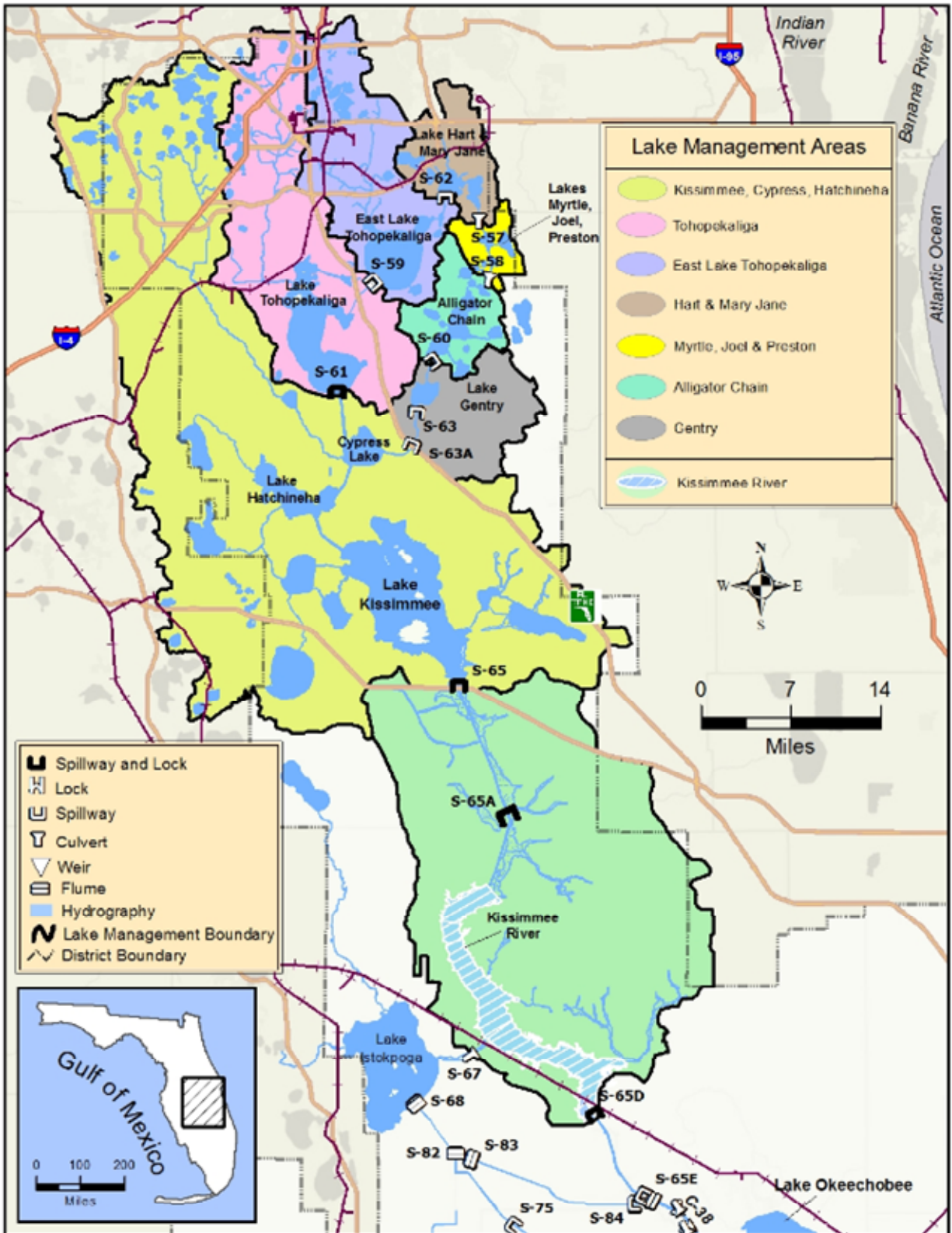


Figure 14. The Kissimmee Basin.

LAKE OKEECHOBEE

According to the USACE web site, Lake Okeechobee average daily lake stage is at 10.99 feet NGVD for June 11, 2019 increasing 0.17 feet from the previous week. This value is based on the use of four interior lake stations (L001, L005, L006 and LZ40) and three perimeter stations (S-308, S-4 and S-133). The Lake is now 0.3 feet lower than a month ago and 3.19 feet lower than a year ago when stages were roughly a foot higher than the top of the preferred ecological envelope (Figure 1). The Lake dropped into the Beneficial Use sub-band on March 7, 2019 and is currently 0.28 feet above the Water Shortage sub-band but running parallel to it over the past week or more (Figure 2). Lake stage is currently lower than in 2017, making the lowest levels for this time of year since 2011 (Figure 3). According to RAINДАР, during the week of June 04 to June 10, 2019, 2.5 inches of rain fell directly over the Lake, compared to 1.95 inches the previous week. Most of the watershed received similar amounts, between 1.5 – 2.5 inches (Figure 4).

Despite the rainfall over the lake and watershed, average daily inflows (minus rainfall) to the Lake decreased slightly from 291 cfs to 245 cfs. The inflows from the Kissimmee River decreased from 285 cfs to 225 cfs (Table 1).

Total outflows (minus evapotranspiration) decreased substantially from the previous week, going from 3,380 average daily cfs to 1,135 cfs this past week. (Table 1). Outflows south through the S-350s decreased from 2,848 cfs to 1,118 cfs. Outflows west via S-77 decreased from 553 cfs to just 17 cfs and there were several days of backflows as basin runoff flowed back into the lake through the structure. Outflows east via S-308 were zero again this week. The corrected average daily evapotranspiration value for the week based on the L006 and LZ40 weather platform solar radiation was down slightly this week, at 0.16 inches.

Total lake inflows and outflows for the past week are detailed in Table 1, as well as the approximate change in lake stage from each major structure's total flows over the period. Figure 5 shows the combined average daily cfs for inflows and outflows for the Lake over the past eight weeks. These data are provisional and are subject to change.

The most recent wading bird survey (June 6, 2019) reported approximately 4,500 foraging wading birds on the lake, roughly double the mid-May survey (Figure 6). Given the rains and subsequent increase in lake stage that occurred after the survey, numbers of foraging birds is likely to decrease by the next survey. Wading birds are still nesting on the lake this year but only at about 25% of the average numbers due to low water conditions.

The most recent satellite imagery (June 3, 2019) using NOAA's cyanobacteria monitoring product derived from EUMETSAT's Sentinel OLCI sensor data showed bloom potential dissipated slightly in the center of the lake but increased in northern portions of the Lake, with potentially high cyanobacterial densities along the northeast shoreline (Figure 7). Images from 2016-2019 at similar times of year show how variable bloom conditions can be from year to year, and they vary considerably from month to month, as well. Note that 2016 had high coverage of blooms due to El Nino conditions in the spring and subsequent high summer lake stages, while 2017 had stages very similar to present conditions and had lower bloom coverage. 2018 had high lake stages and extremely turbid water from Hurricane Irma, so blooms were suppressed until later in the summer, when they ultimately covered up to 90% of the lake.

Water Management Recommendations

Lake Okeechobee stage is 10.99 feet NGVD, increasing 0.17 feet from the previous week but remaining 0.30 ft lower than the previous month, and 3.19 ft below the stage one year ago. The Lake dropped into the Beneficial Use sub-band on March 7, 2019 and has been staying roughly parallel with the Water Shortage sub-band, currently 0.28 feet above. The lake remains below the bottom of the ecological envelope (currently 1.01 feet below), which varies seasonally from 12.5 – 15.5 feet NGVD (+/- 0.5 ft). With the onset of the wet season, lake stage ascension rates will become important in the recovery of SAV and EAV (Submerged and Emergent Aquatic Vegetation) in the nearshore zone; high ascension rates will stress newly established plants and could dramatically reduce the beneficial effects of low lake stages experienced throughout the dry season. The latest satellite image estimating cyanobacteria bloom potential on the lake was June 3 and suggests there is a medium-to medium-high bloom risk in the north and northeast portions of the lake, respectively.

Table 1. Average daily inflows and outflows and the approximate depth equivalents on Lake Okeechobee for various structures.

INFLOWS	Previous week Avg Daily CFS	Avg Daily Flow cfs	Equivalent Depth Week Total (in)	OUTFLOWS	Previous week Avg Daily CFS	Avg Daily Flow cfs	Equivalent Depth Week Total (in)
S-65E & S-65EX1	285	225	0.1	S-77	553	17	0.0
S-71 & S-72	0	0	0.0	S-308	-39	0	0.0
S-84 & S-84X	1	5	0.0	S-351	1151	618	0.3
Fisheating Creek	5	6	0.0	S-352	992	435	0.2
S-154	0	0	0.0	S-354	705	65	0.0
S-191	0	0	0.0	L-8 Outflow	17		
S-133 P	0	0	0.0	ET	2958	2217	1.1
S-127 P	0	0	0.0	Total	6338	3352	1.7
S-129 P	0	0	0.0				
S-131 P	0	0	0.0				
S-135 P	0	0	0.0				
S-2 P	0	0	0.0				
S-3 P	0	0	0.0				
S-4 P	0	0	0.0				
L-8 Backflow		9	0.0				
Rainfall	3924	5071	2.5				
Total	4215	5316	2.6				

Provisional Data

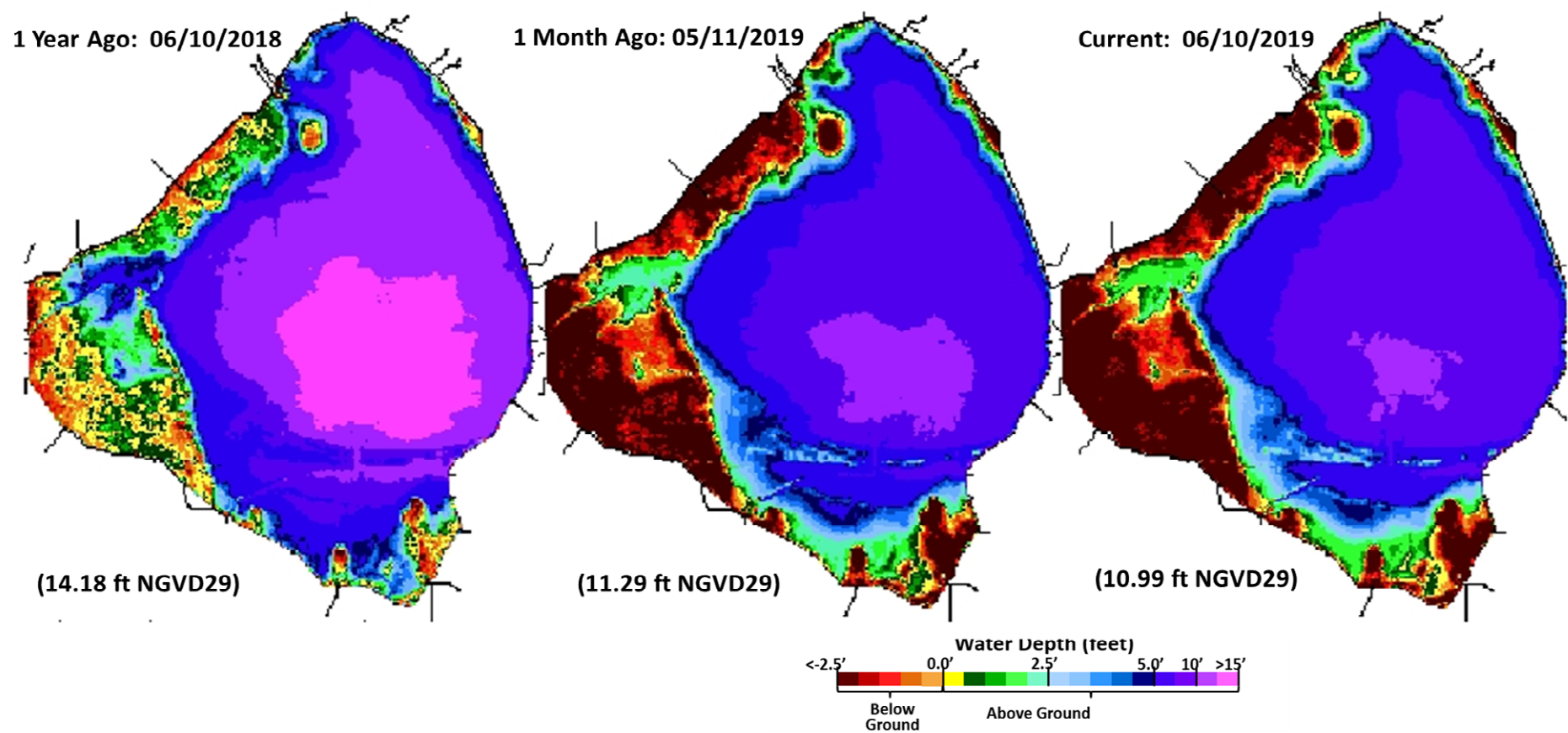
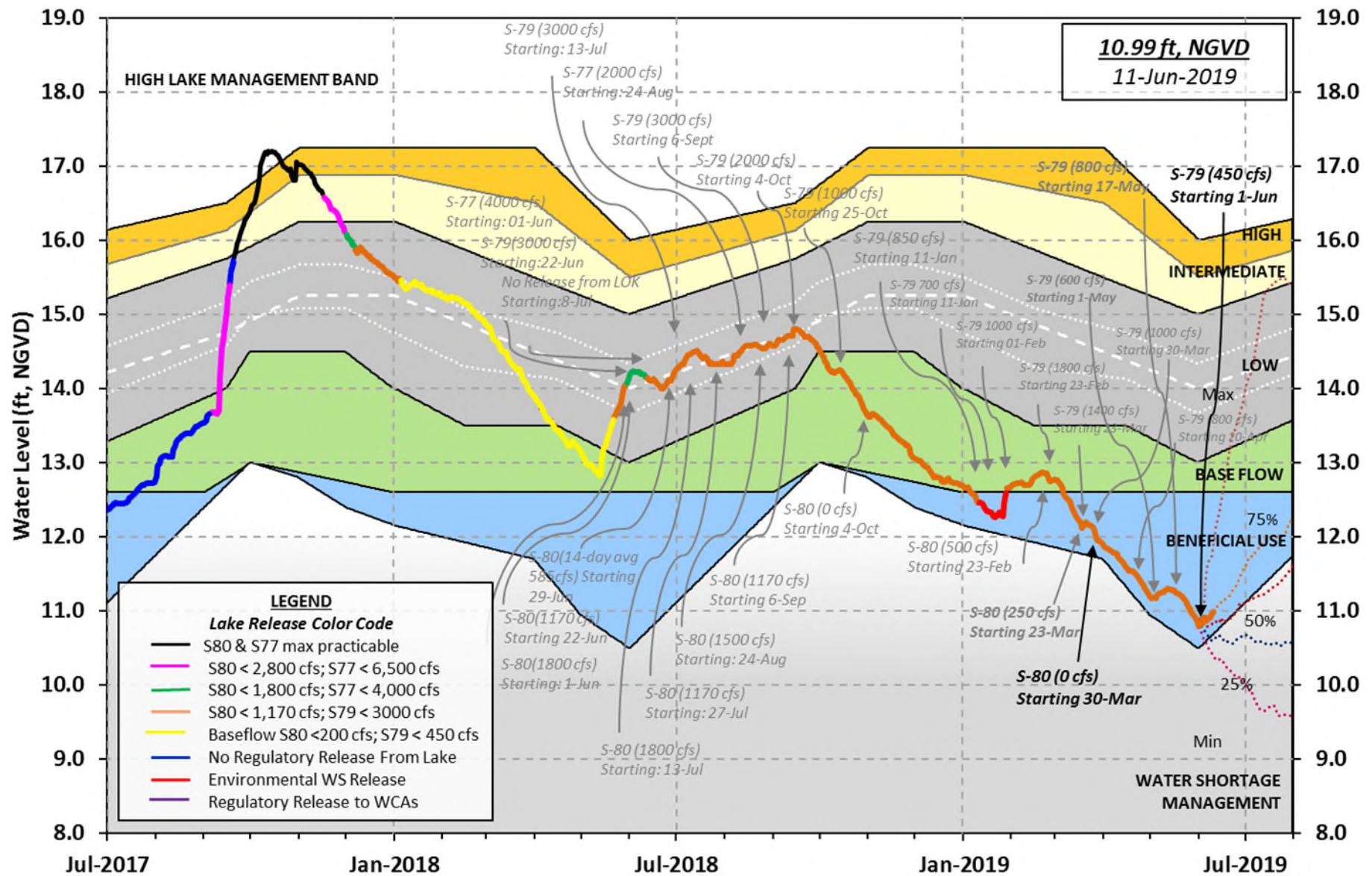


