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M E M O R A N D U M

TO: John Mitnik, Chief, Operations, Engineering and Construction Bureau
Paul Linton, Chief, Operations Section

FROM: SFWMD Staff Environmental Advisory Team

DATE: April 2, 2019

SUBJECT: Weekly Environmental Conditions for Systems Operations

Summary

Weather Conditions and Forecast

A cold front over or just north of the northern portion of the District this morning should push southward to north of Lake Okeechobee by sunset, the southern portion of the District overnight, and just south of the Florida Keys by daybreak on Wednesday. Favorable large-scale conditions such as enhanced moisture, the 'lift' ahead of the front, and an increase of low-level instability should help to generate some rains across the District today. However, the main upper-level forcing associated with the front is expected to remain to the north of the area and quickly accelerate northeastward into the Atlantic, a pattern that would favor total District rainfall of no more than a tenth of an inch and likely less. The rains, widely scattered in nature, should begin first over the northwestern portion of the District this morning and then spread southeastward or redevelop closer to the middle and upper east coasts during the afternoon and then diminish all areas by early evening; much lower rain chances and areal average rainfall are expected over the southwest, with some chance that little to no substantive rain would occur over that region. The fast motion of rain areas should keep areal average totals generally a tenth of an inch or less and local maxima at or lower than one inch. High moisture levels north of the stalled boundary in the Florida Straits should keep a chance of rain in the forecast over the southern third of the District on Wednesday and Thursday, with the greatest rain chances over the far south and southwest; meanwhile dry conditions are expected over the northern two-thirds of the District both days. Summertime levels of moisture and much warmer temperatures and enhanced instability during the afternoon, in combination with well-defined sea and lake breeze interactions, should produce an increased chance of rain from Friday through Sunday but mainly over interior sections of the District. The one limiting factor during that time could be the position of the subtropical jet stream to the south of the area, which would generally counteract a more significant increase of rains. With the low-level wind forecast to become more southeasterly and stronger by the weekend, the maximum of rainfall over inland areas is predicted to shift to the west and possibly extend to the west coast. Late this weekend a vigorous storm system is then forecast to move out of the southern Plains and approach the District by early next week. Continued high levels of moisture, enhanced instability, and strong dynamical forcing should create a scenario of possibly significant rains either Monday or Tuesday this week, with some chance that the Monday-Tuesday total would exceed 0.5 inches. Drying is forecast in the wake of the cyclone around mid-week that could last at least a couple of days. For the week ending next Tuesday morning, the deterministic total quantitative precipitation forecast is about normal while the probabilistic model output indicates a likelihood of nearly 0.4 inches and an even chance of a total around 0.6 inches. The increase of rains this week should be rather conspicuous, especially considering how dry the first half and the last ten days of March were.

Kissimmee

Tuesday morning stages were 56.1 feet NGVD (1.2 feet below schedule) in East Lake Toho, 53.8 feet NGVD (0.5 feet below schedule) in Toho, and 49.9 feet NGVD (1.1 feet below schedule) in Kissimmee-

Cypress-Hatchineha; headwater stages were 46.3 feet NGVD at S-65A and 25.7 feet NGVD at S-65D. Tuesday morning discharges were 360 cfs at S-65, 277 cfs at S-65A, 488 cfs at S-65D and 403 cfs at S-65E. Dissolved oxygen concentration in the Kissimmee River averaged 6.4 mg/L for the week. Kissimmee River mean floodplain depth on Sunday was 0.19 feet.

Lake Okeechobee

Lake Okeechobee stage is 11.86 feet NGVD, decreasing 0.25 feet from the previous week. The Lake dropped into the Beneficial Use sub-band on March 7, 2019 and is now 0.18 feet above the Water Shortage sub-band. The Lake remains below the bottom of the ecological envelope (currently 1.2 feet below), which varies seasonally from 12.5 – 15.5 feet NGVD. Given the potential for above average rainfall associated with a weak El Niño conditions this winter/spring and the poor condition of SAV and EAV in the nearshore zone, these lower lake stages are ideal for vegetation recovery, but will reduce habitat for fish and wildlife in the near-term and encourage spread of invasive vegetation in the upper marsh. Satellite imagery suggests the potential for algal blooms has increased along the western shore, particularly within Fisheating Bay.

Estuaries

Total inflow to the St. Lucie Estuary averaged 265 cfs over the past week with 81 cfs coming from Lake Okeechobee. Over the past week, salinity increased in the estuary. The seven-day average salinity at the US1 Bridge is within the good range for adult eastern oysters. Total inflow to the Caloosahatchee Estuary averaged 1,263 cfs over the past week with 856 cfs coming from the Lake. Over the past week, salinity increased at Ft. Myers and Shell Point. The 30-day moving average surface salinity is 0.3 at Val I-75 and 2.5 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 Shell Point. Given the current estuarine conditions, there are no ecological benefits to the upper estuary associated with freshwater releases from Lake Okeechobee, although some limited benefits may accrue to areas further downstream.

Stormwater Treatment Areas

Over the past week, the STAs/FEBs received approximately 10,600 acre-feet of Lake releases. The total amount of Lake releases sent to the STAs/FEBs in WY2019 (since May 1, 2018) is approximately 448,000 acre-feet. The total amount of inflows to the STAs in WY2019 is approximately 1,498,000 acre-feet. Most STA cells are at or near 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-1E Central Flow-way for vegetation management activities and STA-5/6 Flow-ways 1 and 4 to facilitate the Restoration Strategies grading project in Flow-ways 2 and 3. This week, if Lake releases are sent to the WCAs and conditions allow, releases will be sent to STA-2.

Everglades

Keeping rainfall runoff within the Everglades system, distributing it equally across the WCAs, and moving it south through the system when possible remains ecologically beneficial as the WCAs are at or near average stages for this time of year, with WCA-2A now trending towards the Zone A regulation line. Stages in Taylor Slough are receding as is typical for this time of year and flows to Florida Bay have become less dependable and less consistent. The 30-day moving average salinity at the MFL sentinel site TR has risen to 10.5 psu and is still rising. Salinities within the bay range from 29 psu to 39 psu and remain slightly above average for this time of year. Wading bird nesting has begun at the Alley North colony in WCA-3A and the coastal colonies: Broad River, Otter and Cabbage Bay.

Supporting Information

KISSIMMEE BASIN

Kissimmee Basin Rainfall

The Upper Kissimmee Basin received 0.20 inches of rainfall in the past week and the Lower Basin received 0.01 inches (SFWMD Daily Rainfall Report 4/1/2018).

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: 4/2/2019

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)						
							3/31/19	3/24/19	3/17/19	3/10/19	3/3/19	2/24/19	2/17/19
Lakes Hart and Mary Jane	S-62	10	LKMJ	60.4	R	60.7	-0.3	-0.4	-0.5	-0.3	-0.3	-0.2	0.0
Lakes Myrtle, Preston, and Joel	S-57	0	S-57	60.7	R	60.7	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1
Alligator Chain	S-60	0	ALLI	63.6	R	63.6	0.0	-0.1	-0.3	-0.2	-0.2	-0.2	-0.2
Lake Gentry	S-63	30	LKGT	61.1	R	61.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
East Lake Toho	S-59	43	TOHOE	56.2	R	57.4	-1.2	-1.4	-1.5	-1.4	-1.4	-1.2	-1.0
Lake Toho	S-61	185	TOHOW, S-61	53.2	R	54.4	-1.2	-1.4	-1.6	-1.4	-1.3	-1.2	-1.0
Lakes Kissimmee, Cypress, and Hatchineha	S-65	452	KUB011, LKIS5B	49.9	R	51.0	-1.1	-0.9	-0.8	-0.8	-0.7	-0.8	-1.0

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: 4/2/2019

Metric	Location	1-Day Average		Average for the Preceding 7-Days ¹								1/27/19
		3/31/2019	3/31/19	3/24/19	3/17/19	3/10/19	3/3/19	2/24/19	2/17/19	2/10/19	2/3/19	
Discharge (cfs)	S-65	421	452	833	529	513	1,368	2,386	3,220	2,653	1,615	950
Discharge (cfs)	S-65A ²	317	353	699	420	409	1,190	2,280	3,154	2,472	1,517	764
Discharge (cfs)	S-65D ²	430	563	859	505	1,103	2,310	3,097	2,668	1,564	1,221	621
Headwater Stage (feet NGVD)	S-65D ²	25.78	25.76	25.77	25.78	25.72	25.76	25.77	25.81	25.82	25.90	26.00
Discharge (cfs)	S-65E ²	393	539	855	497	1,026	2,167	2,945	2,533	1,442	1,151	606
Discharge (cfs)	S-67	0	9	162	0	51	30	53	0	0	0	0
DO (mg/L) ³	Phase I river channel	6.9	6.4	6.2	5.2	5.4	4.1	3.4	4.0	5.3	6.5	6.6
Mean depth (feet) ⁴	Phase I floodplain	0.19	0.24	0.35	0.29	0.43	0.86	1.20	1.25	0.71	0.46	0.12

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

²S-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.

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

⁴1-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)

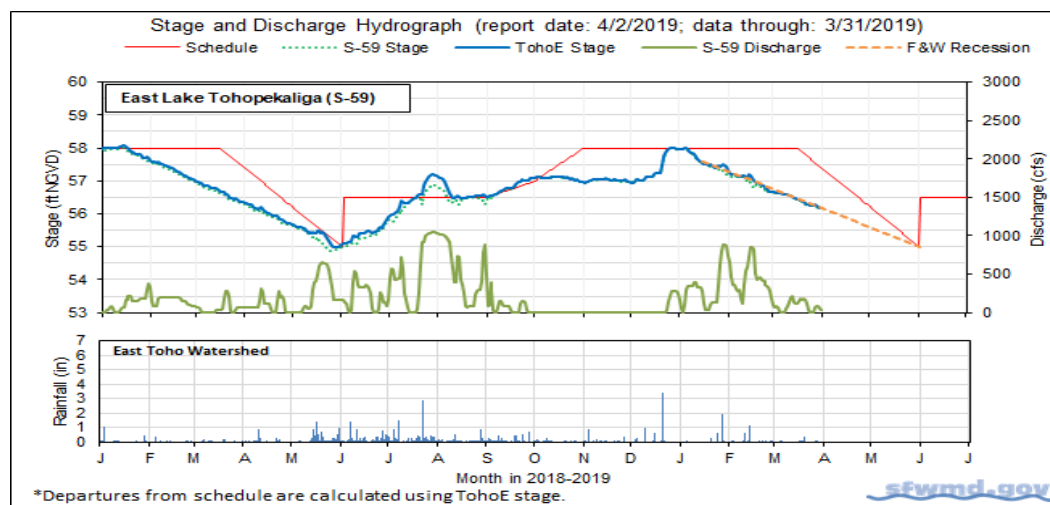


Figure 1.

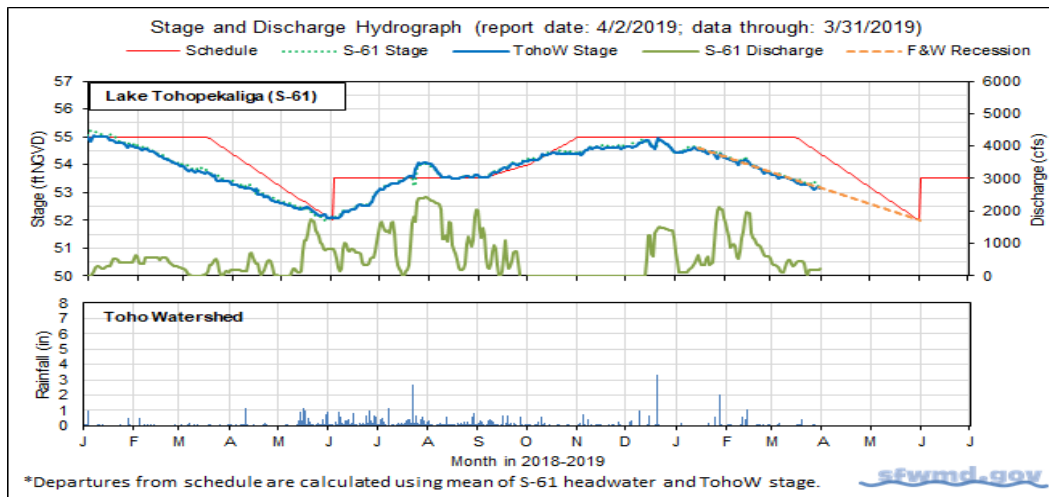


Figure 2.

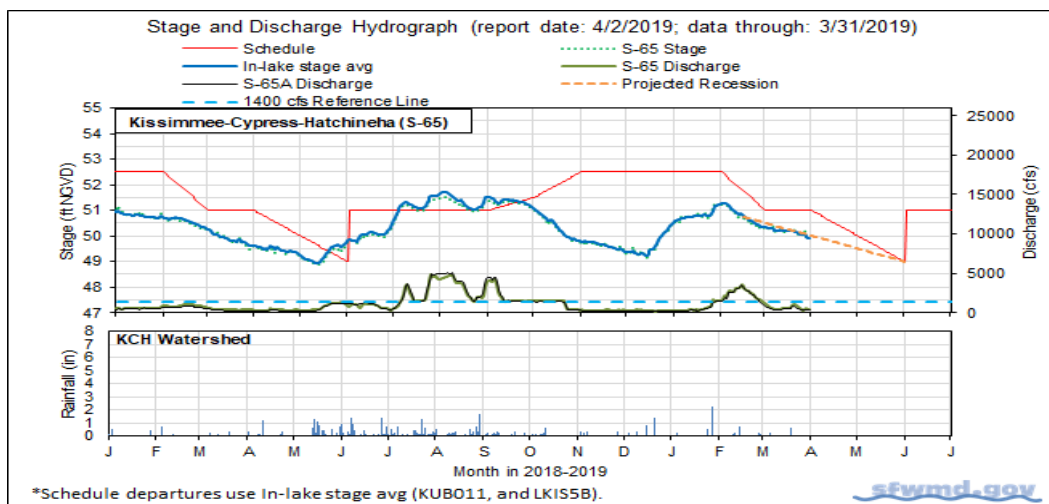


Figure 3.