Figure 1. Water depth estimates on Lake Okeechobee based on the South Florida Water Depth Assessment Tool.

Lake Okeechobee Water Level History and Projected Stages



LORS-2008
Adopted by USACE 28-April-2008

Projected Stage Percentiles From SFWMD-HESM Position Analysis

Figure 2. Recent Lake Okeechobee stage and releases, with projected stages based on a dynamic position analysis.

Lake Okeechobee Water Level Comparison

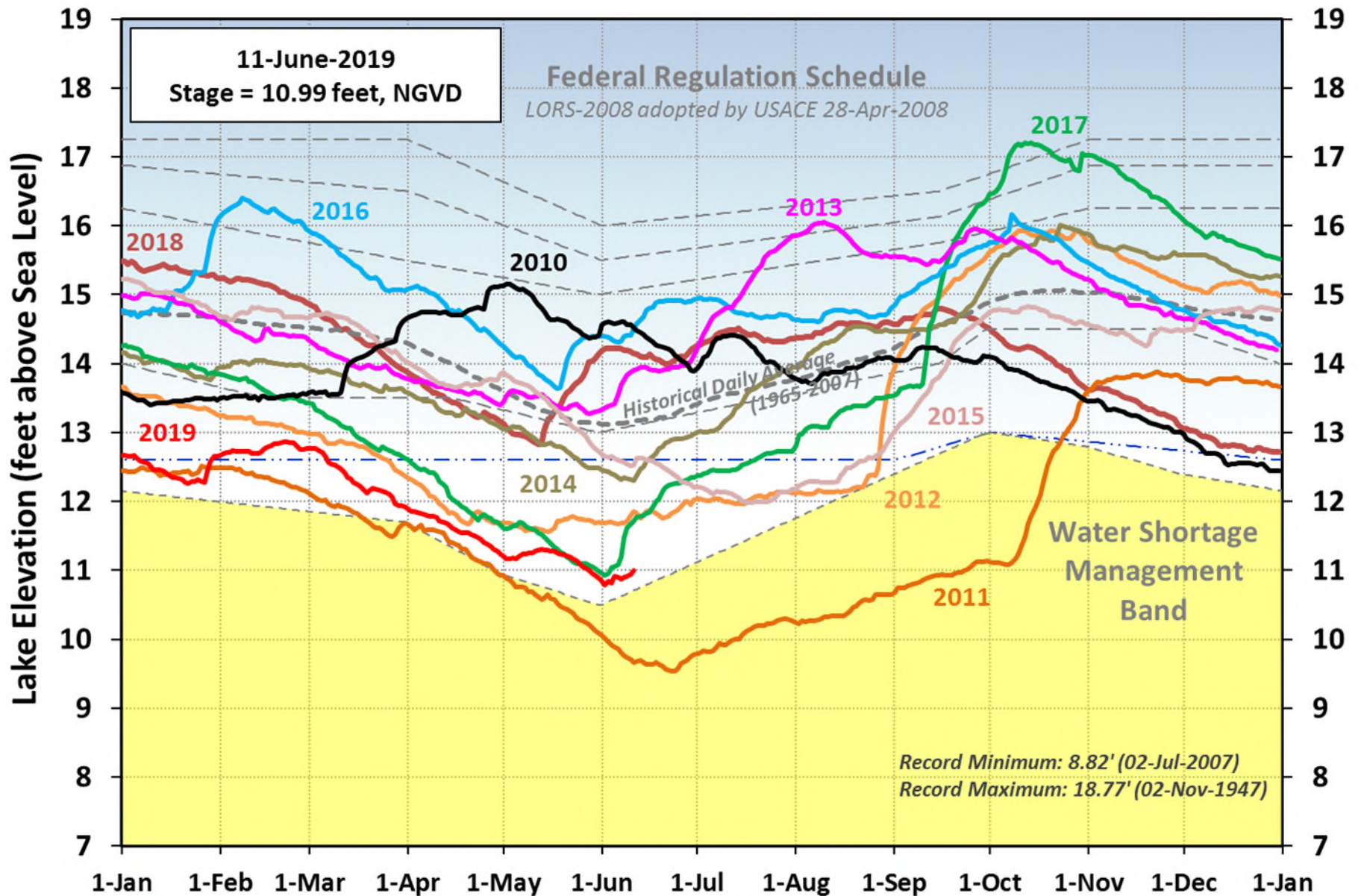


Figure 3. Select annual stage hydrographs for Lake Okeechobee from 2010 – 2019.

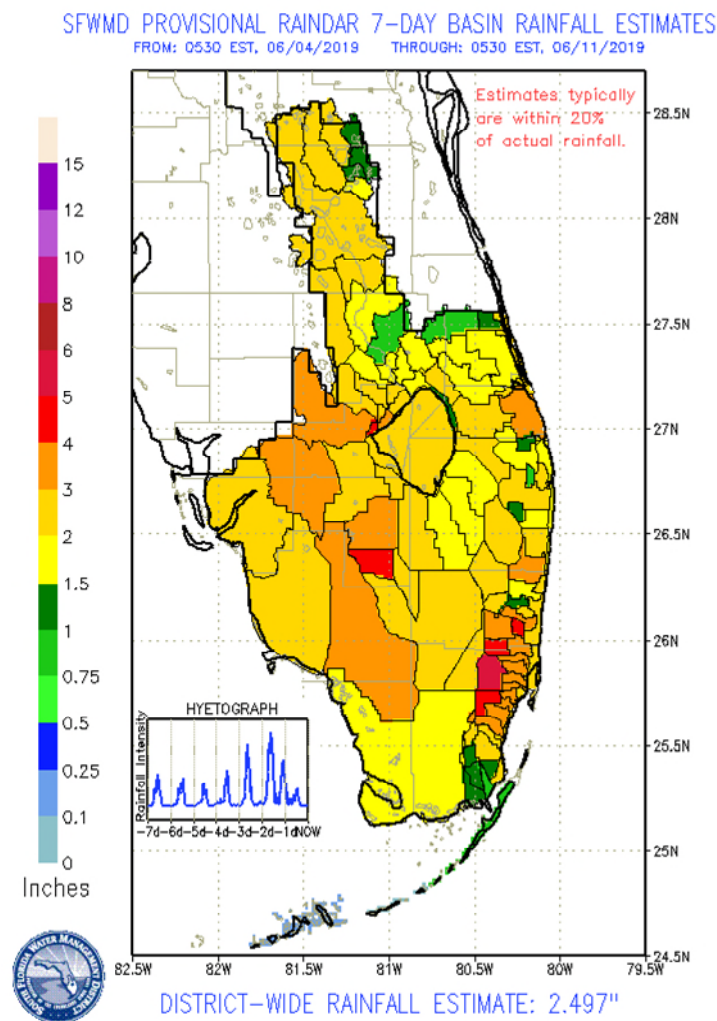


Figure 4. Rainfall estimates by basin.

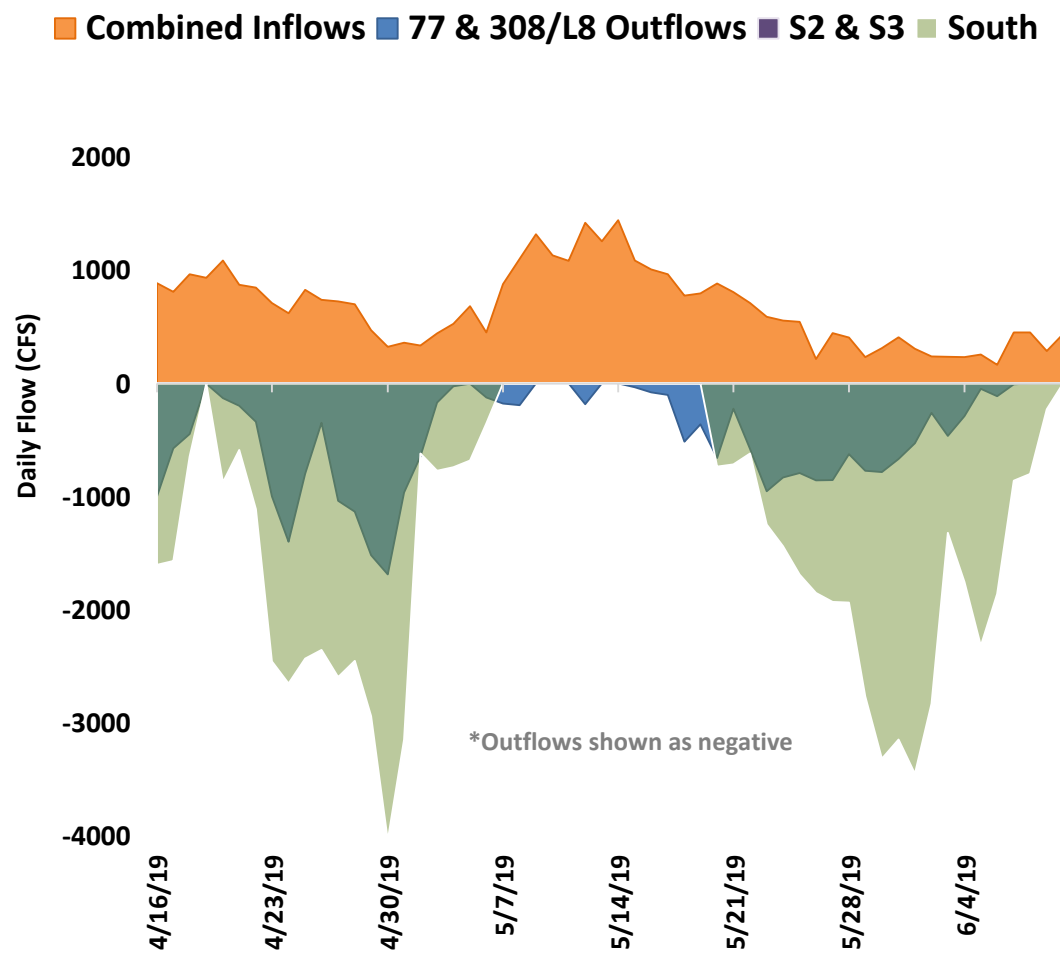


Figure 5. Major inflows (orange) and outflows (blue) of Lake Okeechobee, including the S-350 structures designated as South (green). The L-8 Canal flows through Culvert 10A are included as outflows when positive, and as inflows when backflowing into the lake. All inflows and outflows are shown as positive and negative, respectively, for visual purposes.

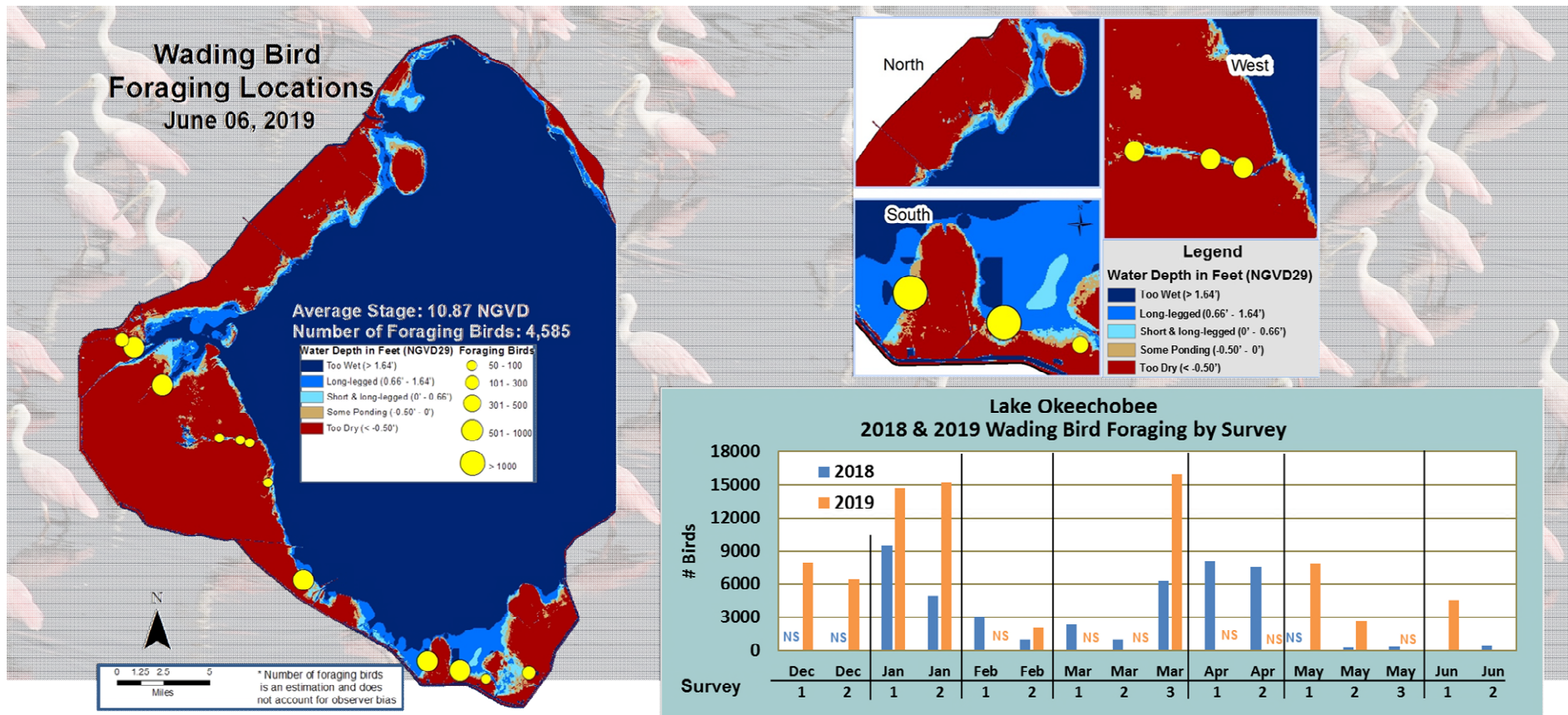


Figure 6. Locations of foraging flocks of wading birds observed during a monitoring flight on June 06, 2019 are shown in yellow, with circle sizes representing the size of the flocks. Previous survey totals from this season and from 2018 are compared in the bar graph.

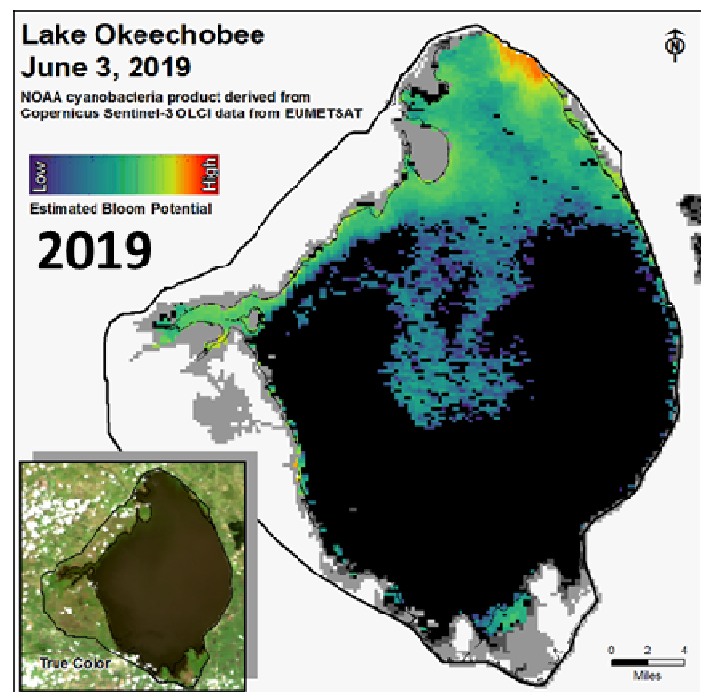
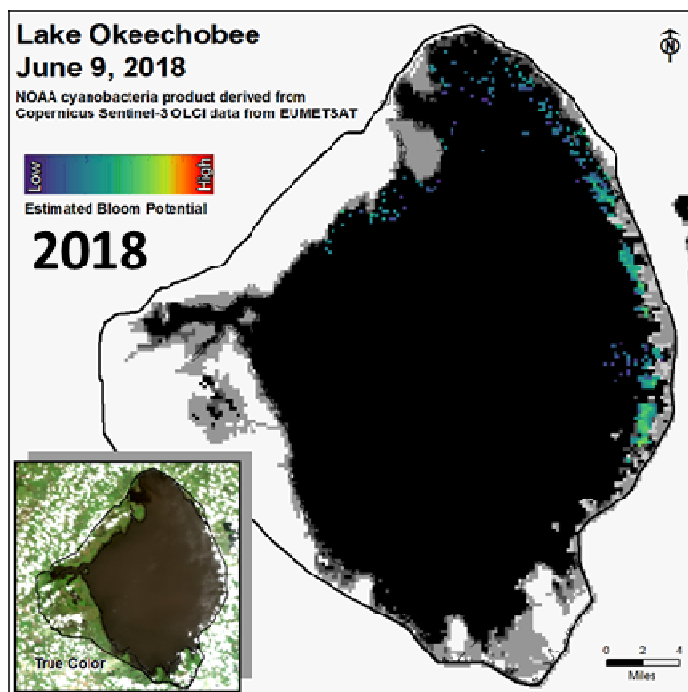
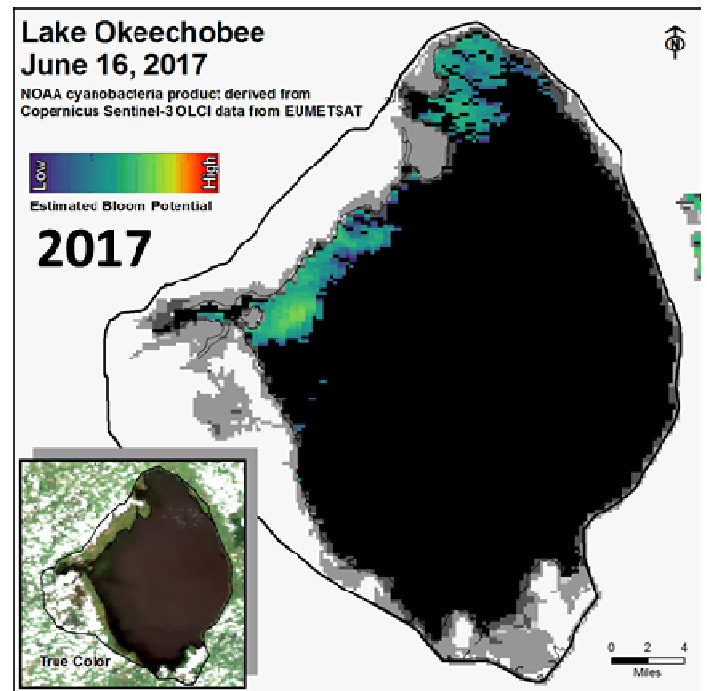
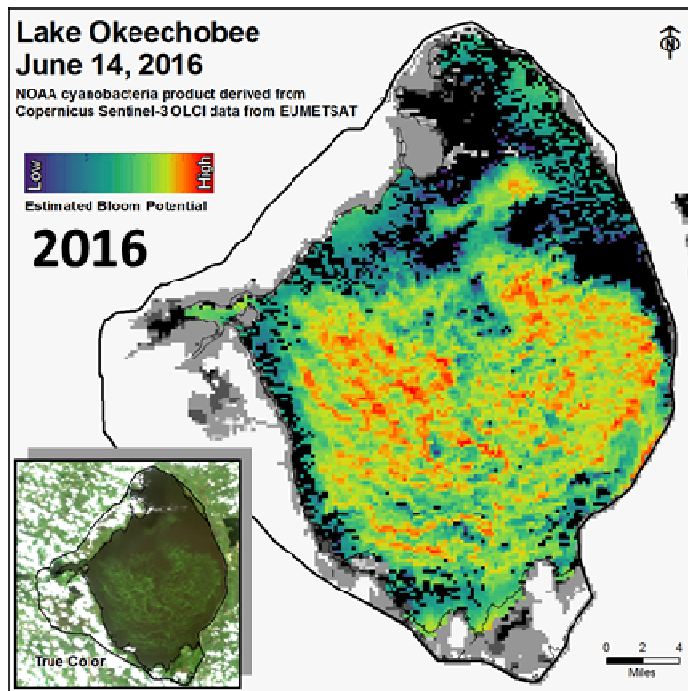


Figure 7. Potential for cyanobacterial blooms on Lake Okeechobee based on NOAA's harmful algal bloom monitoring system derived from Copernicus Sentinel-3 OLCI data from EUMETSAT. Gray indicates cloud cover.

ESTUARIES

St. Lucie Estuary:

Last week total inflow to the St. Lucie Estuary averaged approximately 627 cfs (Figures 1 and 2) and last month inflow averaged about 457 cfs. Last week's provisional averaged inflows from the tidal basin and the structures are shown in Table 1.

Table 1. Weekly average inflows (data are provisional).

Location	Flow (cfs)
Tidal Basin Inflow	392
S-80	0
S-308	0
S-49 on C-24	39
S-97 on C-23	40
Gordy Rd. structure on Ten Mile Creek	156

Over the past week, salinity remained about the same throughout the estuary (Table 2, Figures 3 and 4). The seven-day moving average of the water column (an average of the surface and bottom salinity) at the US1 Bridge is estimated to be 21.1. Salinity conditions in the middle estuary are within the good range for adult eastern oysters (Figure 3).

Table 2. Seven-day average salinity at three monitoring sites in the St. Lucie Estuary. Current average is in bold face type, previous average in parentheses. The envelope reflects the preferred salinity range for adult eastern oysters (*Crassostrea virginica*) in the middle estuary.

Sampling Site	Surface	Bottom	Envelope
HR1 (North Fork)	14.0 (13.9)	19.3 (18.2)	NA ¹
US1 Bridge	20.6 (20.1)	21.7 (21.8)	10.0-26.0
A1A Bridge	28.5 (28.9)	29.6 (30.7)	NA ¹

¹Envelope not applicable.

Caloosahatchee Estuary:

Last week total inflow to the Caloosahatchee Estuary averaged approximately 838 cfs (Figures 5 and 6) and last month inflow averaged about 894 cfs. Last week's provisional averaged inflows from the structures are shown in Table 3.

Table 3. Weekly average inflows (data is provisional).

Location	Flow (cfs)
S-77	17
S-78	29
S-79	738
Tidal Basin Inflow	100

Over the past week, surface salinity decreased to Val I75 and increased downstream (Table 4, Figures 7 & 8). The seven-day average salinity values are estimated to be within the good range for adult eastern oysters at Cape Coral and in the fair range at Shell Point and at Sanibel (Figure 9). The 30-

day moving average surface salinity is 2.2 at Val I-75 and 7.6 at Ft. Myers. Salinity conditions between Val I-75 and Ft. Myers are good for tape grass.

Table 4. Seven-day average salinity at six monitoring stations in the Caloosahatchee Estuary. Current average is in bold face type, previous average in parentheses. The envelope reflects the preferred salinity range for tape grass (*Vallisneria americana*) at Val I-75 and for adult eastern oysters (*Crassostrea virginica*) elsewhere.