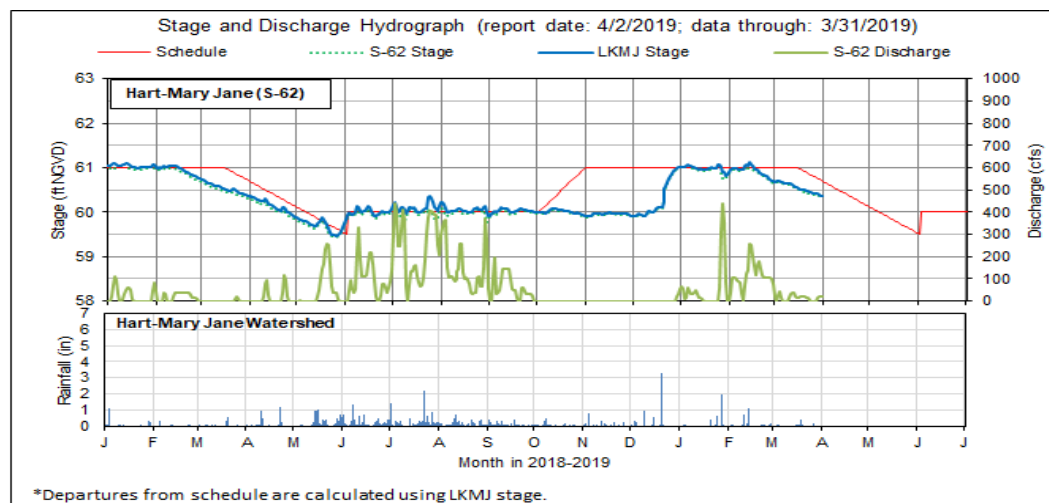


Figure 4.

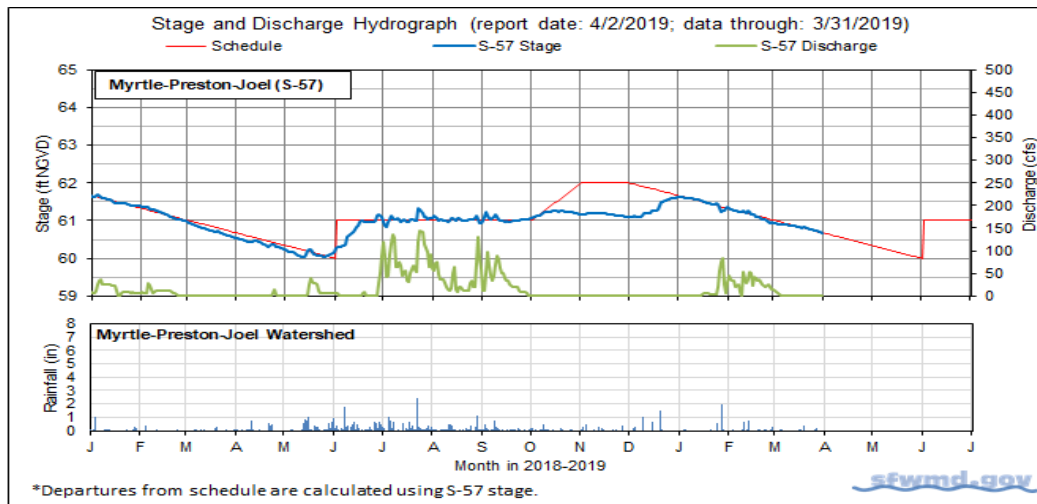


Figure 5.

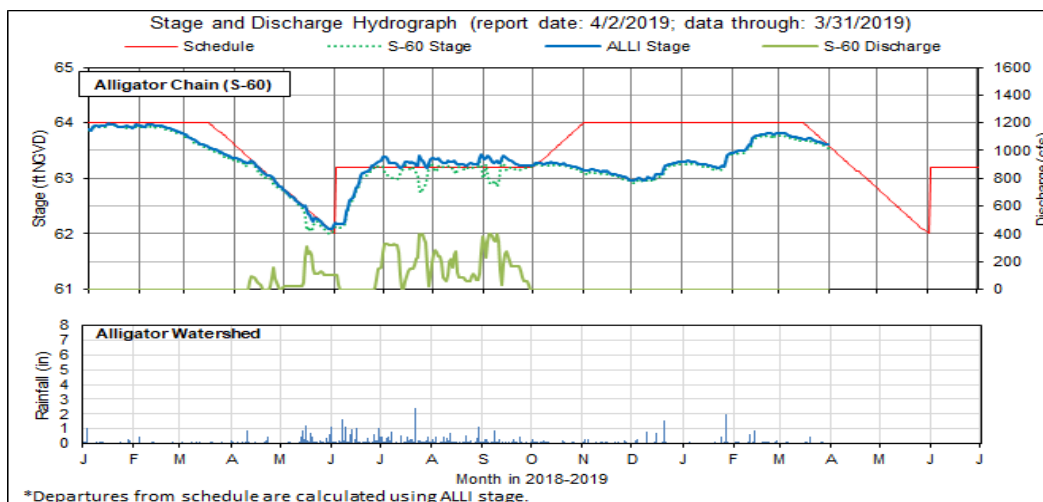


Figure 6.

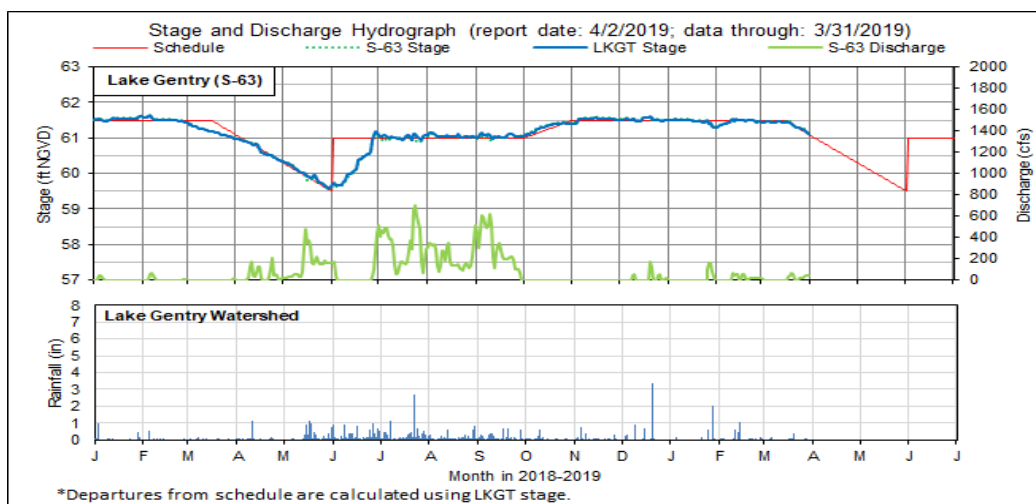


Figure 7.

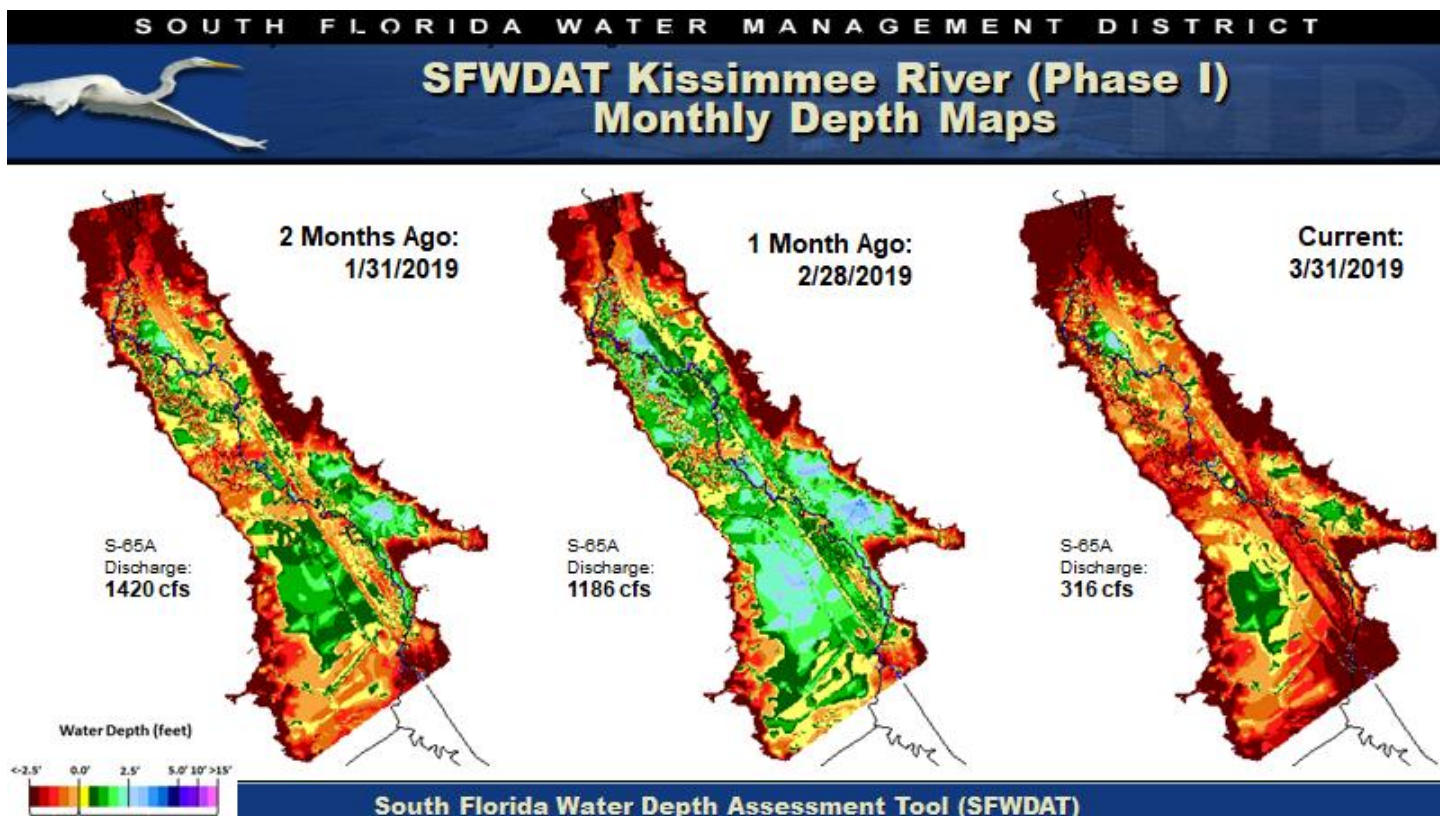


Figure 8. Phase I area floodplain water depths for this week, one month ago, and two months ago. Note that the WDAT color-coding has been modified to accommodate greater water depths; these maps are not directly comparable to Kissimmee Basin WDAT maps published prior to January 16, 2012.

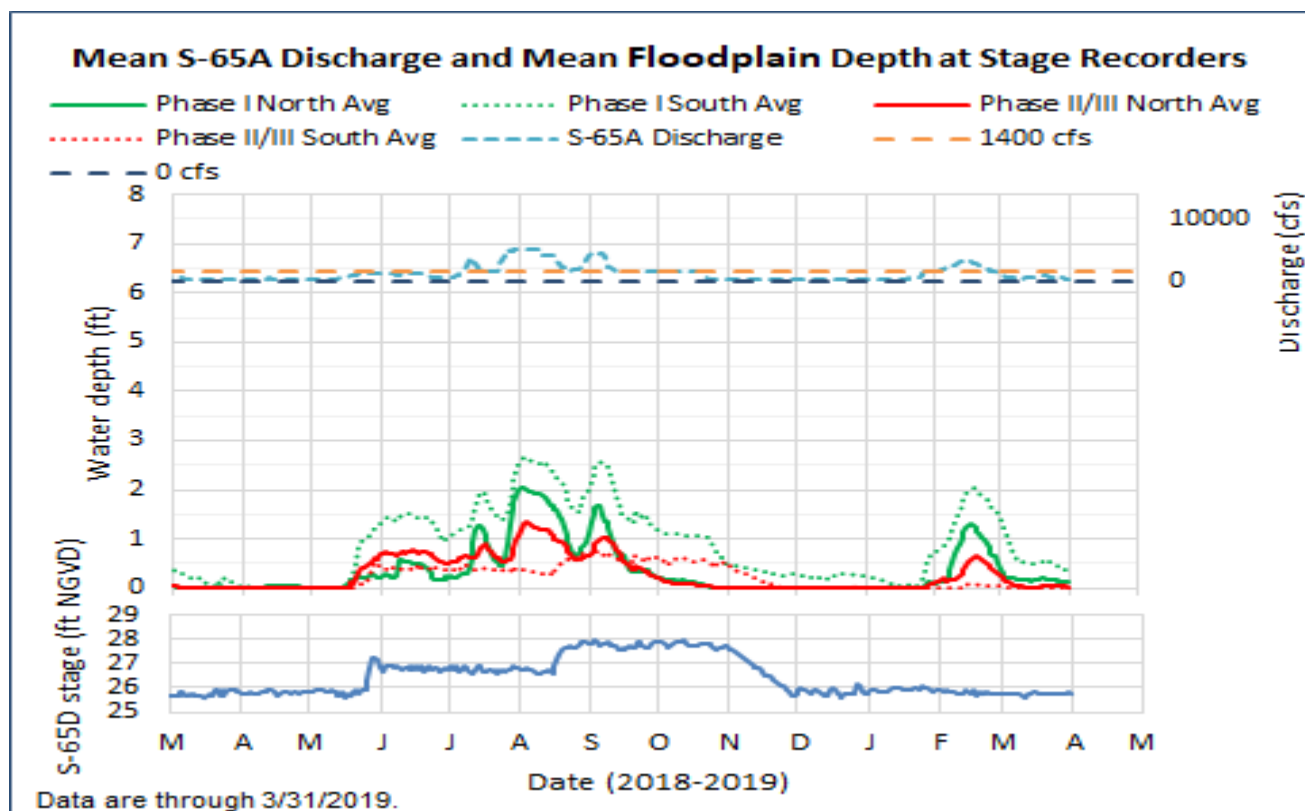


Figure 9. Mean water depth at stage recorders in the northern Phase I, southern Phase I, northern Phase II/III, and southern Phase II/III areas in relation to the S-65A discharge and S-65D headwater stage.

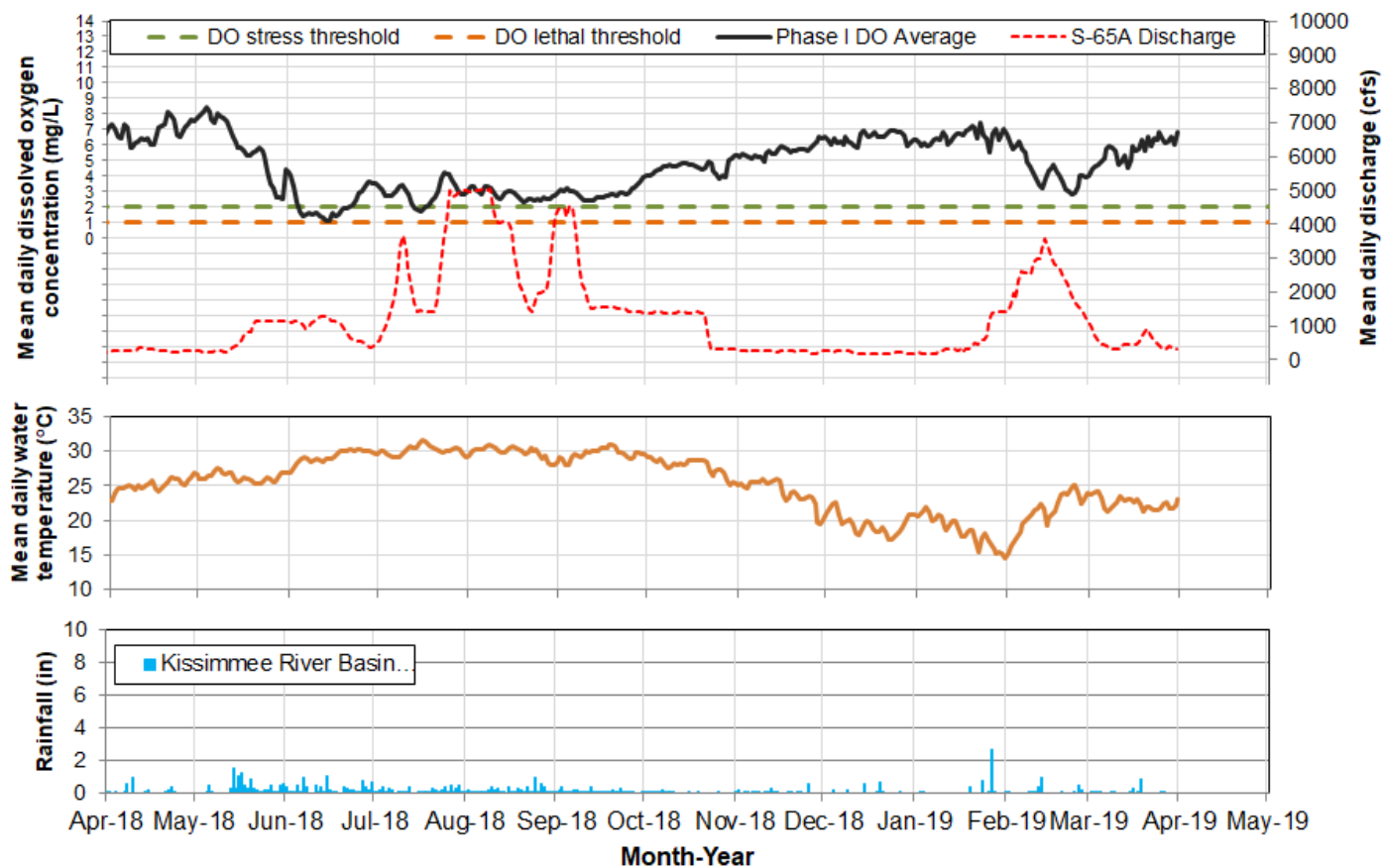


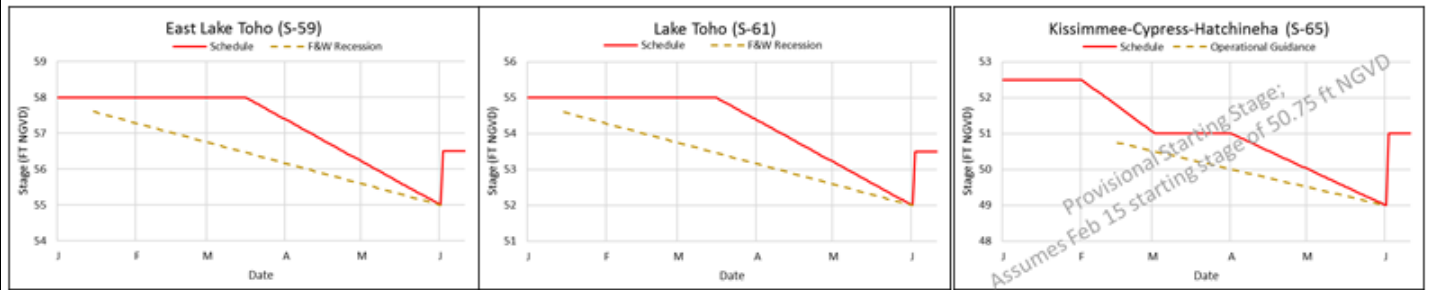
Figure 10. Mean daily dissolved oxygen, discharge, temperature and rainfall in the Phase I river channel.

Water Management Recommendations

Kissimmee Basin Adaptive Recommendations and Operational Actions

Recommendation Date	Recommendation	Purpose	Outcome	Source	Report Date
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
10/22/2018	Reduce S-65/S-65A discharge to approximately 300 cfs (minimum discharge) in one step of approximately 1100 cfs today.	Reduce rate of stage decline in lakes Kissimmee-Cypress-Hatchineha	Implemented	SFWMD Water Mgt/KB Ops	10/23/2018
10/16/2018	No new recommendations.		N/A		10/16/2018
10/9/2018	No new recommendations.		N/A		10/9/2018
10/2/2018	No new recommendations.		N/A		10/2/2018
9/25/2018	No new recommendations.		N/A		9/25/2018
9/18/2018	No new recommendations.		N/A		9/18/2018
9/11/2018	No new recommendations.		N/A		9/11/2018
9/4/2018	No new recommendations.		N/A		9/4/2018
8/28/2018	No new recommendations.		N/A		8/28/2018
8/21/2018	No new recommendations.		N/A		8/21/2018
8/14/2018	No new recommendations.		N/A		8/14/2018
8/7/2018	No new recommendations.		N/A		8/7/2018
7/23/2018-7/24/2018	Increase discharge from 1400 cfs to 3000 cfs, then 3200 cfs and 3500 cfs.	For flood control in Lake Kissimmee.	Implemented	SFWMD Water Mgt/KB Ops	7/31/2018

Dry Season Operations Slide 1 - 2018-2019 (NOTE revised discharge table)



Other Considerations

- KCH starting stage may vary; the maximum is 50.75 ft NGVD on Feb 15.
- Maintain S65/S65A discharge of at least 300 cfs.
- If outlook is for extreme dry conditions meet with KB staff to discuss modifications to this plan.

Version 1: January 14 2019

Discharge Rate of Change Limits for S65/S65A (revised 1/14/19).

Q (cfs)	Maximum rate of INCREASE (cfs/day)	Maximum rate of DECREASE (cfs/day)
0-300	100	-50
301-650	150	-75
651-1400	300	-150
1401-3000	600	-300
>3000	1000	-1000

Figure 11A. Slide 1 of the 2018-2019 Dry Season Operations Plan for S-59, S-61, and S-65/S-65A.

Dry Season Operations Slide 2 - 2018-2019

East Lake (ELT) and Toho (WLT)

- **East Toho and Toho Recessions:**
 - Make releases to begin recessions on Jan 15 with lake stage approximately 0.4 ft below winter pool and continue to follow straight line recessions through May 31st to the extent practical
- **East Toho and Toho Stage Reversals :**
 - Adjust discharge to bring stage back to the recession line within about a week
 - Pre-storm releases may be used to lower stage below the recession line and create storage of about half of the forecast rain volume
 - If stage cannot be brought back to the recession line within about a week, the recession line may need to be reset following discussion with partner agencies
 - In general, the water released from ELT and WLT basins will be released to KHC (to the extent that hydraulic capacity is available) without consideration for Lake KHC stage. However, the priority of KCH is subject to change if more nesting occurs in KCH than Toho or East

Kissimmee-Cypress-Hatchineha (KCH)

- **KCH Recession:**
 - Begin recession on February 15 (subject to change) starting no higher than 50.75 feet
 - To the extent feasible considering discharge constraints, make releases to follow a straight-line recession through May 31
 - In general, use the available storage in Lake KCH to keep flow at S-65D below 1,000 cfs; when possible keep flow below 600 cfs
- **KCH Stage Reversals :**
 - To address reversals, in general increase flow by 100 cfs for every 0.1 foot of rise above the recession line (e.g. from 300 cfs at the line to 800 cfs at 0.5 feet above the line)

Figure 11B. Slide 2 of the 2018-2019 Dry Season Operations Plan for S-59, S-61, and S-65/S-65A.

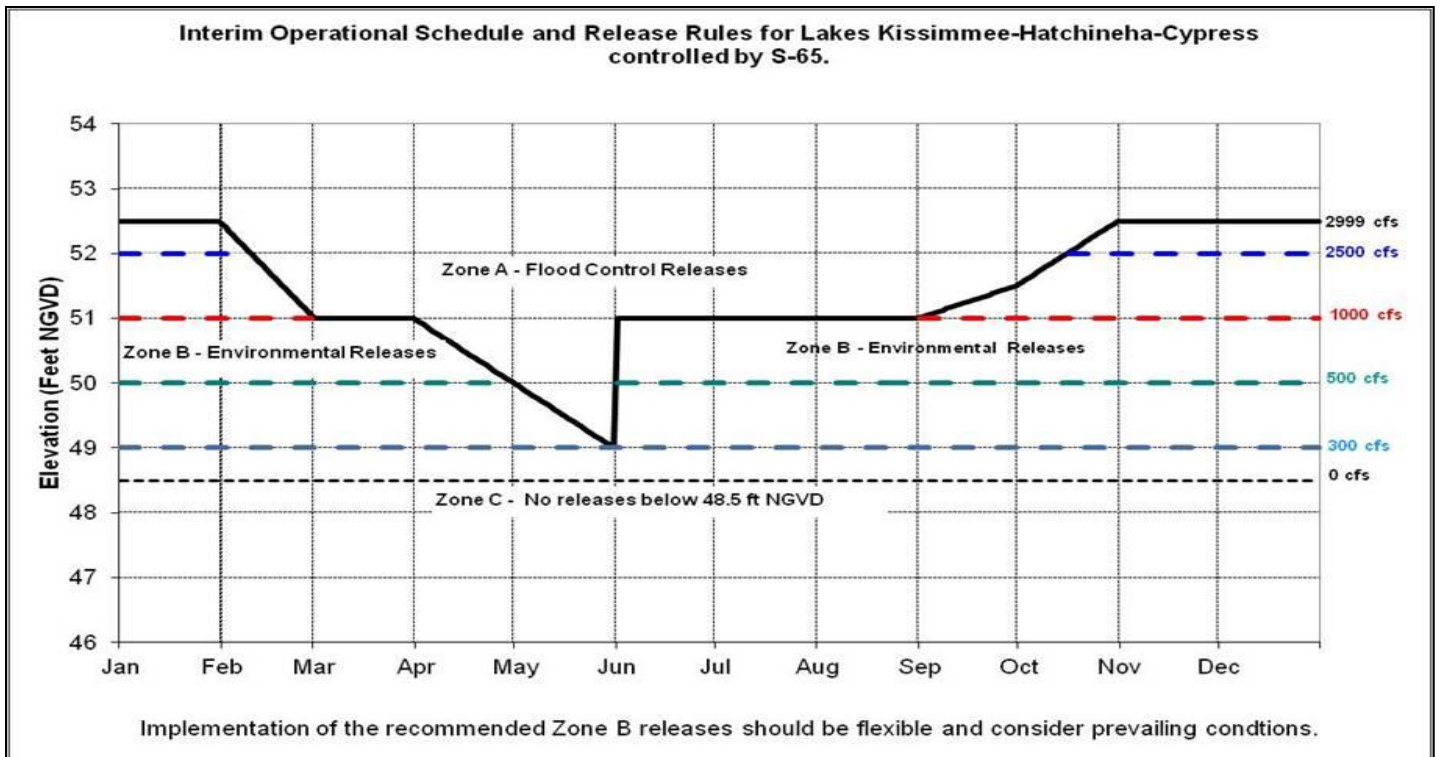


Figure 12. Interim operations schedule for S-65. The discharge schedule shown to the right has not been used in recent years.

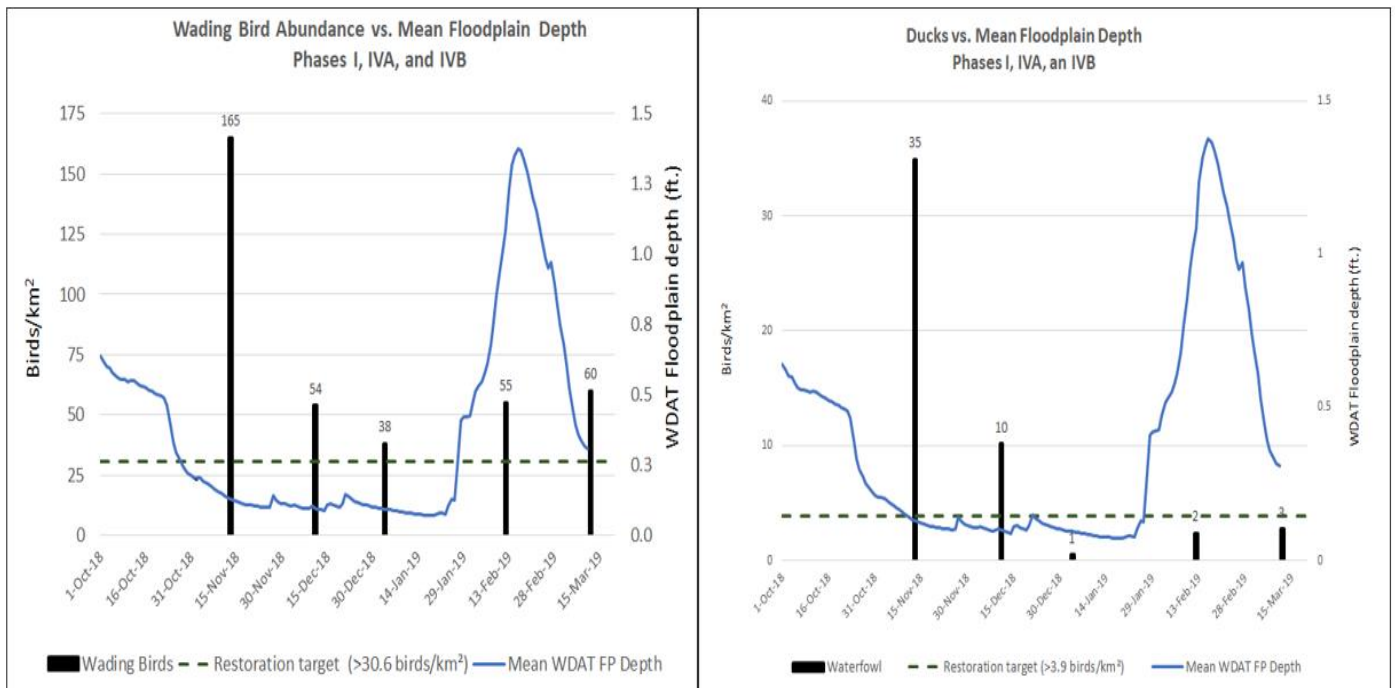


Figure 13. Kissimmee River Wading Bird and Waterfowl Surveys from November 2018 to March 2019.