Sampling Site	Surface	Bottom	Envelope
S-79 (Franklin Lock)	2.2 (3.7)	2.3 (3.9)	NA ¹
Val I75	3.4 (3.5)	3.6 (4.7)	0.0-5.0 ²
Ft. Myers Yacht Basin	10.2 (9.8)	11.2 (12.1)	NA
Cape Coral	19.4 (NR ³)	20.7 (20.4)	10.0-30.0
Shell Point	31.5 (30.4)	31.2 (30.1)	10.0-30.0
Sanibel	31.9 (33.5)	33.2 (33.6)	10.0-30.0

¹Envelope not applicable, ²Envelope is based on a 30-day average, and ³Not Reporting.

Forecast of surface salinity (Table 5 and Figure 10) at Val I-75 for the next two weeks using the autoregression model (Qiu and Wan, 2013) coupled with a linear reservoir model for the tidal basin predicts daily salinity ranging from 2.2 to 5.8 at the end of the next two weeks for pulse release at S-79 ranging from 0 to 800 cfs and Tidal Basin inflows of 90 cfs.

Table 5. Predicted salinity at Val I-75 at the end of forecast period

Scenario	Q79 (cfs)	TB runoff (cfs)	Daily salinity	30 day mean
A	0	90	5.8	4.0
B	300	90	4.3	3.6
C	450	90	3.6	3.2
D	650	90	2.7	3.0
E	800	90	2.2	2.8

Red tide

The Florida Fish and Wildlife Research Institute reported on June 7, 2019, that *Karenia brevis*, the Florida red tide dinoflagellate, was observed at background concentrations in one samples collected from Lee County and was not observed in samples collected from or offshore of St. Lucie, Martin, Palm Beach or Broward counties (no samples from Miami-Dade County).

Water Management Recommendations

Lake stage is in the Beneficial Use sub-band of 2008 LORS. Tributary hydrological conditions are normal. The 2008 LORS recommends no release at S-79 and S-80. Given the current estuarine conditions, there are no ecological benefits to the upper estuary associated with freshwater releases from Lake Okeechobee, but some benefits may accrue to areas further downstream.

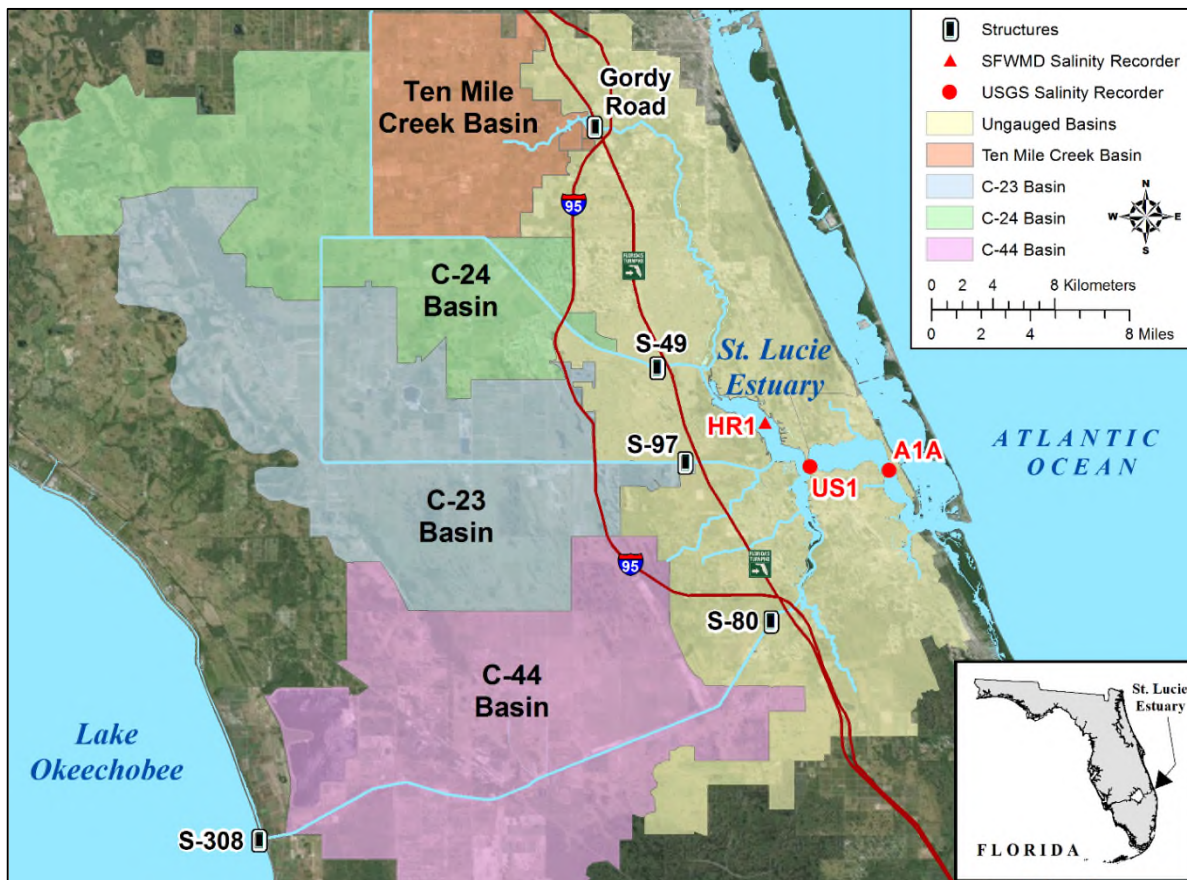


Figure 1. Basins, water control structures, and salinity monitoring for the St. Lucie Estuary.

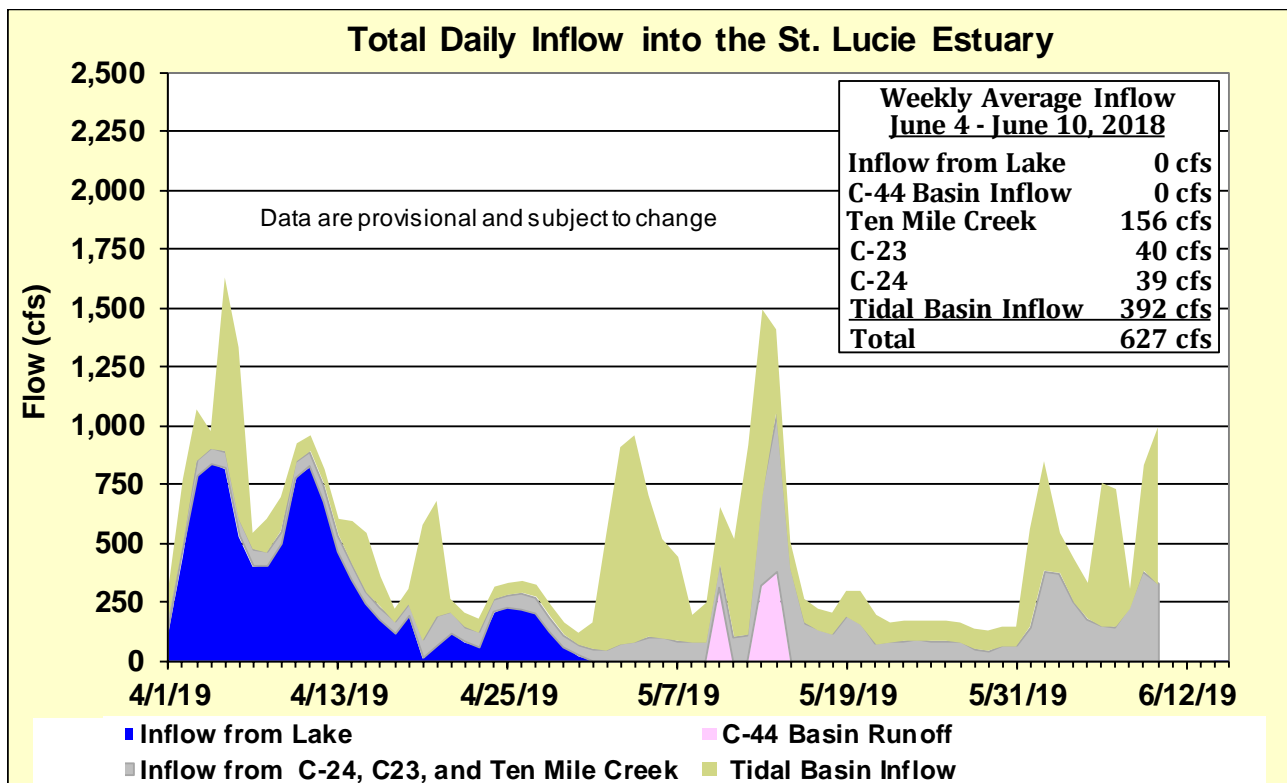


Figure 2. Total daily inflows from Lake Okeechobee and runoff from the C-44, C-23, C-24, Ten Mile Creek, and tidal basins into the St. Lucie Estuary.

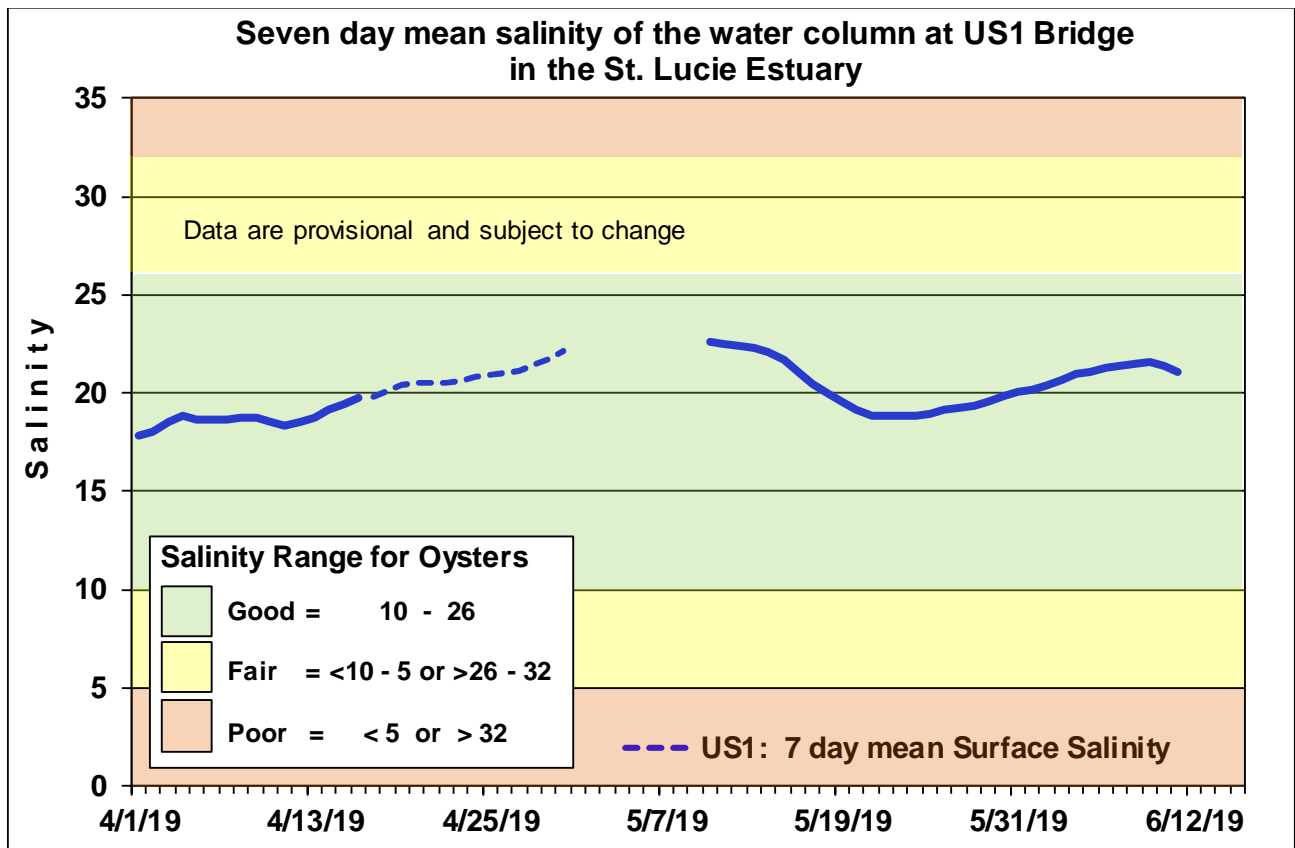


Figure 3. Seven-day mean salinity of the water column at the US1 Bridge.