Figure 14. The Kissimmee Basin.

LAKE OKEECHOBEE

According to the USACE web site, Lake Okeechobee average daily lake stage is at 11.86 feet NGVD for April 1, 2019. 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 0.90 feet lower than a month ago and 1.98 feet lower than a year ago when stages were still recovering from Hurricane Irma (Figure 1). The Lake dropped into the Beneficial Use sub-band on March 7, 2019 and is currently 0.18 feet above the Water Shortage sub-band (Figure 2). Lake stage is the lowest for this time of year since 2011, which followed a very dry rainy season in 2010 (Figure 3). According to RAINДАР, during the week of March 26 - April 1, 2019, 0.06 inches of rain fell directly over the Lake. Much of the remaining watershed received similar amounts except for the upper Kissimmee basin and the east coast which received between 0.25 and 0.75 inches of rain (Figure 4).

Average daily inflows (minus rainfall) to the Lake this week were lower than last week at 471 cfs compared to 1,075 cfs, respectively. The inflows from the Kissimmee River also decreased, going from 908 cfs to 462 cfs. Inflows from the remaining structures decreased from the previous week, including the L8 canal at Canal Point, which averaged 12 cfs of backflow into the Lake versus 31 cfs of backflow the previous week (Table 1).

Total outflows (minus evapotranspiration) increased from the previous week, going from 2,492 average daily cfs to 4,133 cfs this past week (Table 1). Outflows west via S-77 increased from the previous week going from 940 cfs to 1,264 cfs. Outflows to the east via S-308 increased from 16 cfs to 442 cfs, and south through the S-350 structures from 1,535 cfs to 2,426 cfs. The corrected average daily evapotranspiration value for the week based on the L006 and LZ40 weather platform solar radiations was 0.13 inches this week.

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 satellite imagery (Mar 29, 2019) using NOAA's cyanobacteria monitoring product derived from EUMETSAT's Sentinel OLCI sensor data showed bloom potential is low for most of the Lake but is increasing along the western shore and particularly in Fisheating Bay (Figure 6). Bloom potential there is medium, while a few scattered pixels along the western shore showed higher than medium values; suggesting some bloom activity may be visible close to shore along the western marsh, likely within the edge of the emergent marsh where the water is calmer.

Water Management Recommendations

Lake Okeechobee stage is 11.86 feet NGVD, decreasing only 0.25 feet from the previous week. The Lake dropped into the Beneficial Use sub-band on March 7, 2019 and is now 0.18 feet above the Water Shortage sub-band. The Lake remains below the bottom of the ecological envelope (currently 1.2 feet below), which varies seasonally from 12.5 – 15.5 feet NGVD. Given the potential for above average rainfall associated with a weak El Niño conditions this winter/spring and the poor condition of SAV and EAV in the nearshore zone, these lower lake stages are ideal for vegetation recovery, but will reduce habitat for fish and wildlife in the near-term and encourage spread of invasive vegetation in the upper marsh. Satellite imagery suggests the potential for algal blooms has increased along the western shore, particularly within Fisheating Bay.

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 Inflow cfs	Equivalent Depth Week Total (in)
S65E & S65EX1	908	462	0.2
S71 & 72	7	0	0.0
S84 & 84X	167	6	0.0
Fisheating Creek	24	15	0.0
S154	0	0	0.0
S191	0	0	0.0
S133 P	0	0	0.0
S127 P	0	0	0.0
S129 P	0	0	0.0
S131 P	0	0	0.0
S135 P	0	0	0.0
S2 P	0	0	0.0
S3 P	0	0	0.0
S4 P	0	0	0.0
L8 Backflow	-31	-12	0.0
Rainfall	1348	118	0.1
Total	2423	589	0.3

OUTFLOWS	Previous Week Avg Daily cfs	Avg Daily Outflow cfs	Equivalent Depth Week Total (in)
S77	940	1264	0.6
S308	16	442	0.2
S351	326	902	0.4
S352	261	679	0.3
S354	948	845	0.4
L8 Outflow			
ET	2331	1961	0.9
Total	4823	6094	2.9

Provisional Data

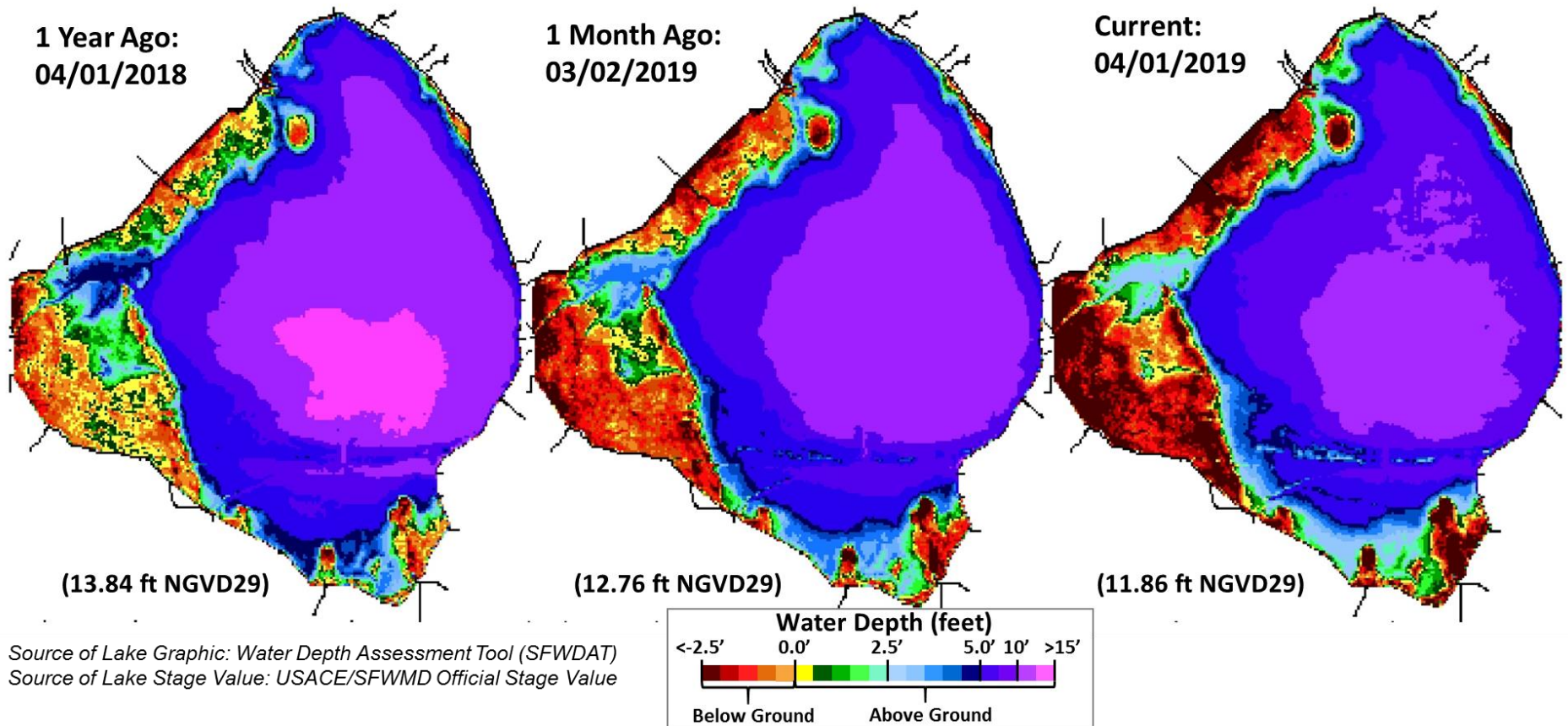


Figure 1. Water depth estimates on Lake Okeechobee based on the South Florida Water Depth Assessment Tool.

Lake Okeechobee Water Level History and Projected Stages

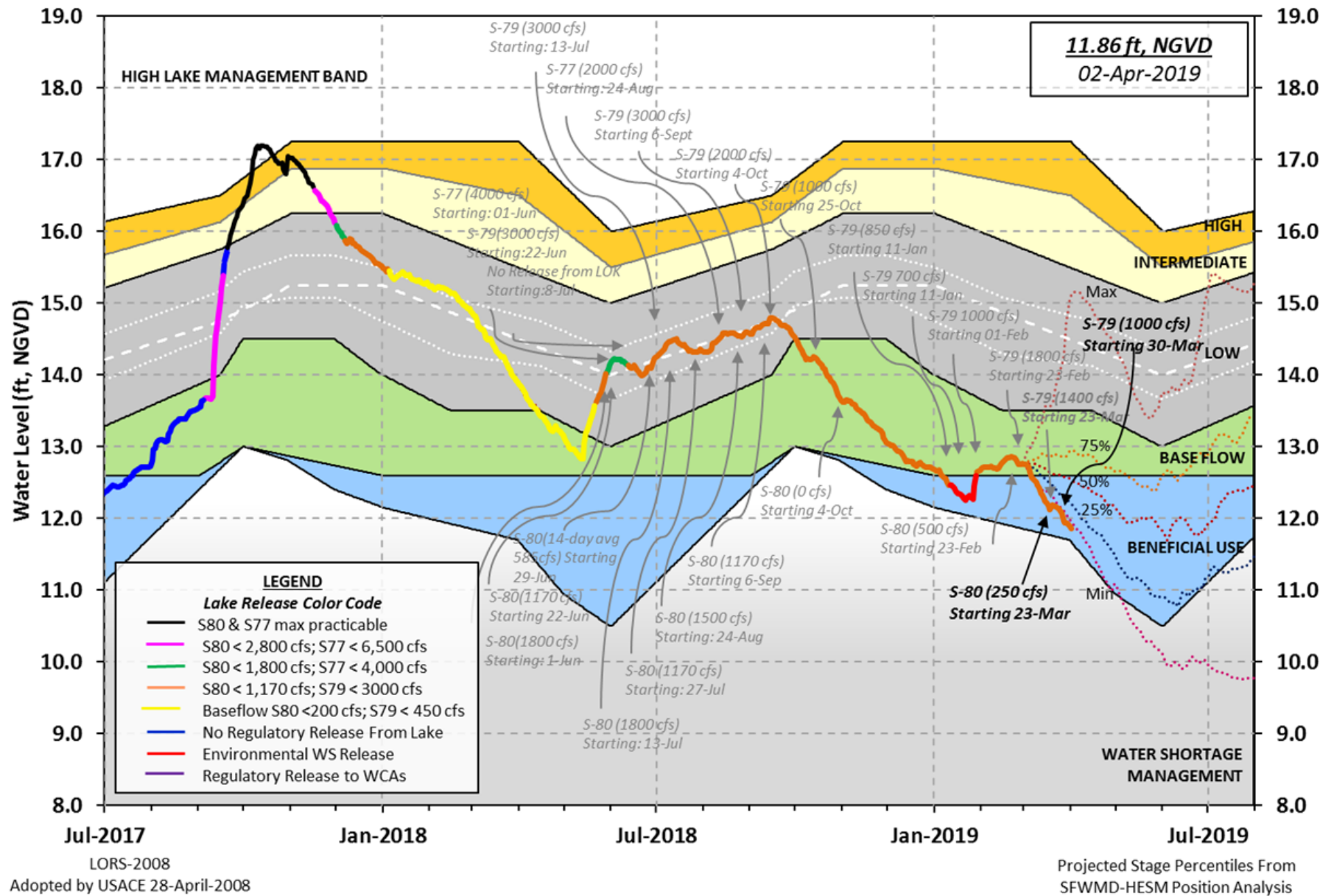


Figure 2. Recent Lake Okeechobee stage and releases, with projected stages based on a dynamic position analysis.

Lake Okeechobee Water Level Comparison

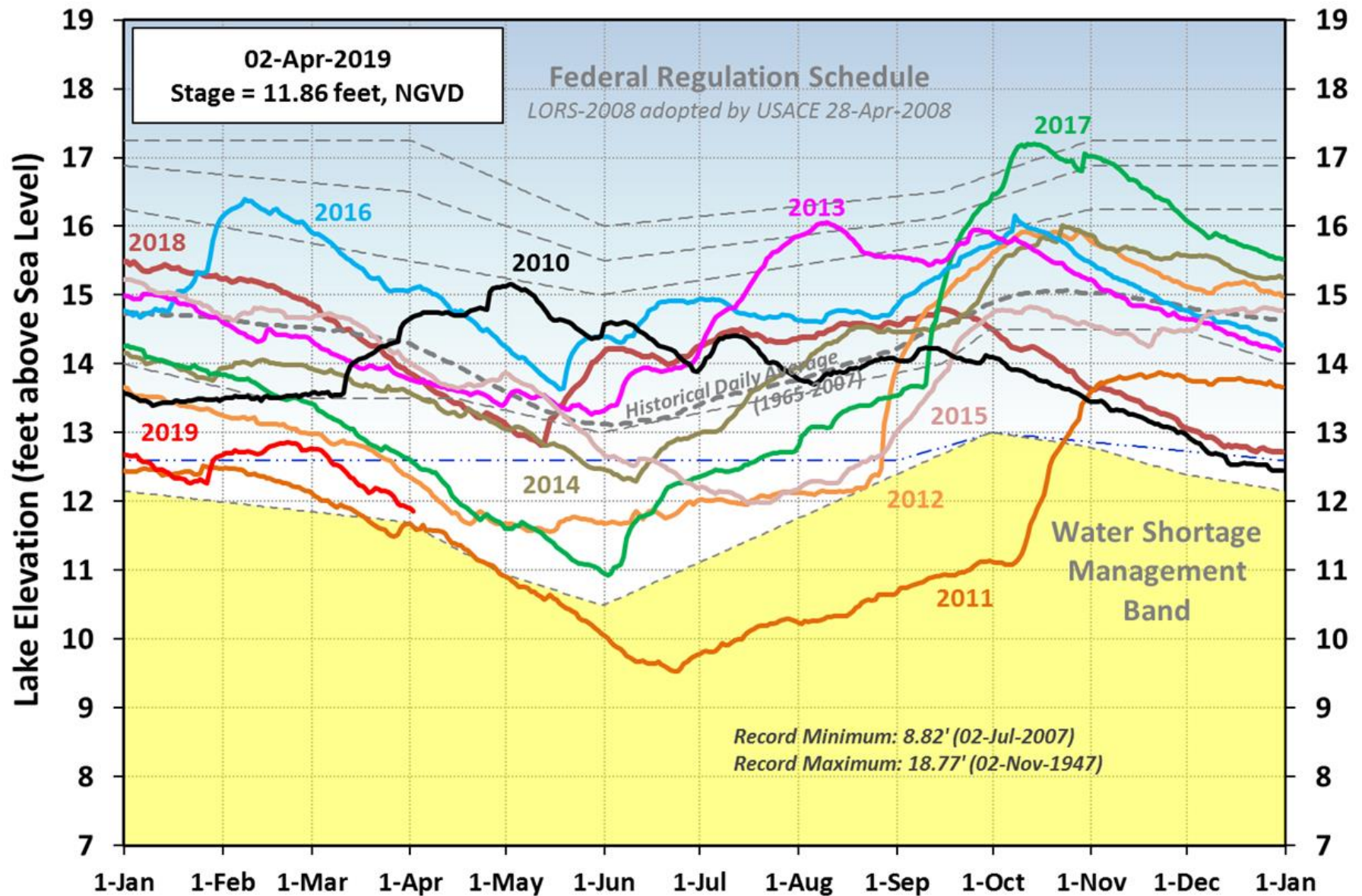


Figure 3. Select annual stage hydrographs for Lake Okeechobee from 2010 – 2019.

SFWMD PROVISIONAL RAINDAR 7-DAY BASIN RAINFALL ESTIMATES

FROM: 0530 EST, 03/26/2019 THROUGH: 0530 EST, 04/02/2019

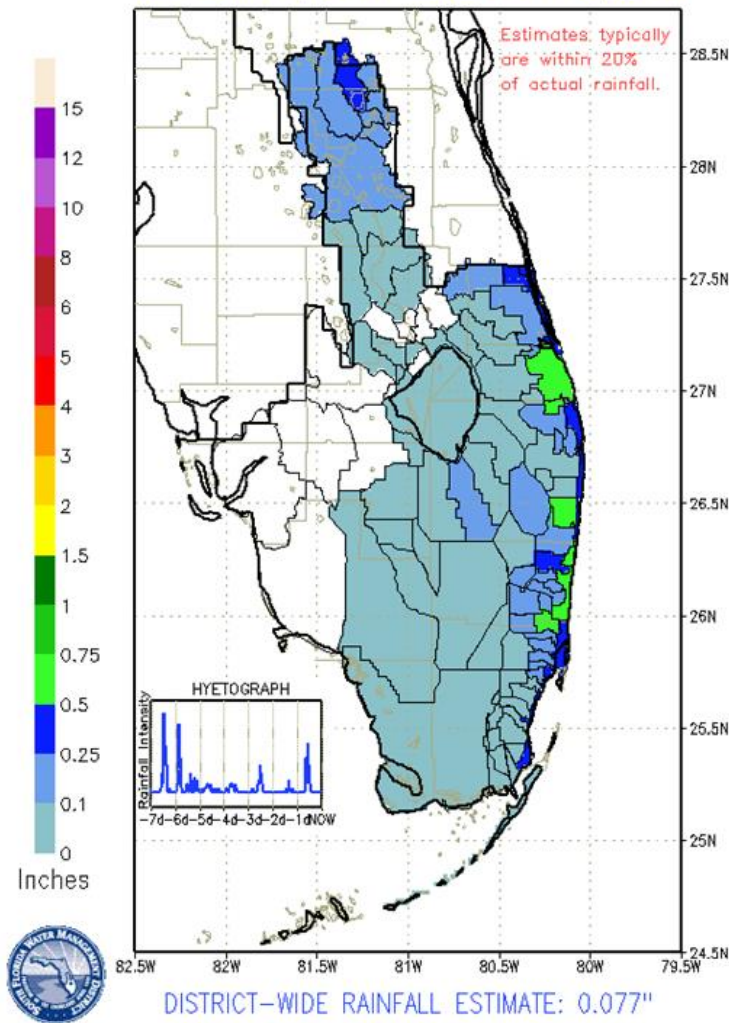


Figure 4. Rainfall estimates by basin.

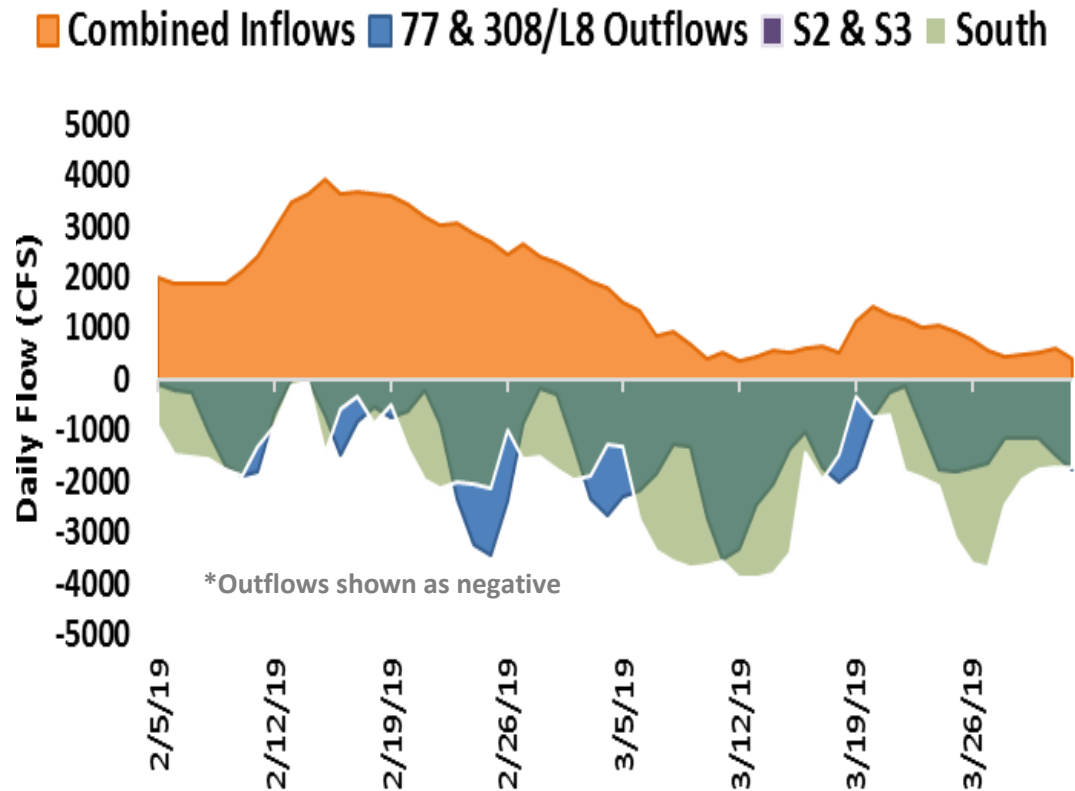


Figure 5. Major inflows (orange) and outflows (blue) of Lake Okeechobee, including the S-350 structures designated as South (green). The L-8 Canal flows through Culvert 10A are included as outflows when positive, and as inflows when backflowing into the lake. All inflows and outflows are shown as positive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

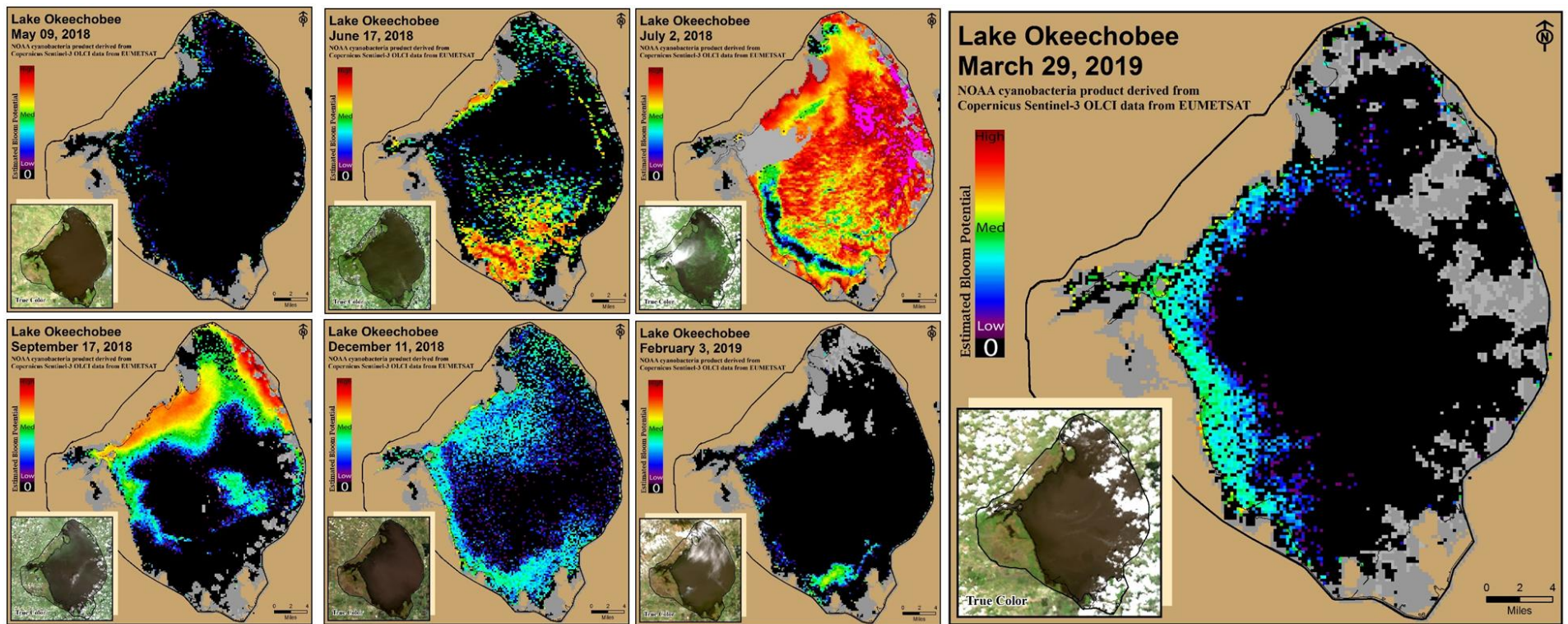


Figure 6. Potential for cyanobacterial blooms on Lake Okeechobee based on NOAA's harmful algal bloom monitoring system derived from Copernicus Sentinel-3 OLCI data from EUMETSAT. Gray indicates cloud cover. All data are experimental and unvalidated at this point in product development.

ESTUARIES

St. Lucie Estuary:

Last week total inflow to the St. Lucie Estuary averaged approximately 265 cfs (Figures 1 and 2) and last month inflow averaged about 629 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	110
S-80	89
S-308	344
S-49 on C-24	0
S-97 on C-23	0
Gordy Rd. structure on Ten Mile Creek	66

Over the past week, salinity increased throughout the estuary (Table 2, Figures 3 and 4). The seven-day moving average salinity of the water column (an average of the surface and bottom salinity) at the US1 Bridge is estimated to be 18.1. 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)	15.0 (14.2)	17.0 (16.1)	NA ¹
US1 Bridge	17.7 (16.4)	18.5 (16.8 ²)	10.0-26.0
A1A Bridge	23.4 (21.6)	28.6 (26.5)	NA ¹

¹Envelope not applicable and ²Three day average.

Caloosahatchee Estuary:

Last week total inflow to the Caloosahatchee Estuary averaged approximately 1,263 cfs (Figures 5 and 6) and last month inflow averaged about 1,835 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	1,264
S-78	880
S-79	1,145
Tidal Basin Inflow	118

Over the past week in the estuary, surface salinity remained about the same to Val I-75 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 at Shell Point (Figure 9). The seven-day average salinity value was not available at Sanibel. The 30-day moving average surface salinity is 0.3 at Val I-75 and 2.5 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)	0.2 (0.2)	0.2 (0.2)	NA ¹
Val I75	0.3 (0.3)	0.4 (0.3)	0.0-5.0 ²
Ft. Myers Yacht Basin	3.2 (2.2)	5.6 (2.7)	NA
Cape Coral	9.8 (9.7)	13.2 (12.3 ³)	10.0-30.0
Shell Point	21.5 (20.8)	22.0 (20.6)	10.0-30.0
Sanibel	NR ⁴ (NR)	NR (NR)	10.0-30.0

¹Envelope not applicable, ²Envelope is based on a 30-day average, ³Two day average, and ⁴Not 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 2.1 to 3.8 at the end of the next two weeks for pulse release at S-79 ranging from 0 to 1000 cfs and Tidal Basin inflows of 175 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	175	3.8	1.2
B	300	175	3.5	1.2
C	450	175	2.9	1.1
D	650	175	2.2	1.0
E	1000	175	2.1	0.9

Red tide

The Florida Fish and Wildlife Research Institute reported on March 29, 2019, that *Karenia brevis*, the Florida red tide dinoflagellate, was observed in one sample collected offshore of Lee County. *Karenia brevis* was not observed in samples collected in Palm Beach County (no samples were collected from St. Lucie, Martin, Broward or Miami-Dade counties).

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, although some limited benefits may accrue to areas further downstream.

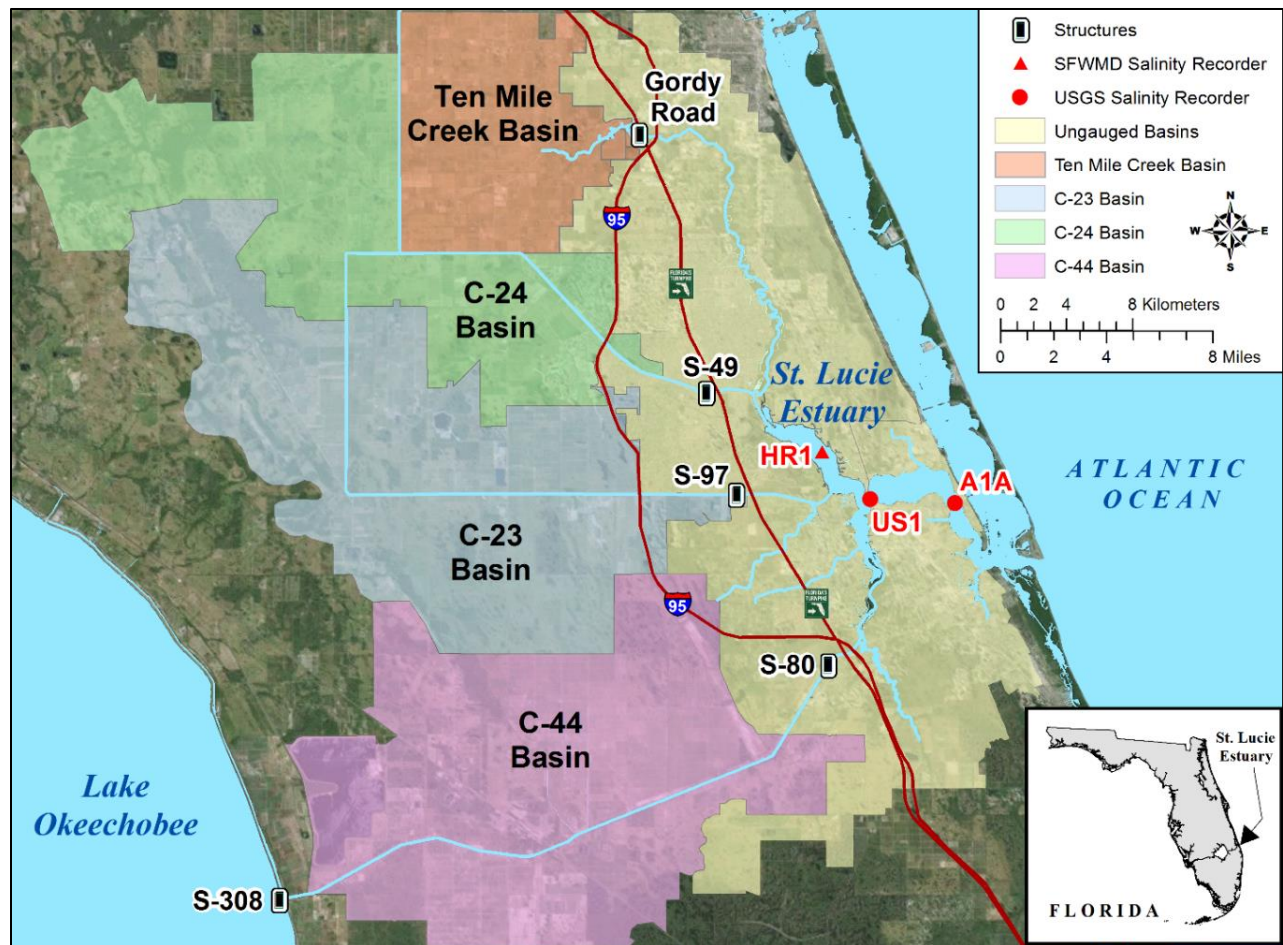


Figure 1. Basins, water control structures, and salinity monitoring for the St. Lucie Estuary.