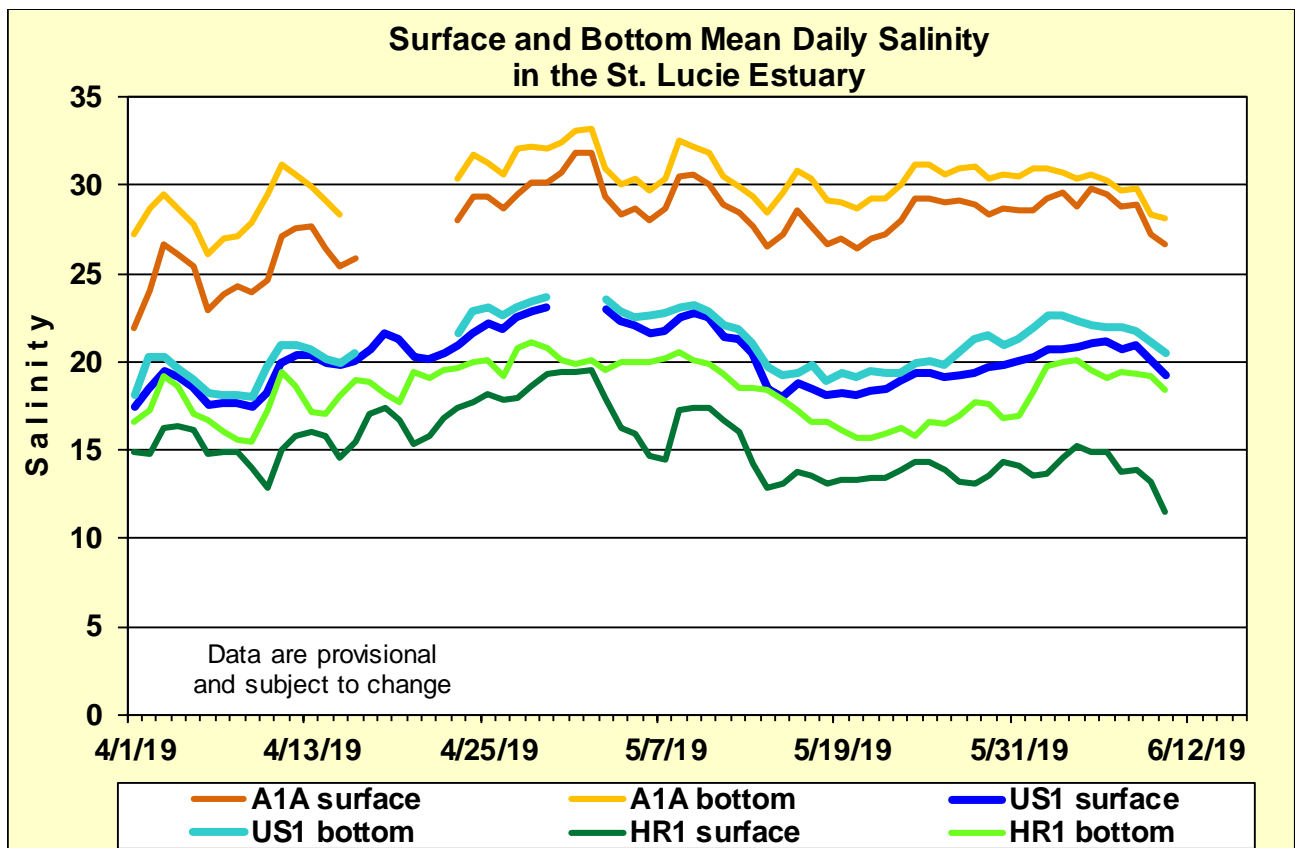


Figure 4. Daily mean salinity at the A1A, US1 and estimated HR1 stations.

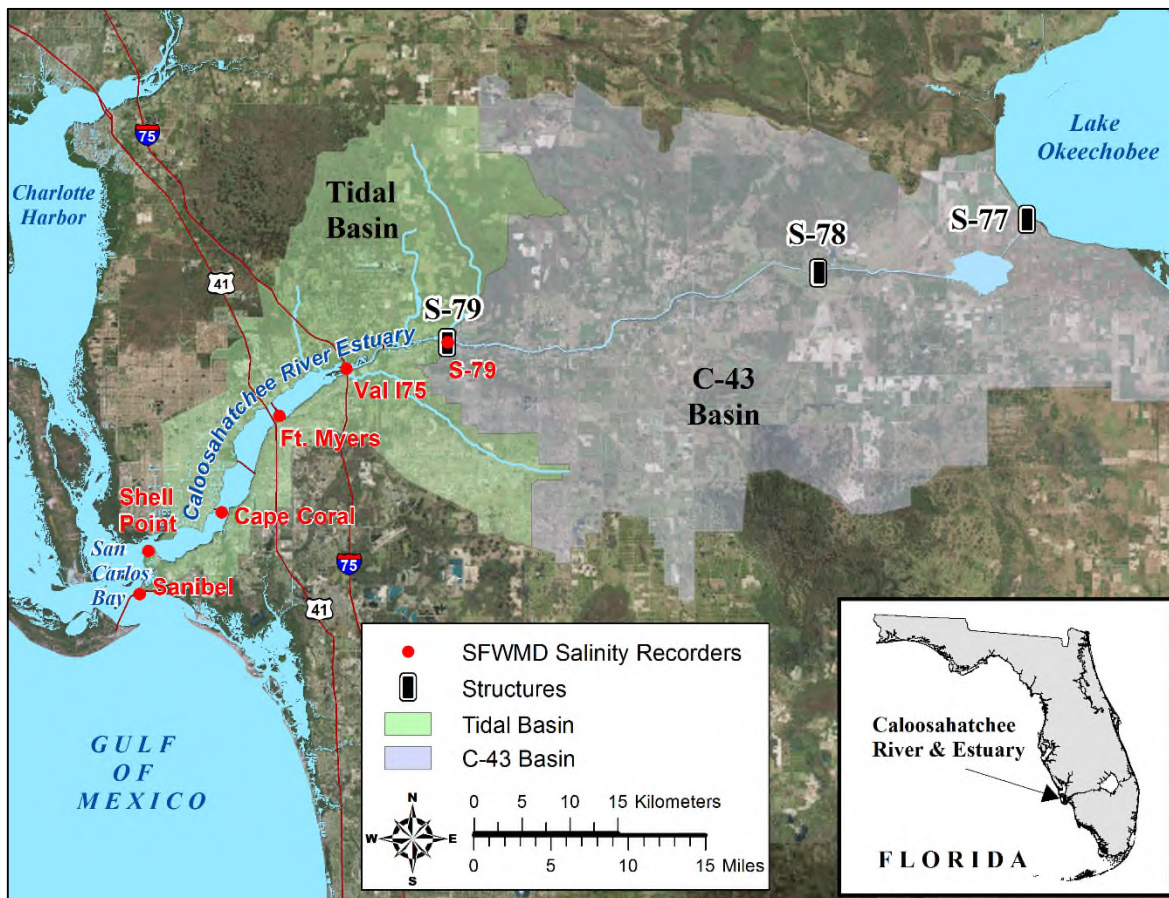


Figure 5. Basins, water control structures, and salinity monitoring for the Caloosahatchee Estuary.

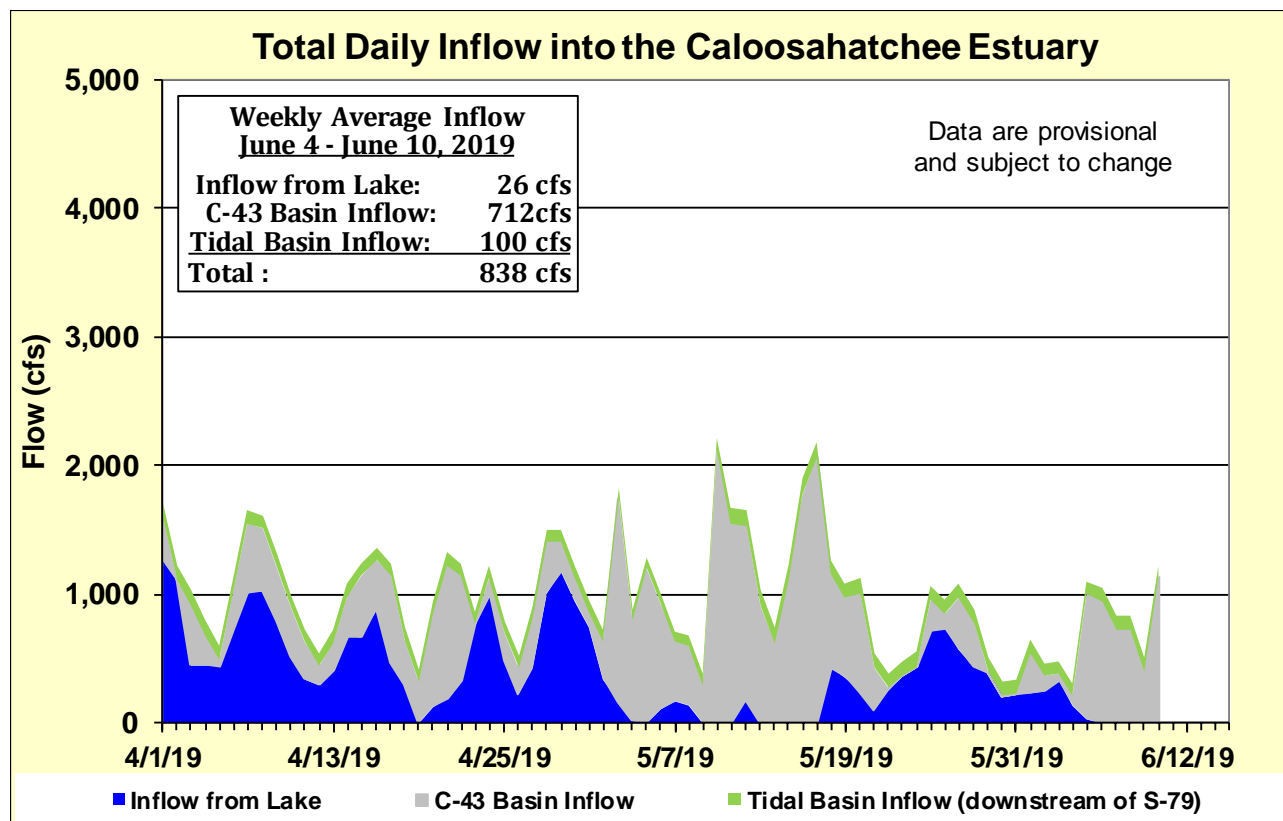


Figure 6. Total daily inflows from Lake Okeechobee, runoff from the C-43 basin, and tributaries in the tidal basin into the Caloosahatchee River Estuary.

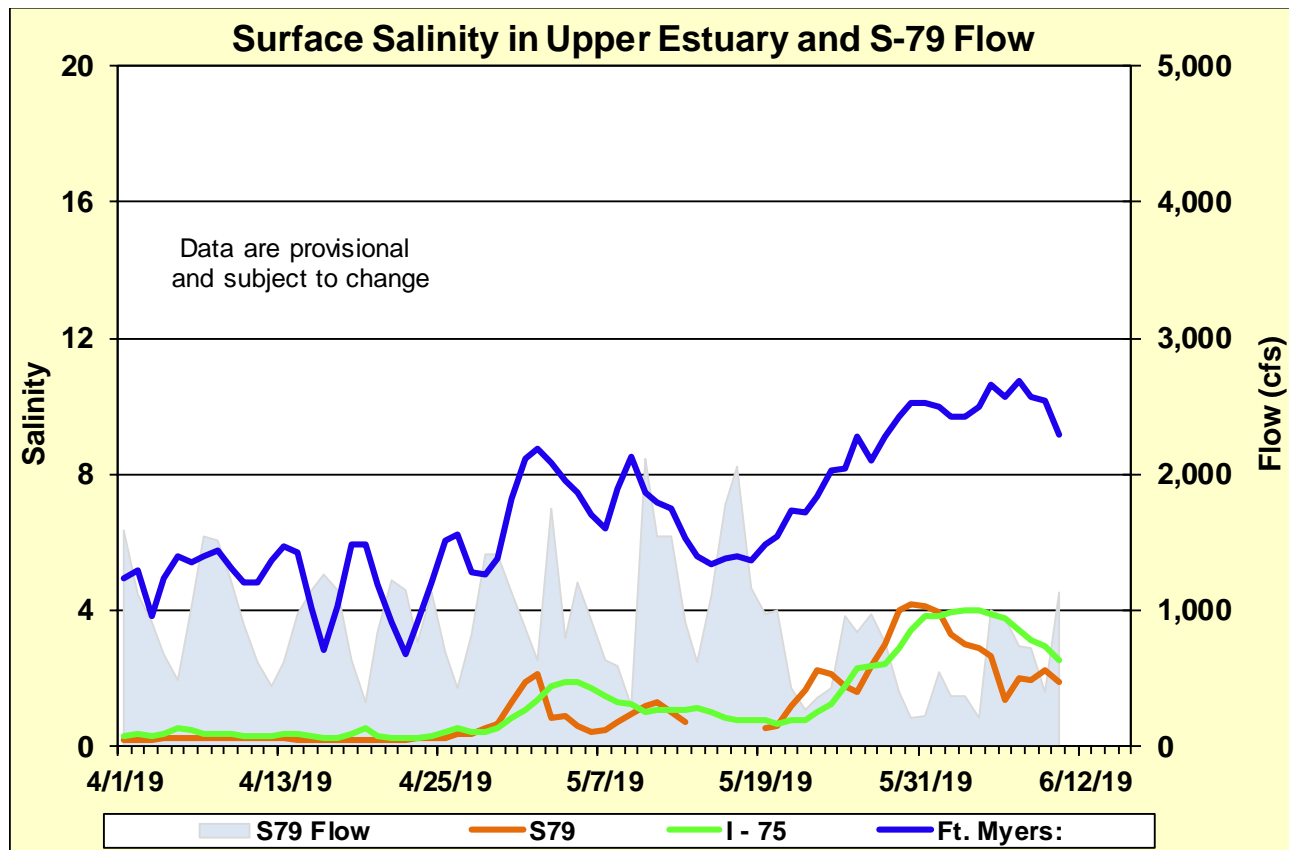


Figure 7. Daily mean flows at S-79 and salinity at upper estuary monitoring stations.

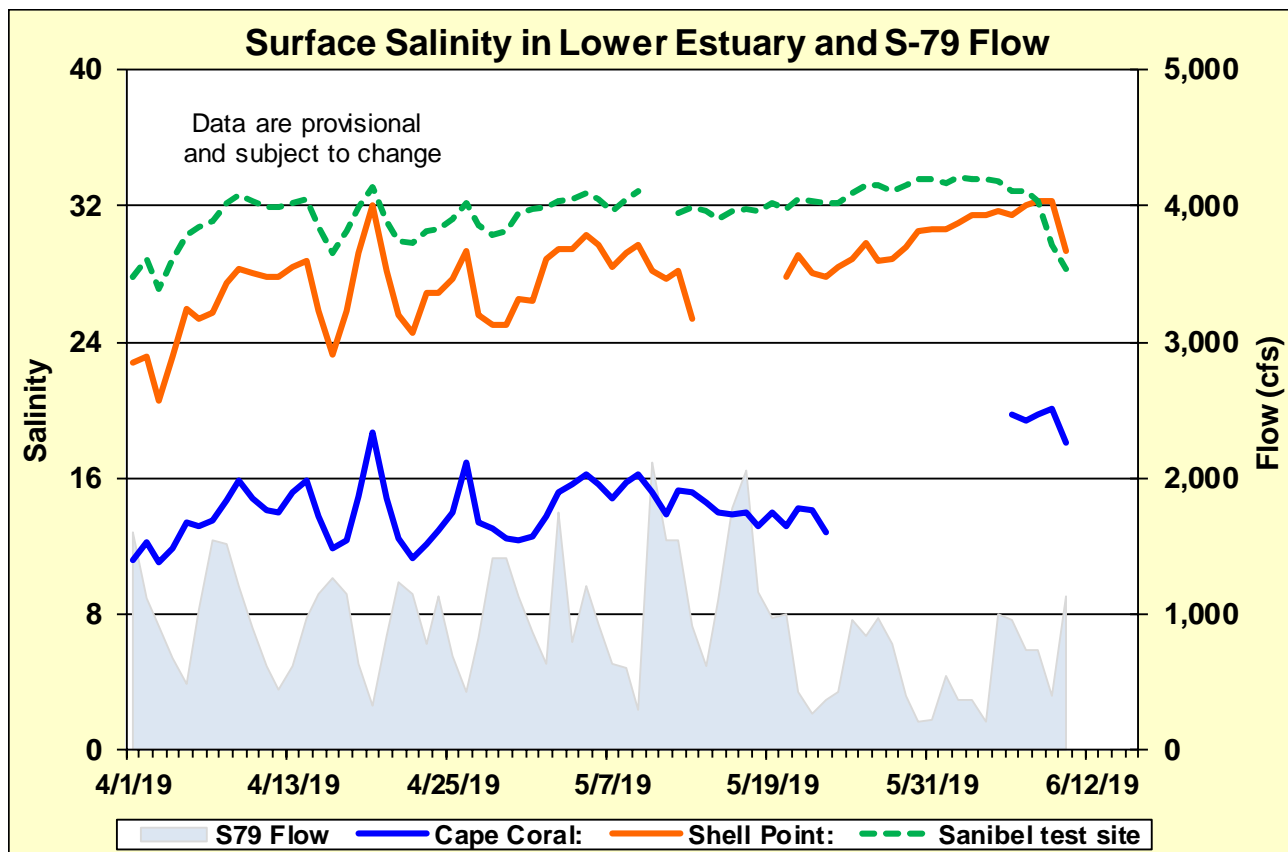


Figure 8. Daily mean flows at S-79 and salinity at lower estuary stations.

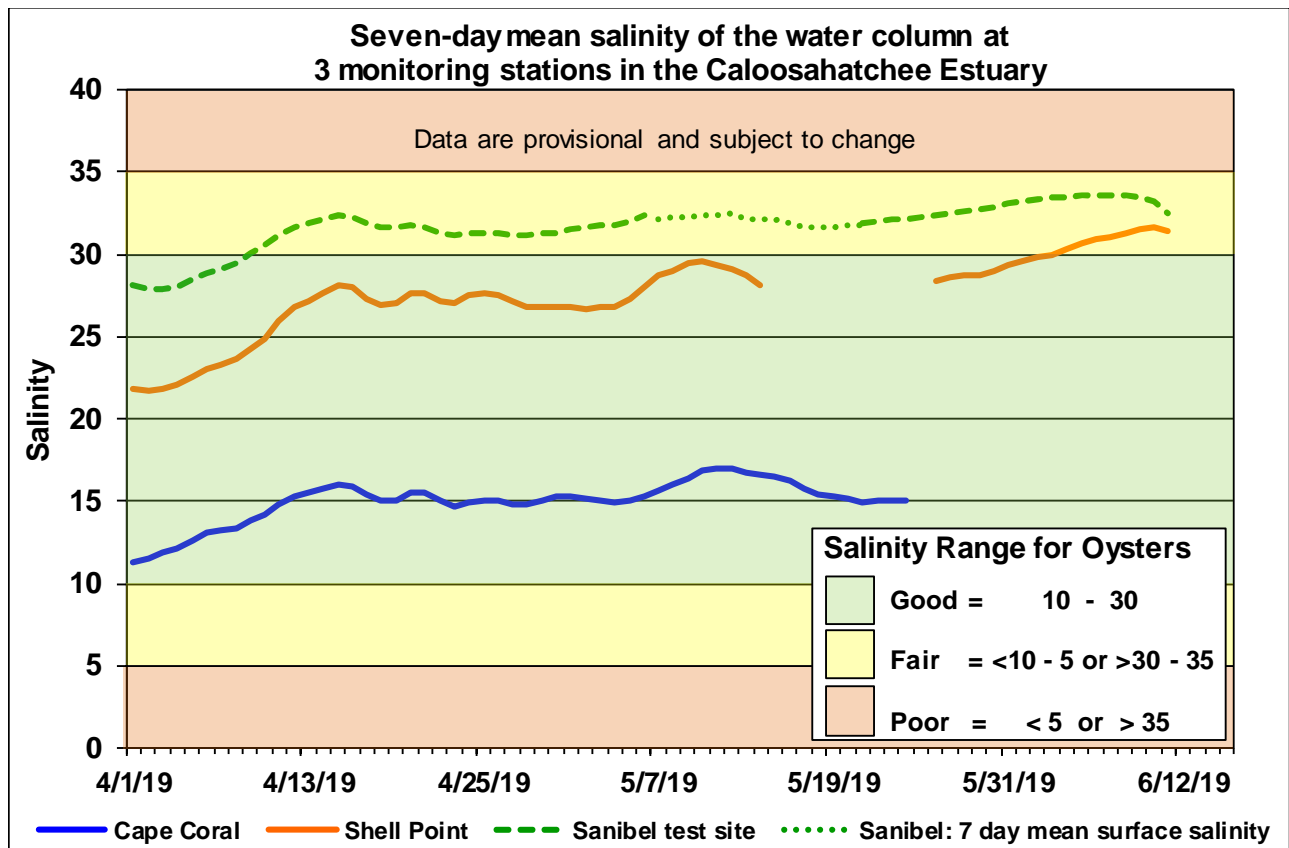


Figure 9. Seven-day mean salinity at Cape Coral, Shell Point, and Sanibel monitoring stations.

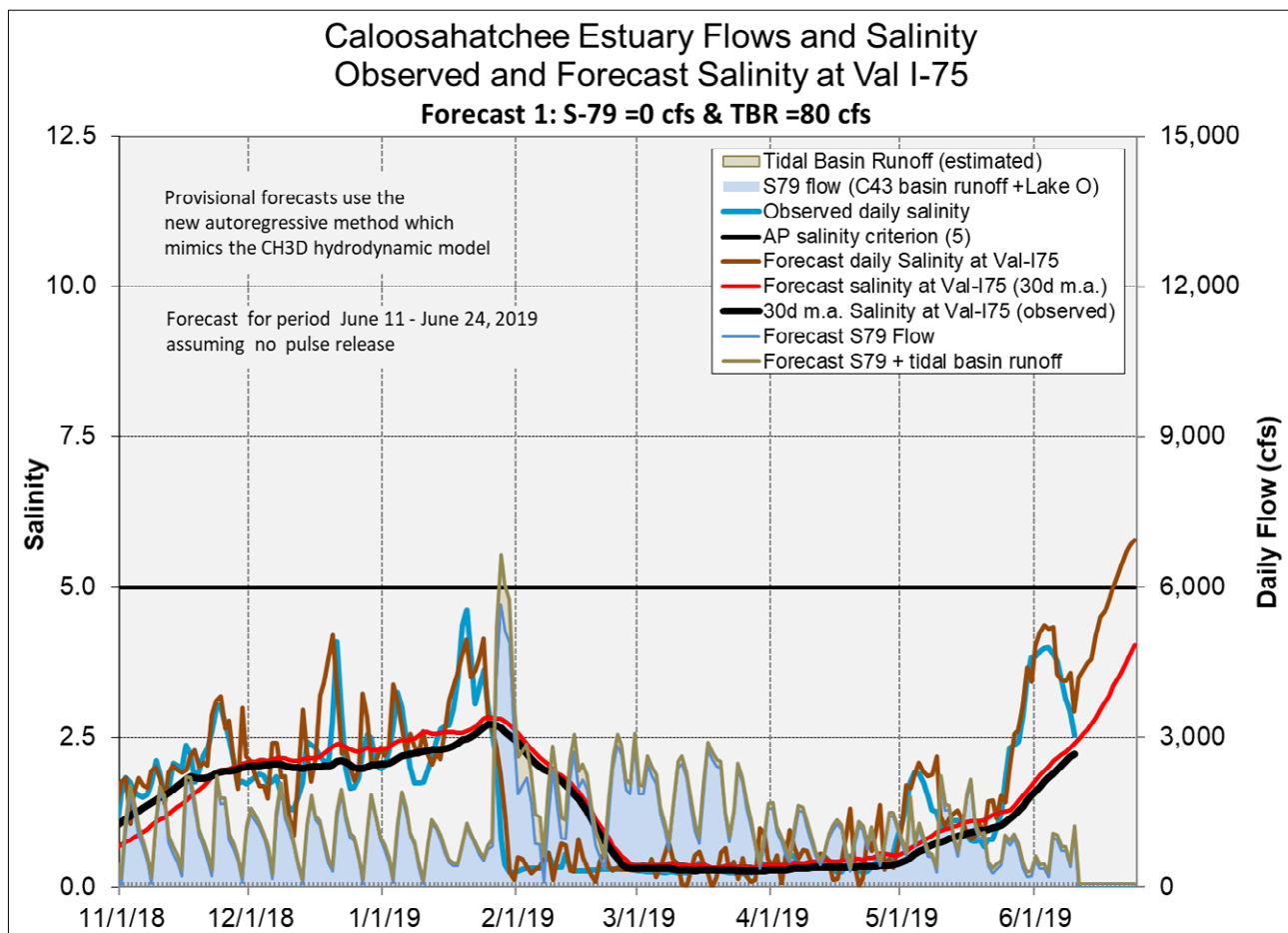
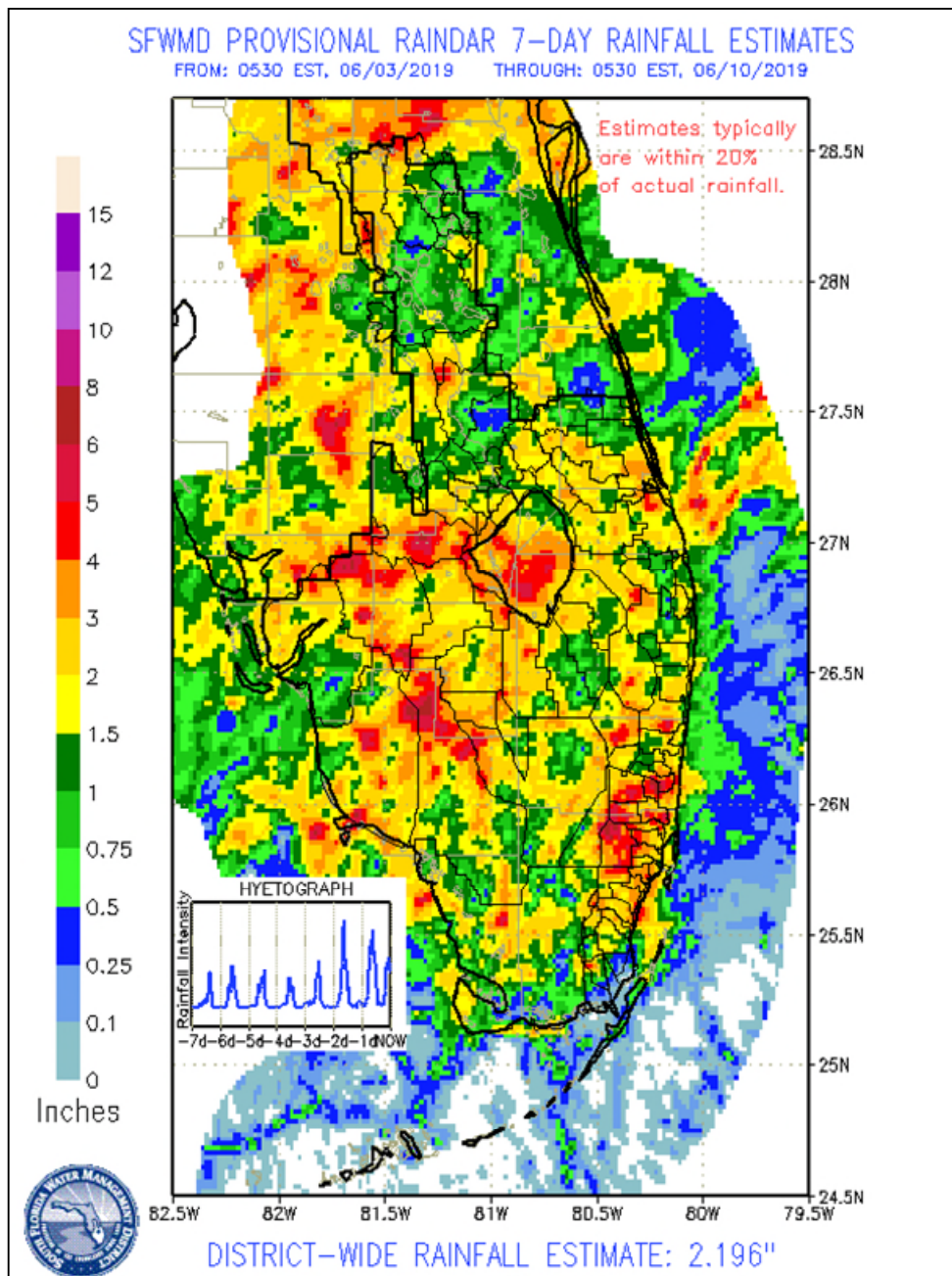


Figure 10. Forecasted Val I-75 surface salinity assuming no pulse release at S79.