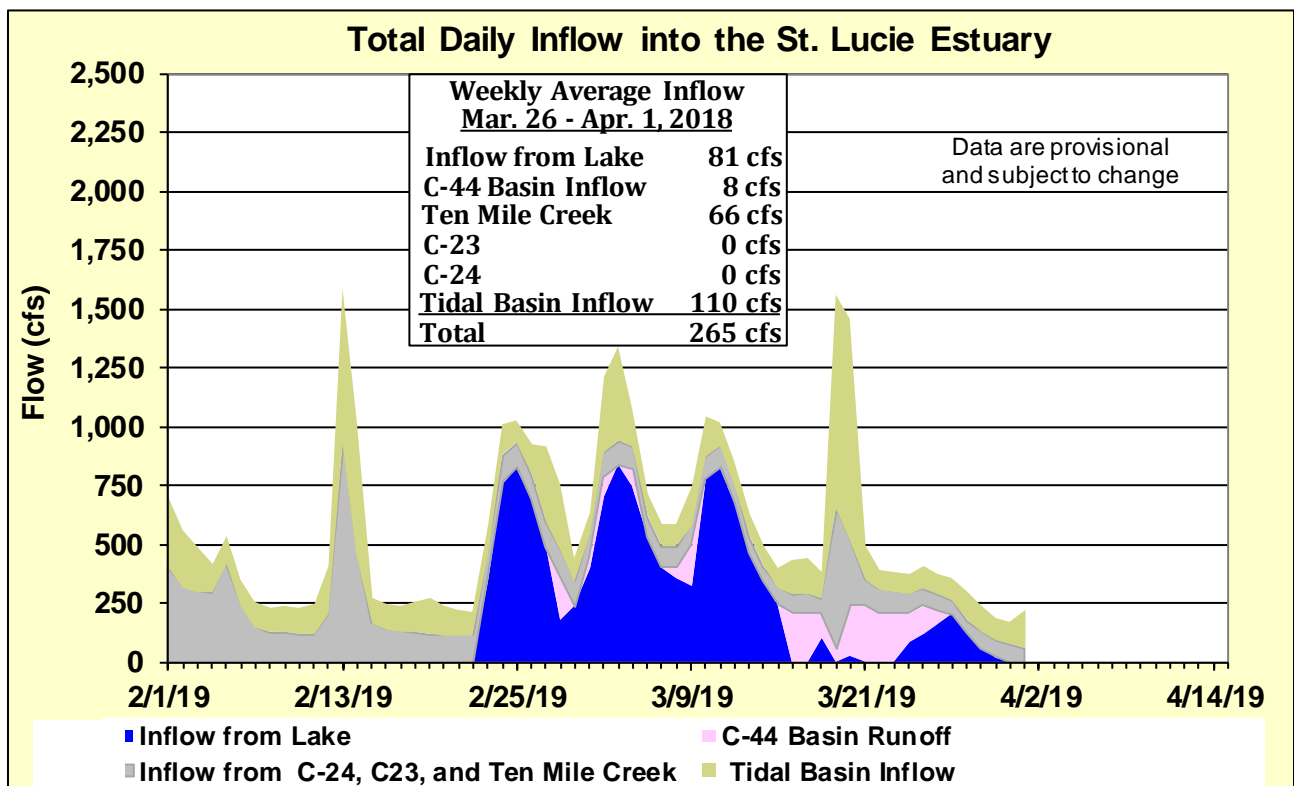


Figure 2. Total daily inflows from Lake Okeechobee and runoff from the C-44, C-23, C-24, Ten Mile Creek, and tidal basins into the St. Lucie Estuary.

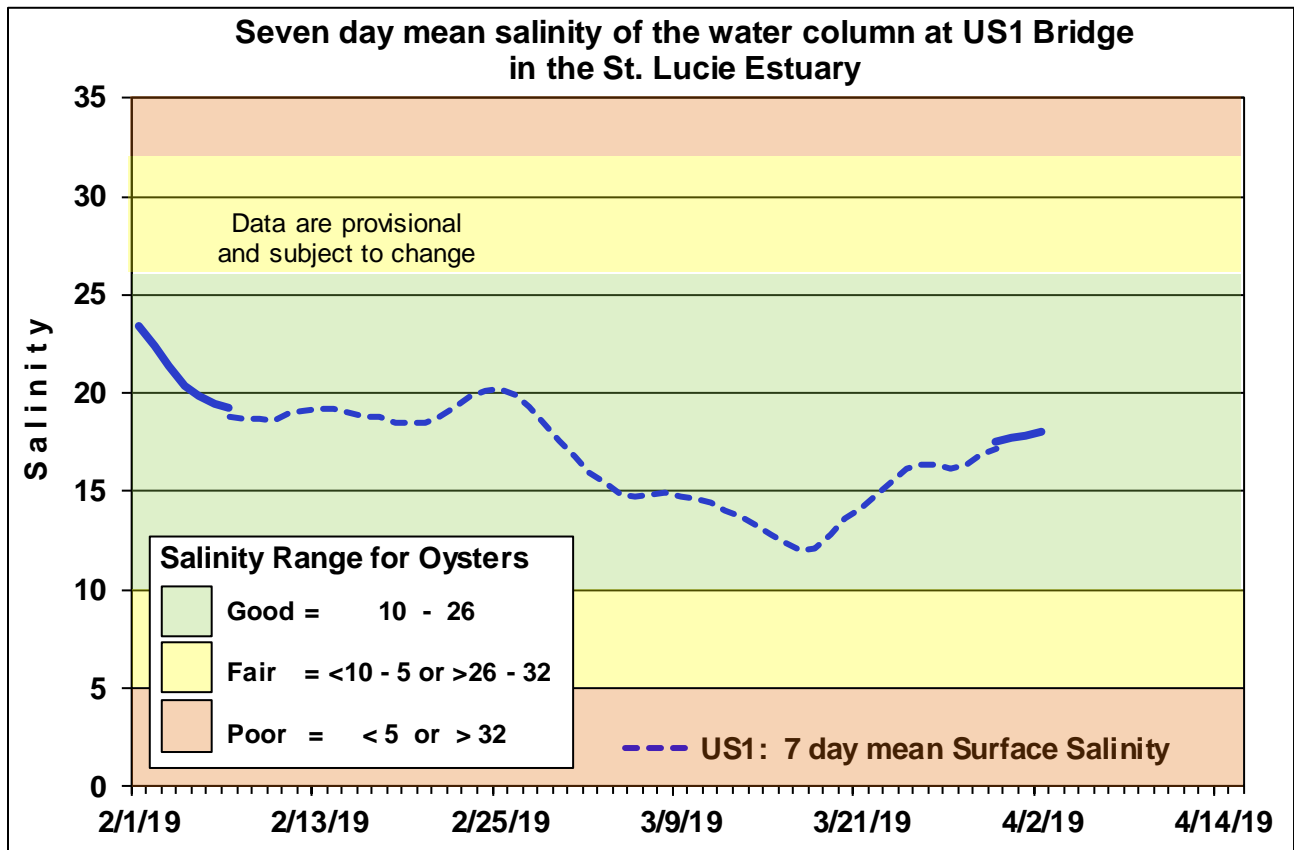


Figure 3. Seven-day mean salinity of the water column at the US1 Bridge.

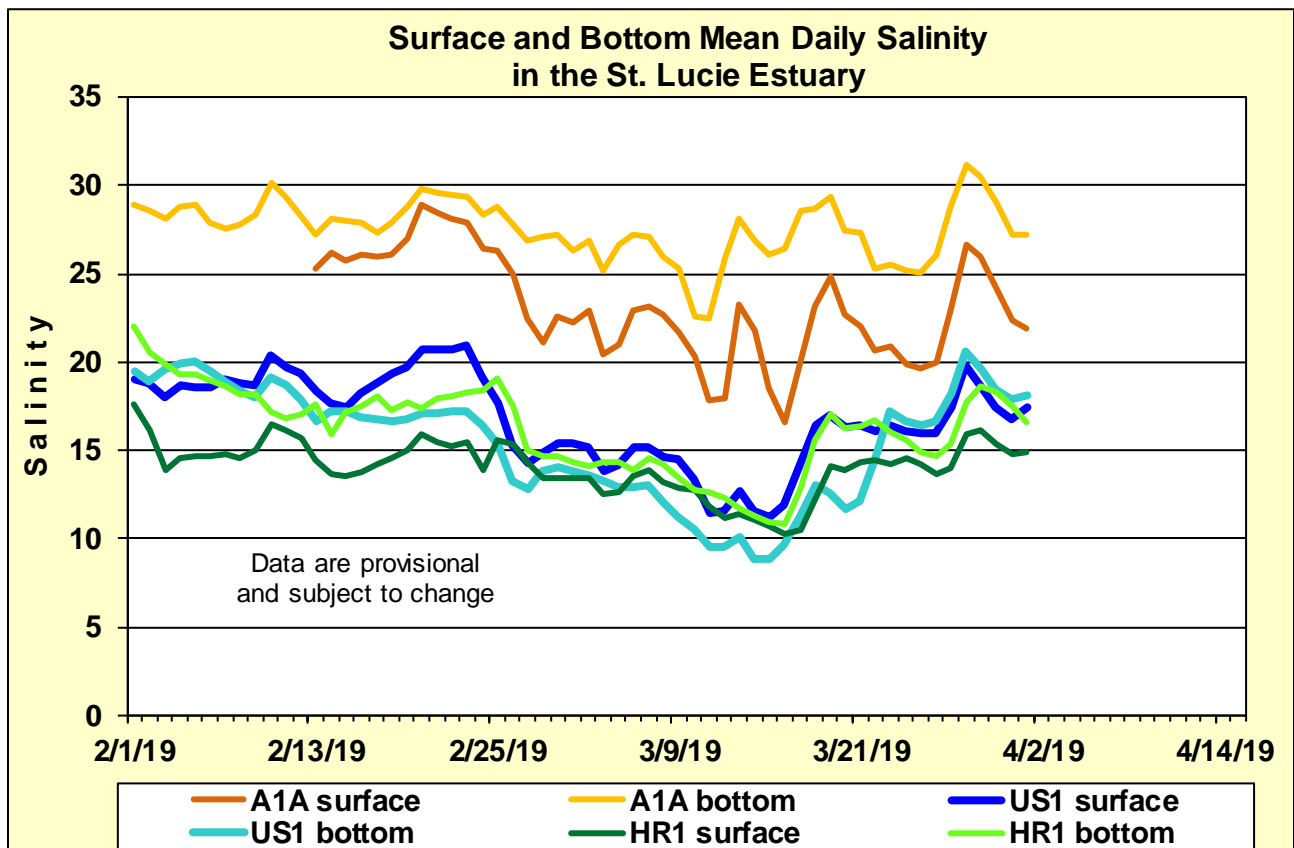


Figure 4. Daily mean salinity at the A1A, US1 and estimated HR1 stations.

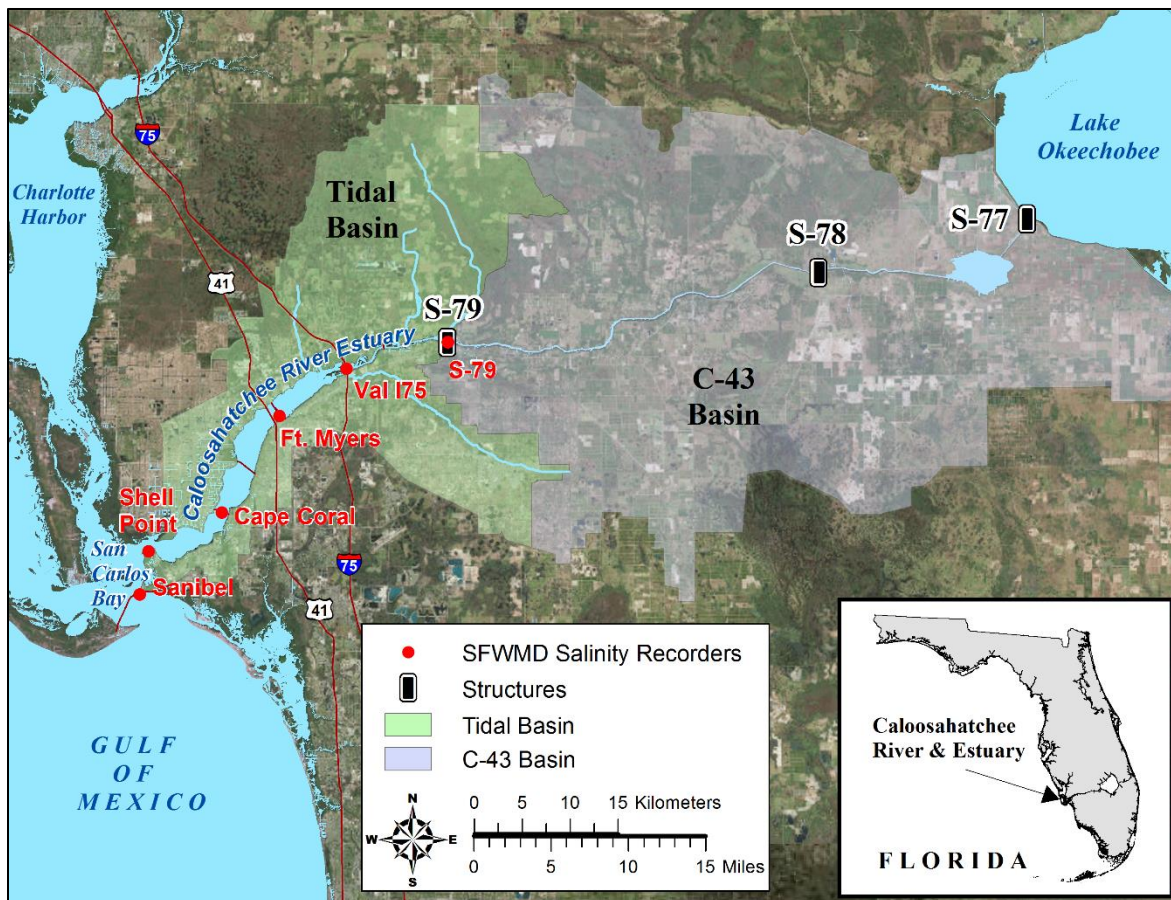


Figure 5. Basins, water control structures, and salinity monitoring for the Caloosahatchee Estuary.