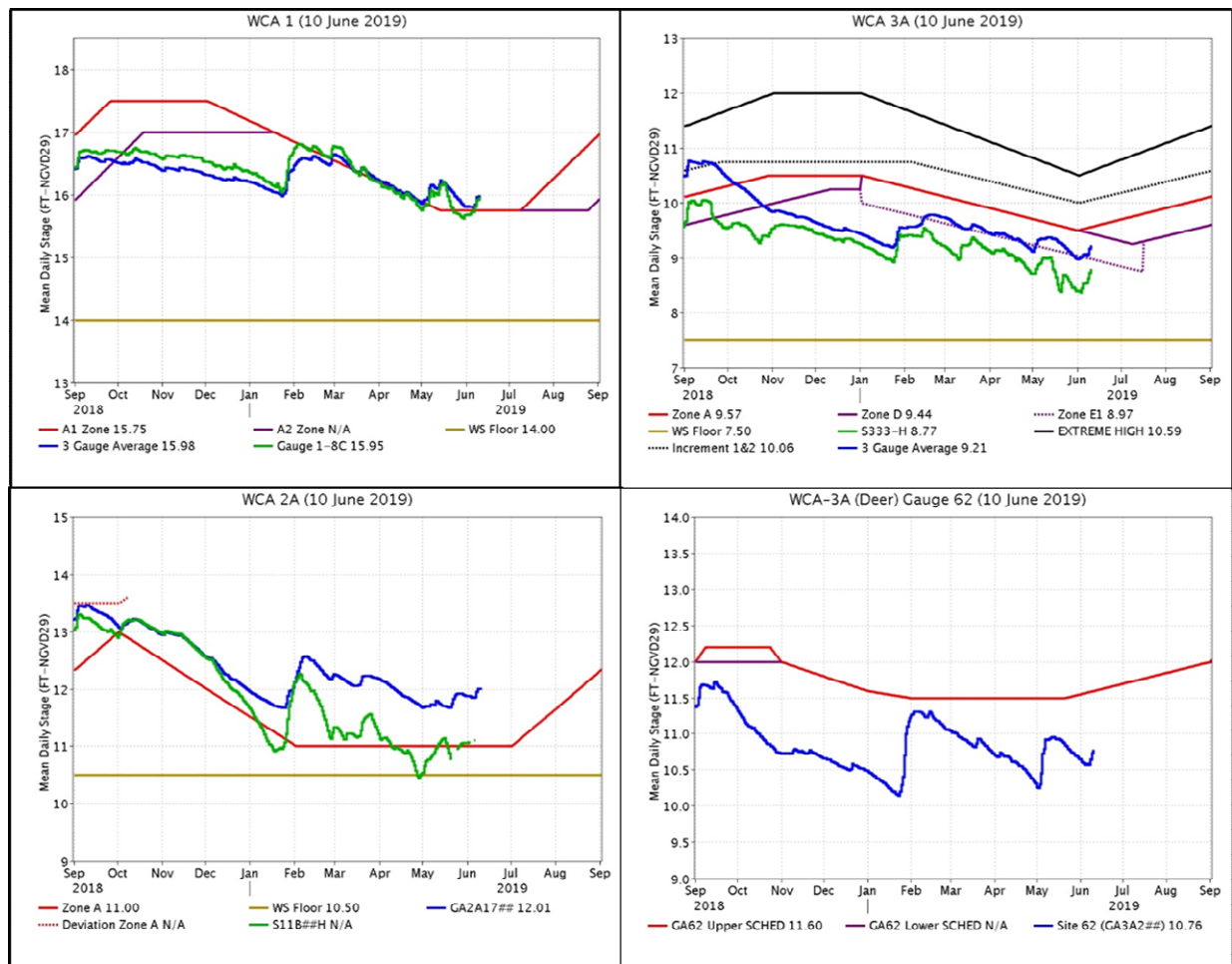
EVERGLADES

At the gauges monitored for this report the stages in the WCAs increased on average 0.13 feet last week. Individual gauge changes ranged from -0.02 feet (ENP NE-SRS) to +0.27 feet (WCA-3A central). Pan evaporation was estimated at 1.88 inches this week.

Everglades Region	Rainfall (Inches)	Stage Change (feet)
WCA-1	2.09	+0.15
WCA-2A	2.57	+0.14
WCA-2B	1.96	+0.01
WCA-3A	1.93	+0.19
WCA-3B	2.24	+0.10
ENP	1.29	-0.02



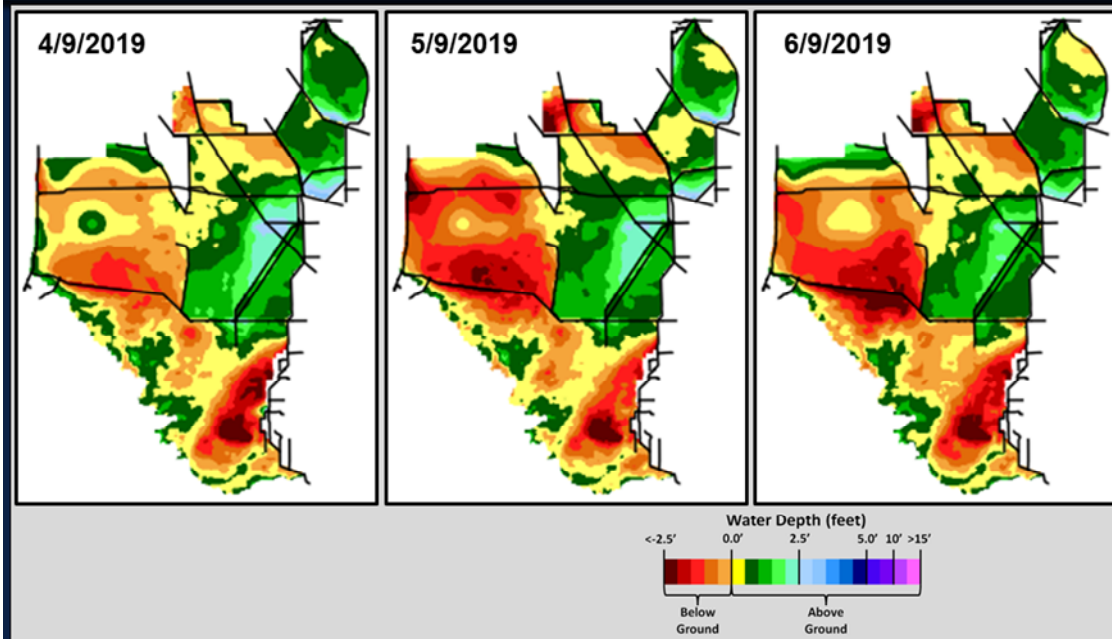
Regulation Schedules: WCA1: Gauge 1-8C just below the regulation line last week rose steadily now 0.20 feet above the Zone A1 line. WCA2A: S11B Headwater stage remains an estimate due to instrumentation issues. The stage is above the Zone A regulation line. WCA-3A: The Three Gauge Average rose above the Zone E1 regulation line this week, now 0.24 above that line and trending upwards. WCA-3A at gauge 62 (Northwest corner) remains below schedule at 0.84 feet below the Upper Schedule.



Water Depths and Changes: The WDAT tool for spatial interpolation of depth monthly snapshots indicate stages in northeastern WCA-3A North remain below ground but are stable. Conditions in WCA-1 look typical for this time of year, with stages receding in the central regions of that basin. WCA-2A depths look typical to wet. As the rest of the system dries down that basin's stages remain stable. WDAT difference output indicates that water level changes within the WCAs over the last month were mixed with stages rising slightly in most of WCA-2A and significantly so in the extreme northeast and northern sections of that basin. In the "1 Year" inset we see the difference between current depth conditions and those a year ago. The current depths are significantly lower across the Everglades compared to last year's, a later start to the wet season extends the wading bird nesting season.



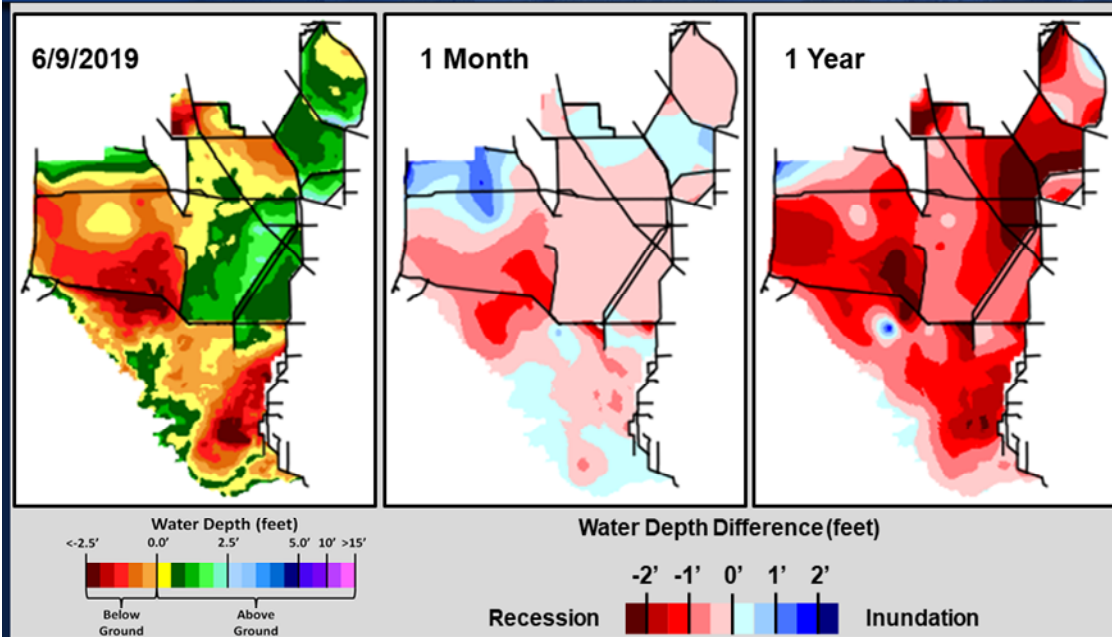
SFWDAT Water Depth Monthly Snapshots



South Florida Water Depth Assessment Tool (SFWDAT)



SFWDAT Everglades Difference Maps (Present - Past)



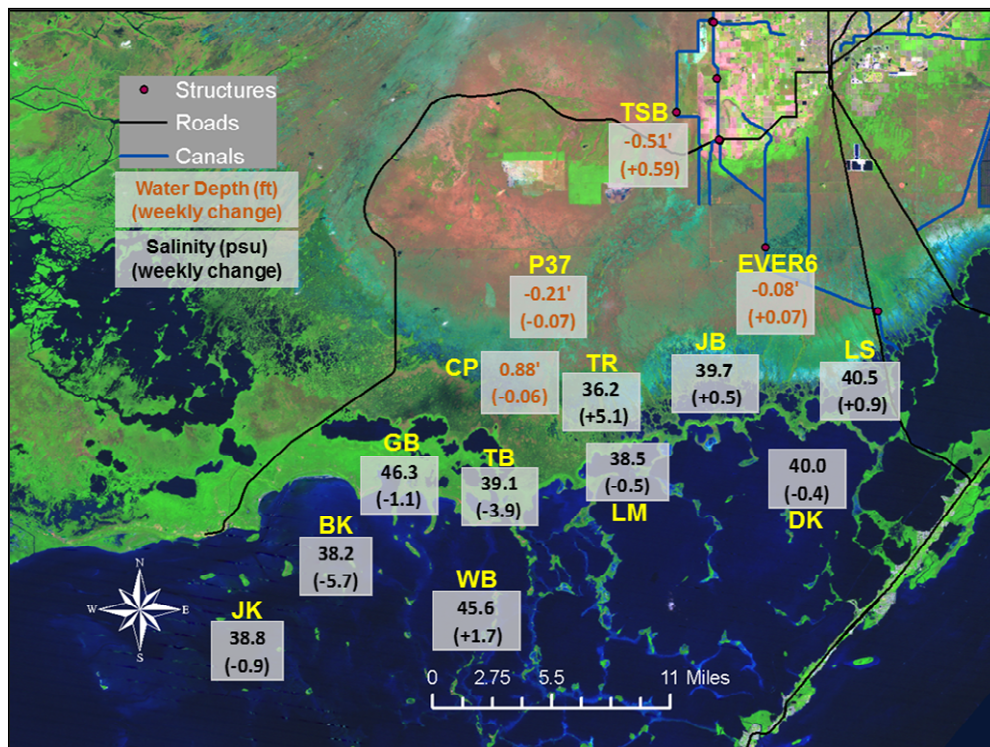
South Florida Water Depth Assessment Tool (SFWDAT)

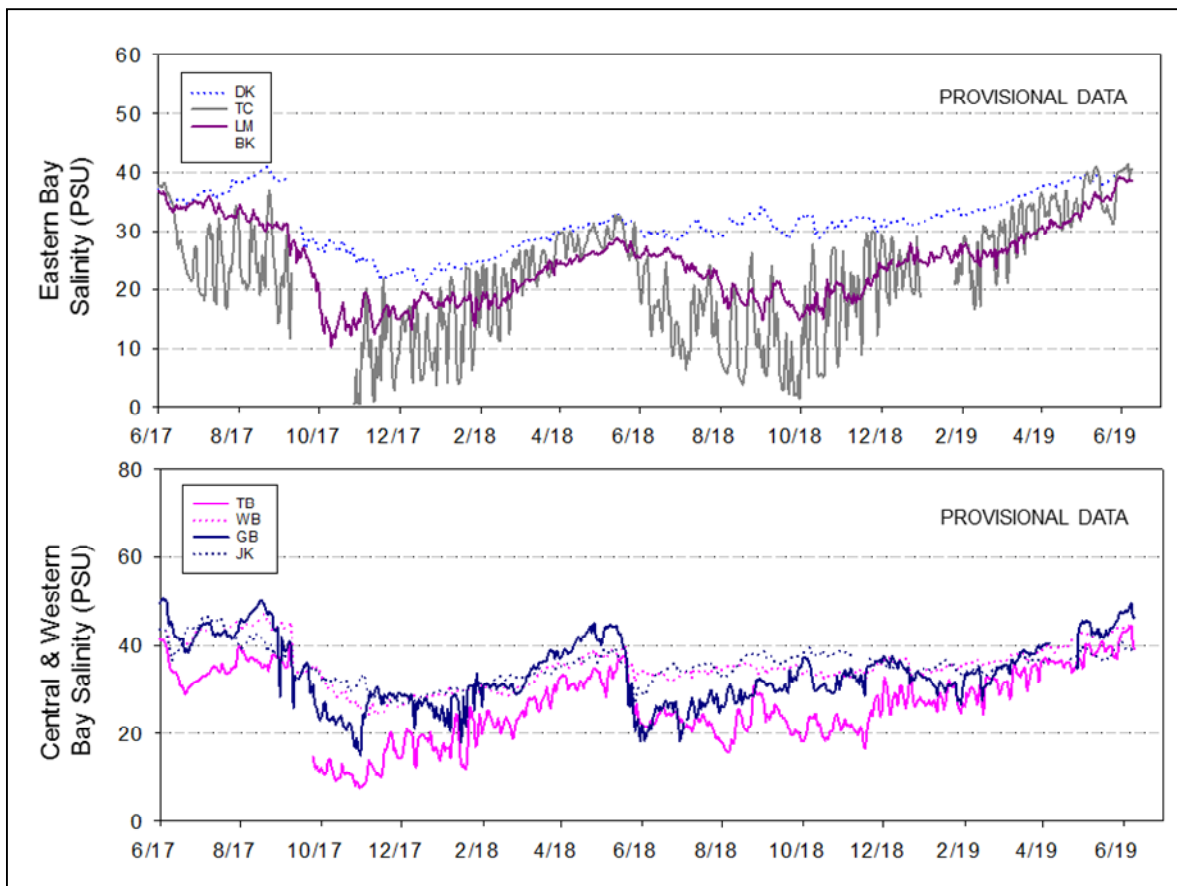
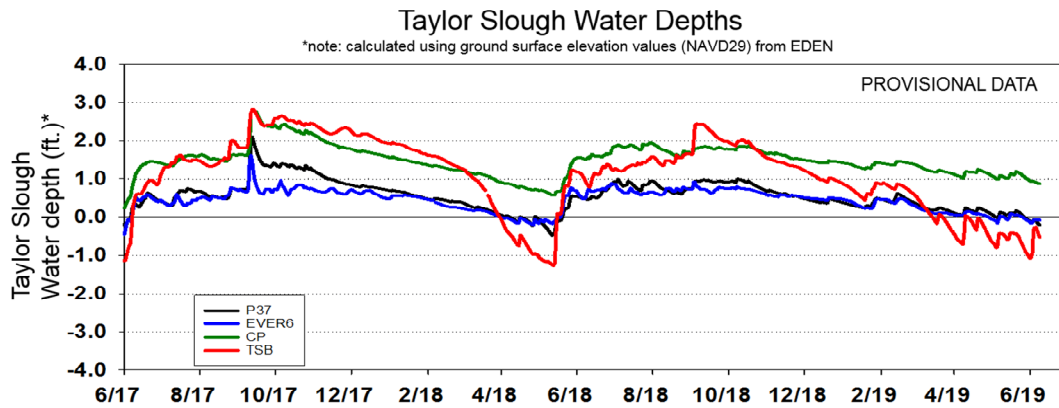
Wading Bird Update bullets: Flight conducted on 6/5 over WCA-1, western WCA-2, WCA-3A North

- Most bird foraging in the system is taking place in the Refuge. Some Ibis nest initiation is taking place in that basin
- Lower number of birds feeding on the western side of southern 2A. That area has dried, to the south conditions remain favorable.
- Foraging in northern regions of WCA-3A South.
- Snowy egrets nesting in multiple colonies in eastern WCA-1 (foraging in STA-1E & Refuge).

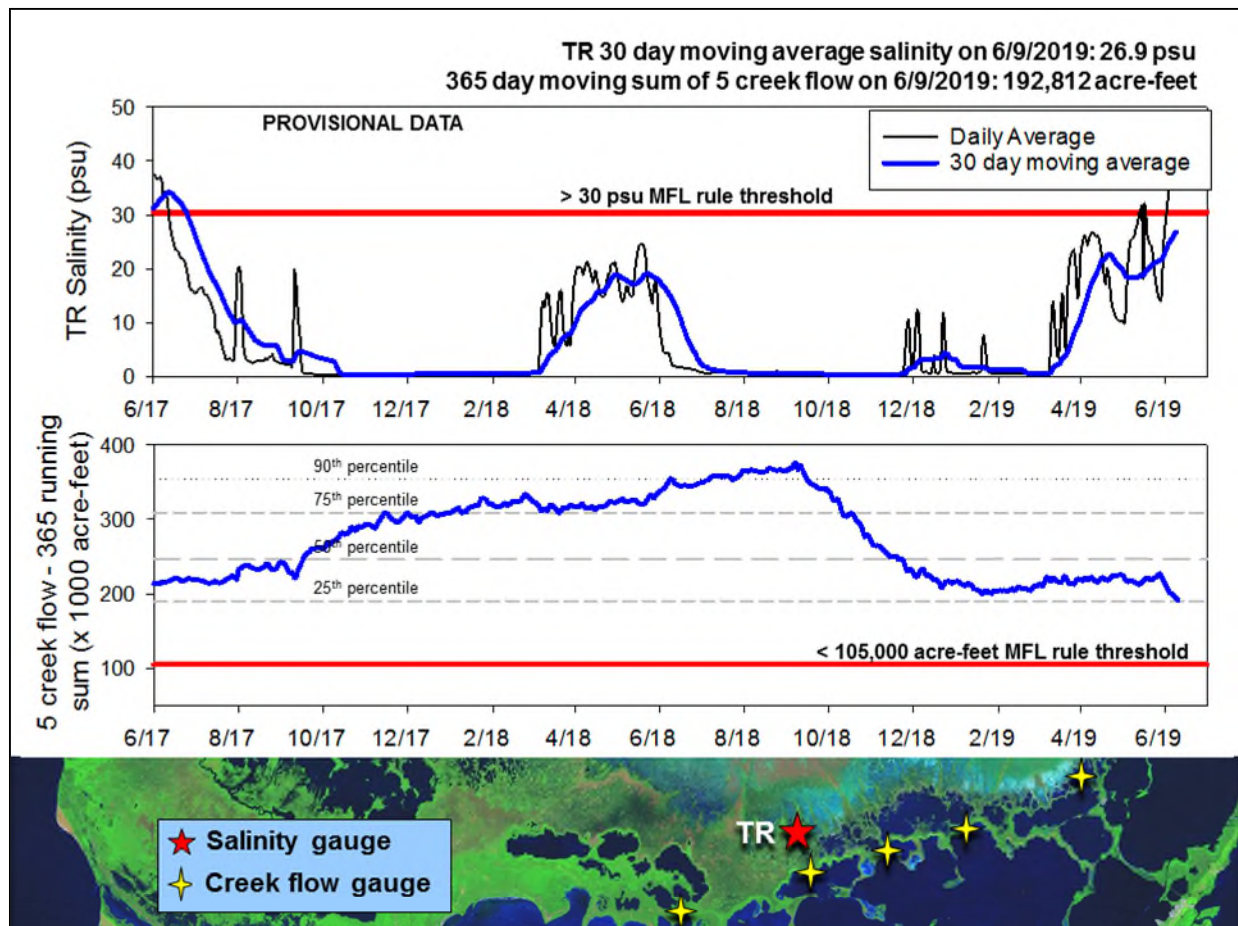
Taylor Slough Water Levels: Spotty rain this past week caused mixed results for stages. On average, Taylor Slough and the Everglades National Park panhandle area stages increased by 0.13 feet, but that average is driven by the half a foot increase in northern Taylor Slough. The only area with above ground water levels is Craighead Pond (CP) which is below sea-level.

Florida Bay Salinities: Salinity in Florida Bay averaged a 1 psu decrease from last week. The largest decreases coincided with the areas of highest rainfall. BK, GB, and TB received 1.5 to 3.5 inches of rain over the last week while all other Florida Bay stations received less than 0.4 inches. Daily average salinities ranged from 39 psu in northeastern Florida Bay to 46 psu in the western central nearshore area.





Florida Bay MFL: Salinity at the TR station in the mangrove zone (tracked for the Florida Bay MFL) stayed at 37 psu for most of last week. The 30-day moving average increased to 26.9 psu as a result. The weekly flow from the 5 creeks feeding Florida Bay was negative (upstream) for all of last week and the weekly total flow was -8,200 acre-feet for the second week in a row. The 365-day moving sum of flow from the five creeks (tracked as part of the Florida Bay MFL criteria) was 192,812 acre-feet which is less than the long-term average of 257,628 acre-feet but slightly above the 25th percentile (190,165 acre-feet). Creek flow is provisional data from the USGS and is highly variable.



Water Management Recommendations

Moderating accretion rates in WCA-1, WCA-2A and WCA-3A South would have ecological benefit as wading birds are foraging and/or nesting in those basins. A rate of ascension less than 0.25 feet per week or less than 0.5 feet per 2 weeks is the general ecological recommendation. Recent Everglades Snail Kite activity and nesting remains high in southern WCA-3A. Moderating the ascension rate in that area would have an ecological benefit for both kite nesting and wading bird foraging. More specific recommendations appear in the summary table below. The red text represents new or modified information or recommendations.

SFWMD Everglades Ecological Recommendations, June 11th, 2019 (red is new)

Area	Weekly change	Recommendation	Reasons
WCA-1	Stage increased by 0.10'	Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect late season conditions that provide wading bird foraging and nesting.
WCA-2A	Stage increased by 0.14'	Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect late season conditions that provide wading bird foraging and nesting.
WCA-2B	Stage increased by 0.01'	Maintain depths at regulation schedule. Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect upstream/downstream habitat and wildlife.
WCA-3A NE	Stage increased by 0.20'	Maintain depths at regulation schedule.	Protect habitat including peat soil development and wildlife.
WCA-3A NW	Stage increased by 0.14'	Maintain depths at regulation schedule. Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	
Central WCA-3A S	Stage increased by 0.27'	Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect tree islands, upstream/downstream habitat and wildlife. Protect conditions for snail kite nesting and that provide wading bird foraging habitat later into the nesting season.
Southern WCA-3A S	Stage increased by 0.13'		
WCA-3B	Stage increased by 0.10'	Maintain depths at regulation schedule. Manage for a rate of ascension less than +0.25' per week, or less than +0.5 per 2 weeks.	Protect upstream/downstream habitat and wildlife.
ENP-SRS	Stage decreased by 0.02'	Make discharges to the Park according to the 2012 WCP rainfall plan.	Protect upstream/downstream habitat and wildlife.
Taylor Slough	Stage changes ranged from -0.07' to +0.59'	Move water southward as possible	When available, provide freshwater buffer for downstream conditions. Decrease potential for high phosphorus input to ENP.
FB- Salinity	Salinity changes ranged -5.7 to +1.7 psu	Move water southward as possible	When available, provide freshwater to maintain low salinity buffer and promote water movement.