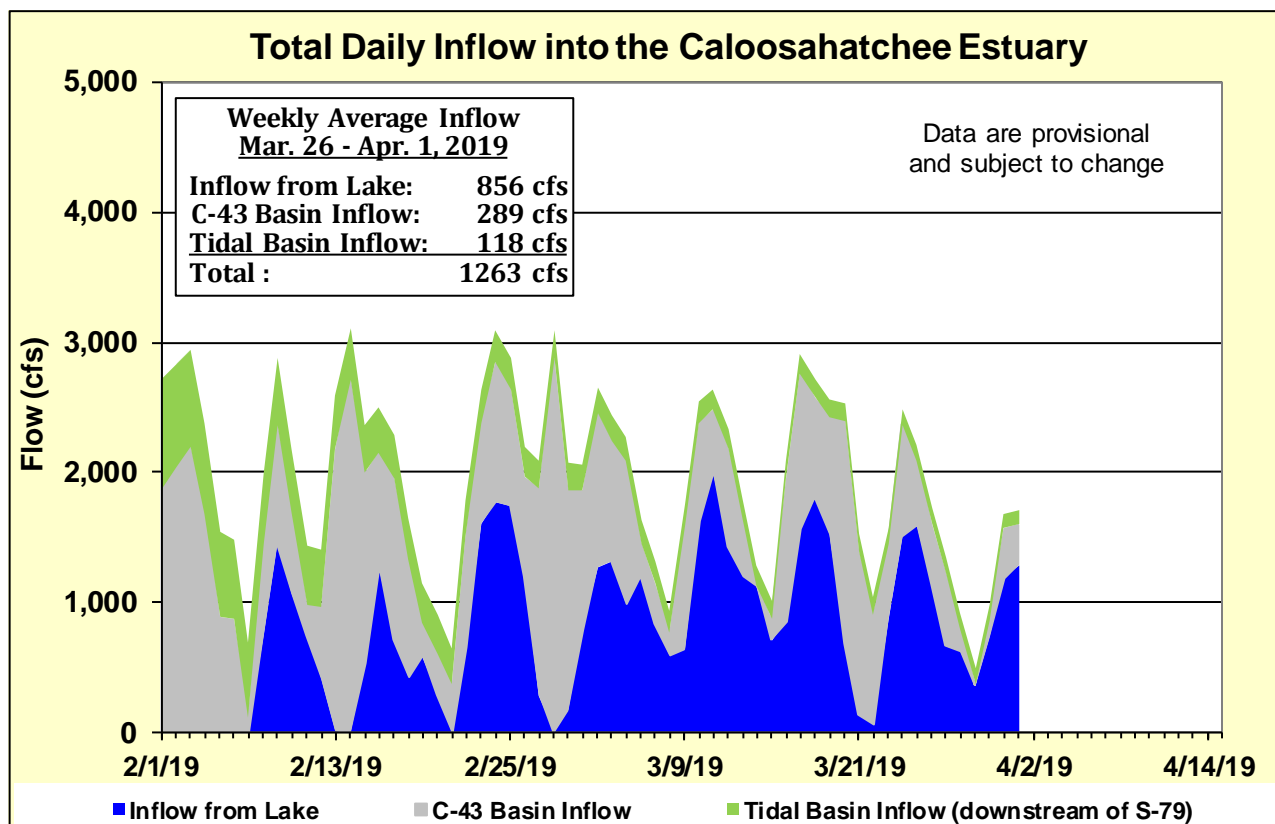


Figure 6. Total daily inflows from Lake Okeechobee, runoff from the C-43 basin, and tributaries in the tidal basin into the Caloosahatchee River Estuary.

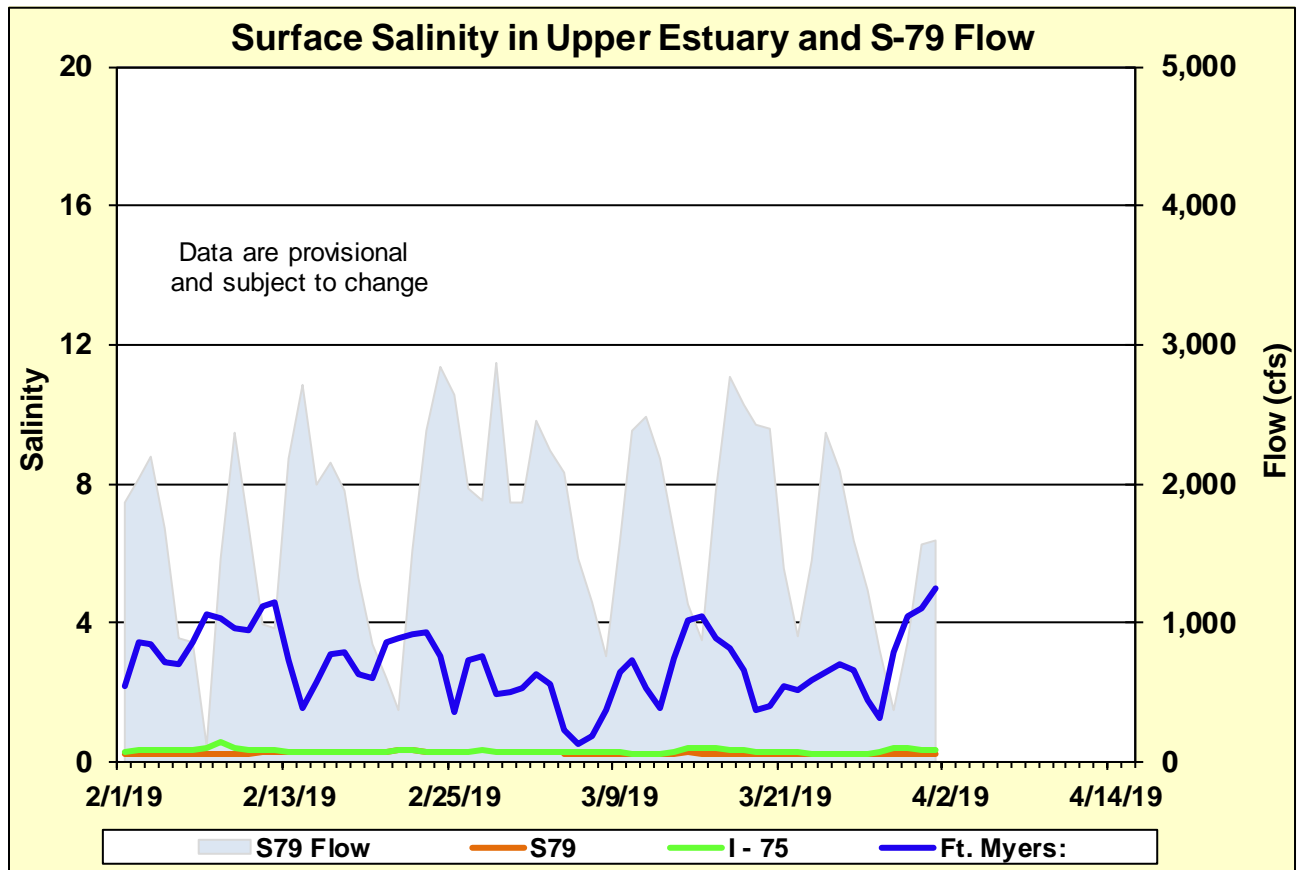


Figure 7. Daily mean flows at S-79 and salinity at upper estuary monitoring stations.

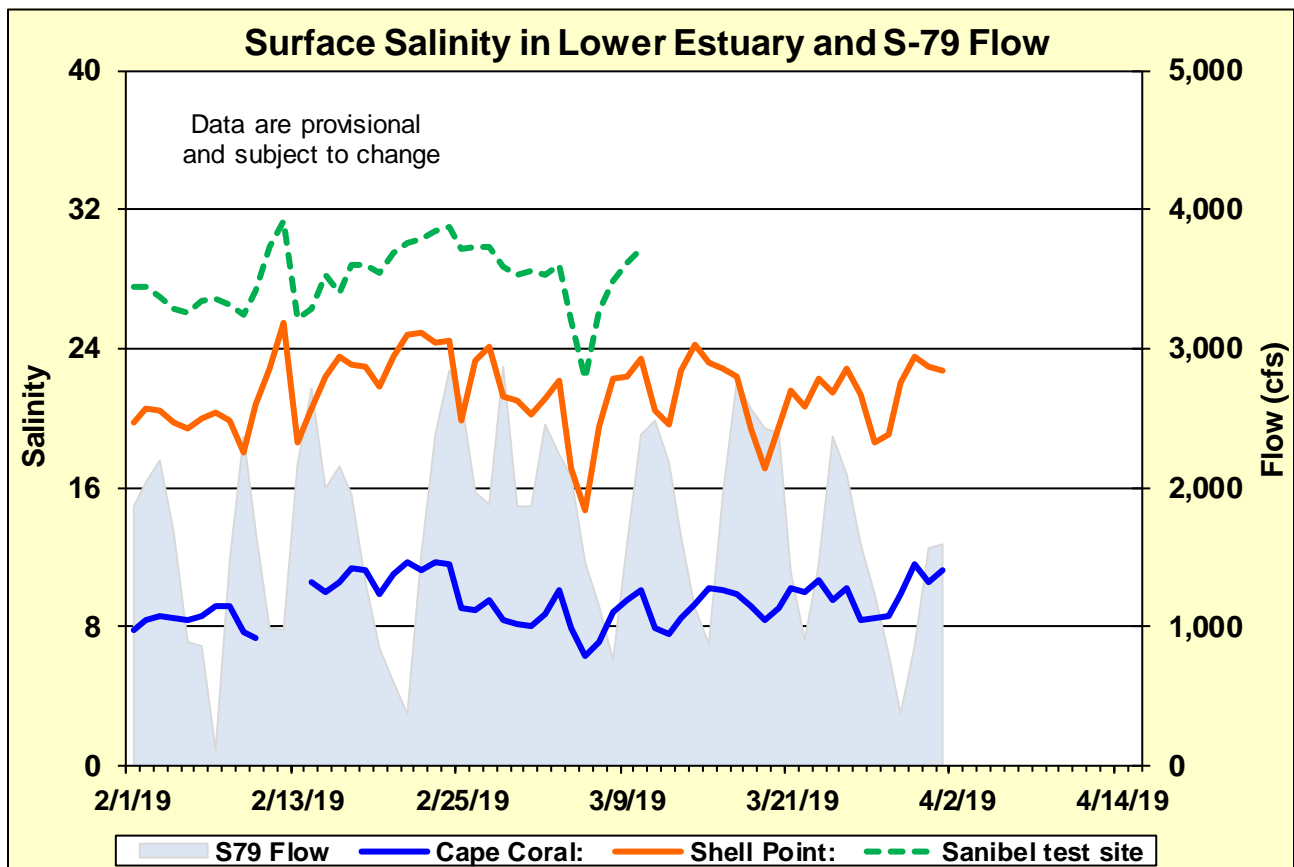


Figure 8. Daily mean flows at S-79 and salinity at lower estuary stations.

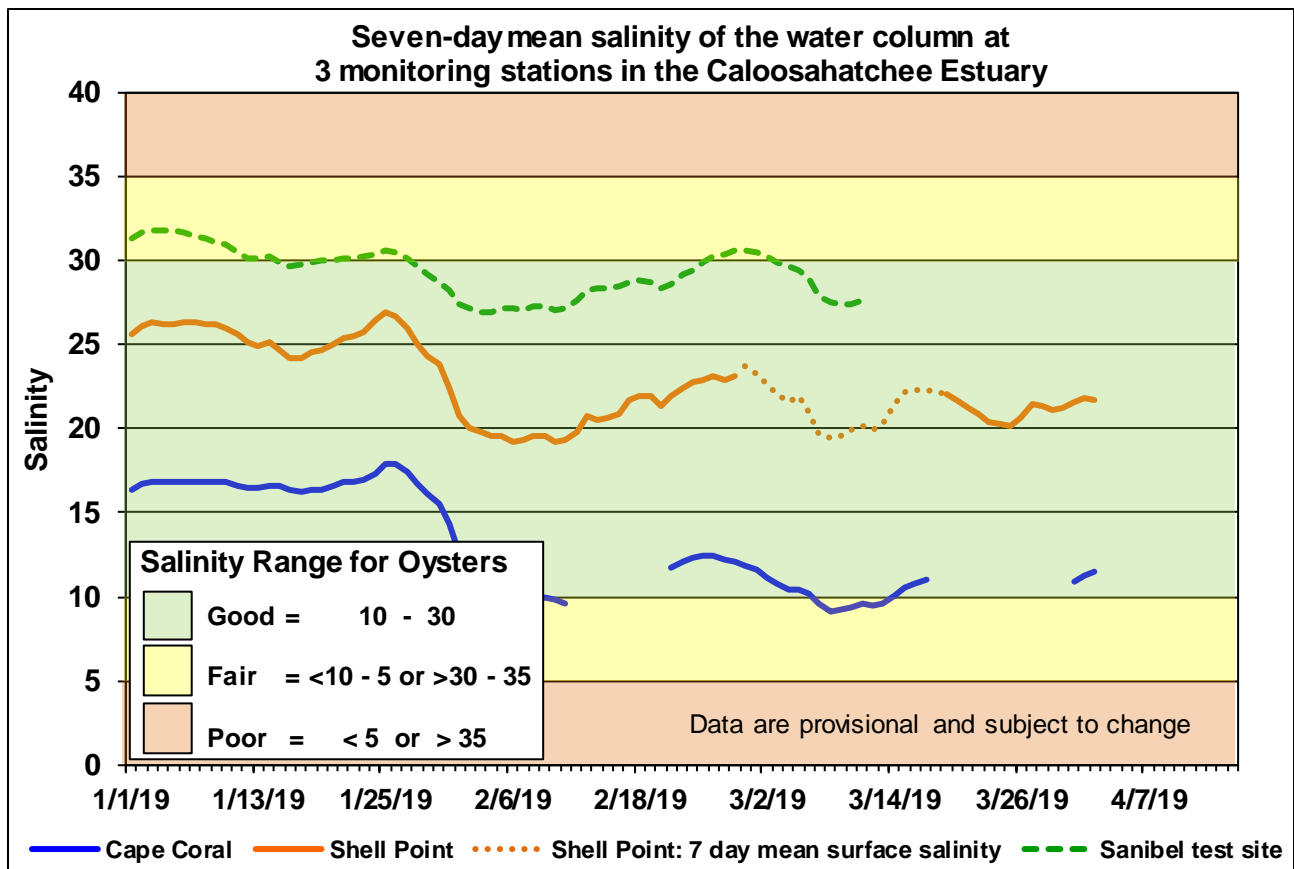


Figure 9. Seven-day mean salinity at Cape Coral, Shell Point, and Sanibel monitoring stations.

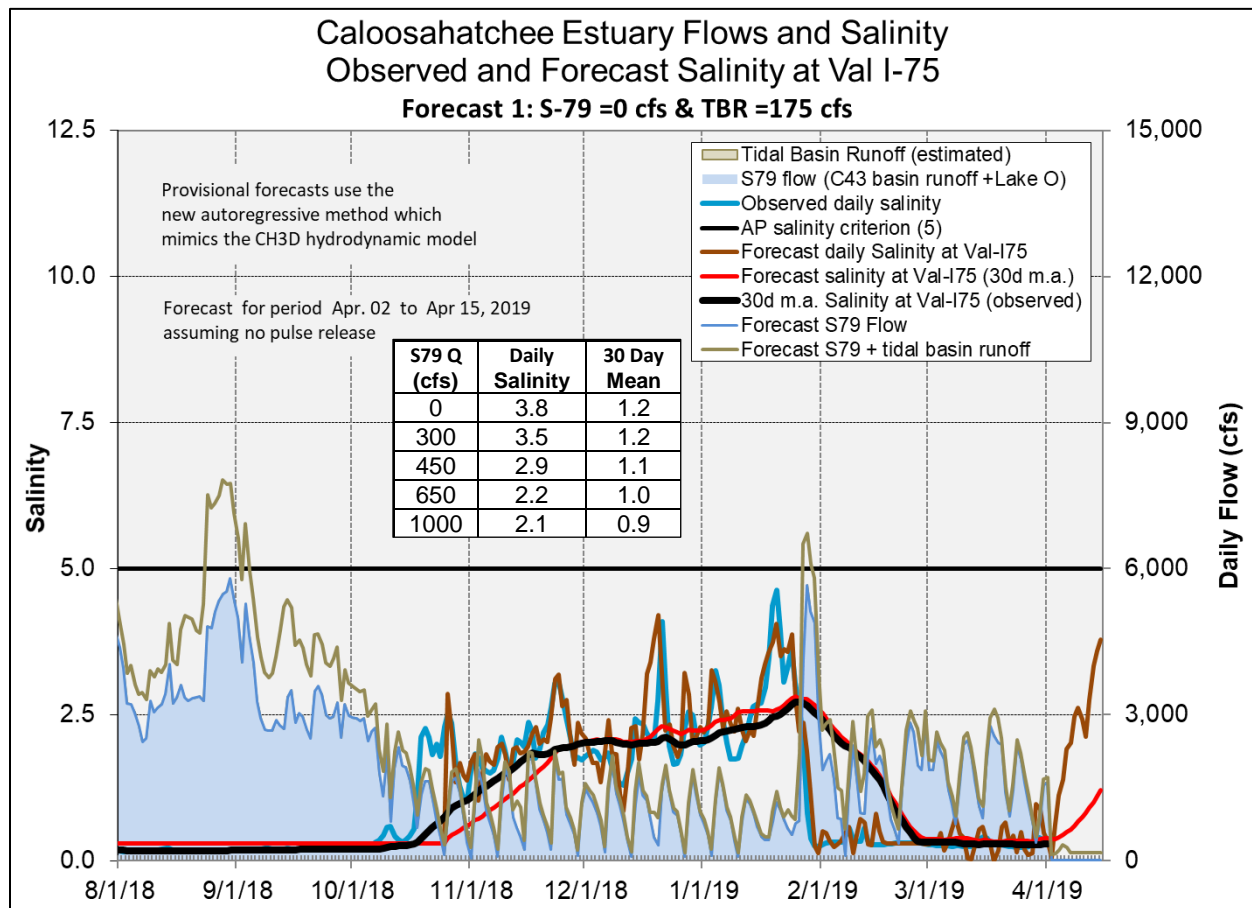



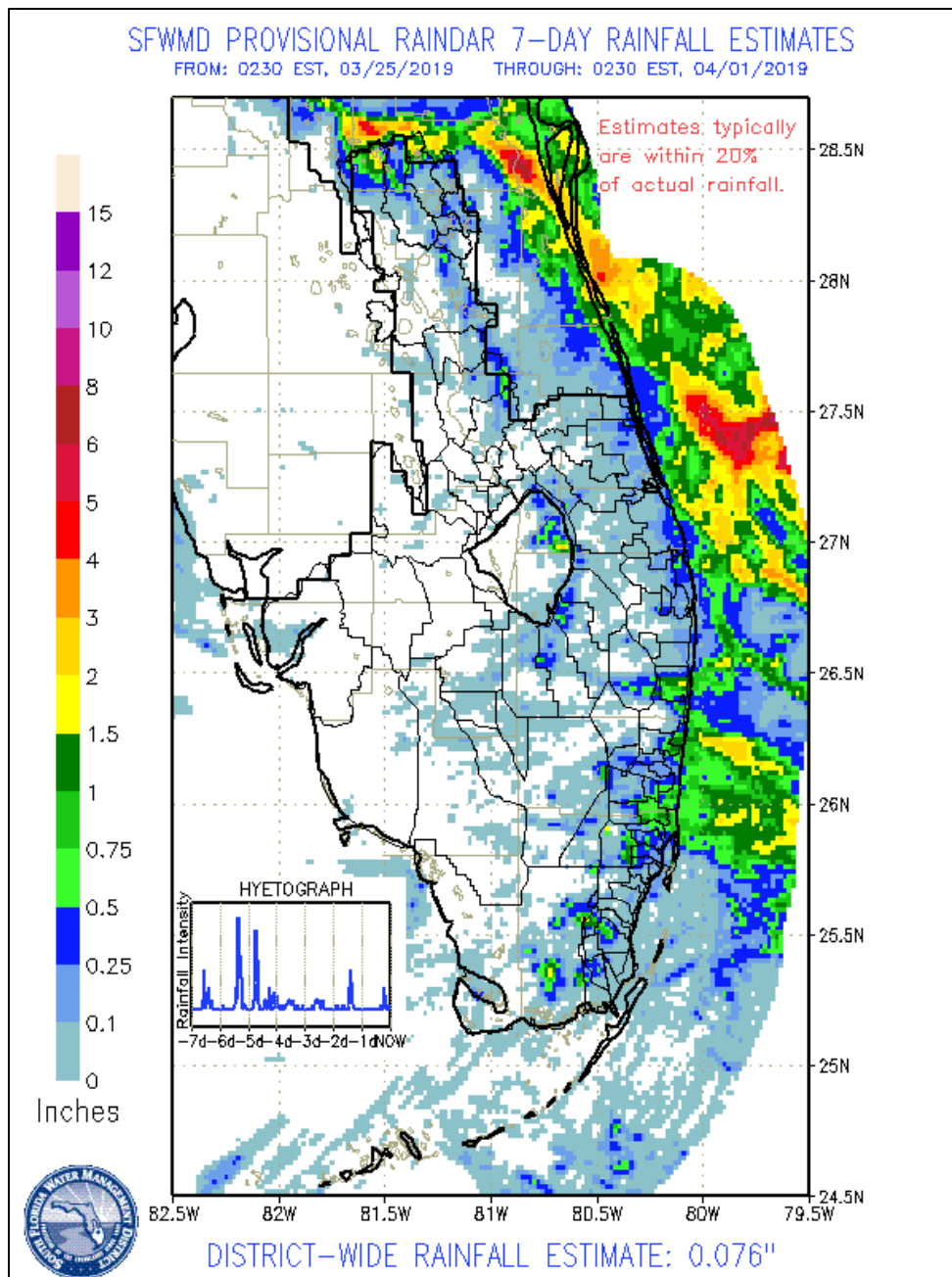


Figure 10. Forecasted Val I-75 surface salinity assuming no pulse release at S-79.

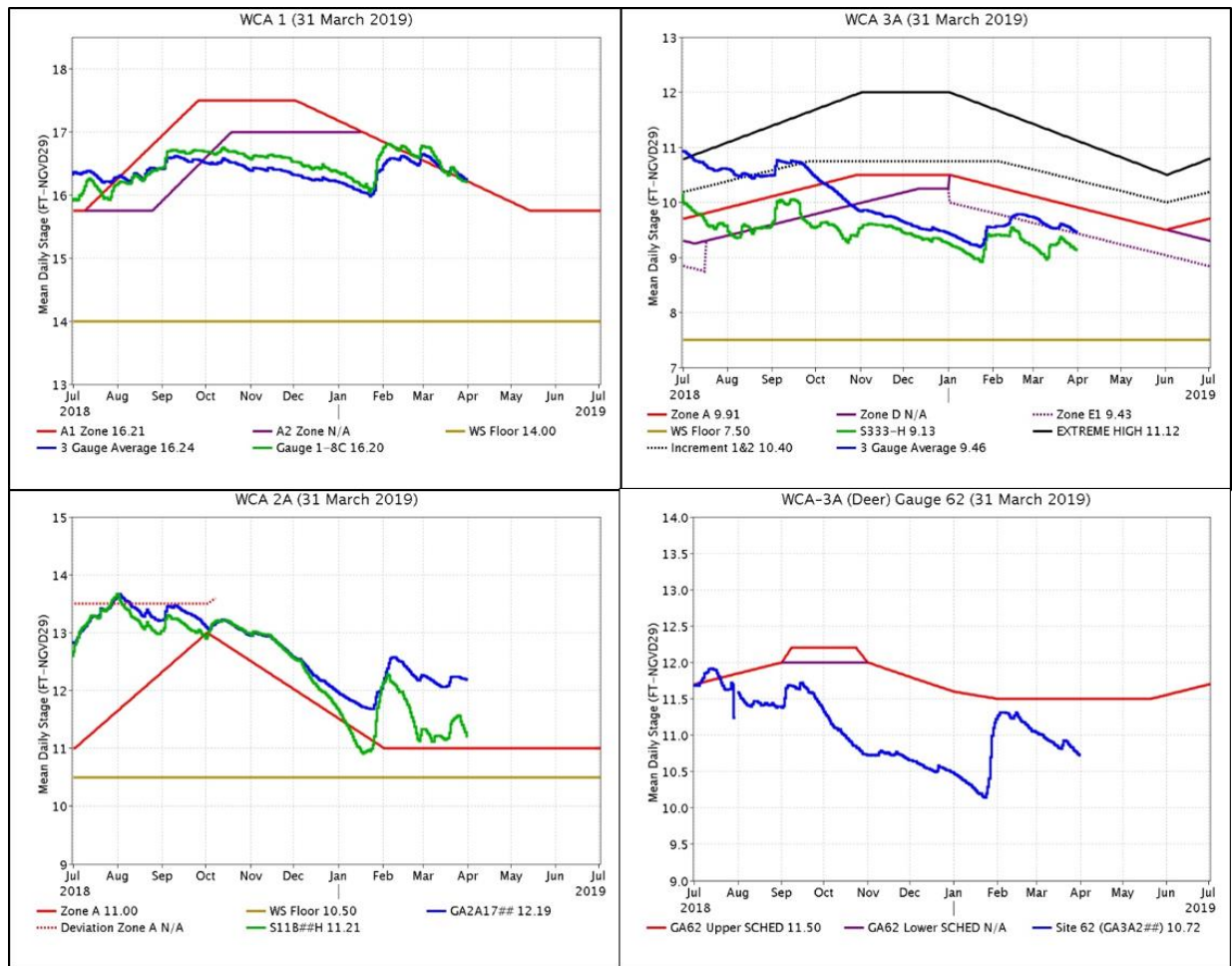
EVERGLADES

With much less rainfall across the Everglades this week, stage changes at the gauge locations monitored for this report returned to a seasonal recession. In the WCAs, recession rates were optimal or slightly higher than those determined optimal for wading bird foraging. The most moderate and extreme individual gauge recessions ranged from -0.05 feet (WCA-3B) to -0.14 feet (northwestern WCA-3A). Pan evaporation was estimated at 2.41 inches this week.

Everglades Region	Rainfall (Inches)	Stage Change (feet)	
WCA-1	0.13	-0.11	 Good  Fair  Poor
WCA-2A	0.02	-0.06	
WCA-2B	0.18	-0.07	
WCA-3A	0.03	-0.11	
WCA-3B	0.10	-0.07	
ENP	0.07	-0.11	



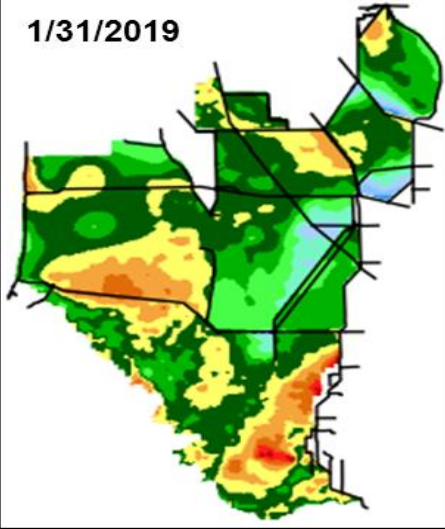
Regulation Schedules: WCA1: Gauge 1-8C is 0.01 feet below the Zone A1 regulation line. The three-gauge average stage is 0.04 above the canal stage. WCA-2A: S-11B Headwater stage trends towards the regulation stage, now 0.21 feet above the Zone A regulation line. WCA-3A: The three-gauge average stage is 0.03 feet above Zone E1 regulation line and continues to follow the regulation line. WCA-3A stage at gauge 62 (northwest corner) is 0.78 feet below the upper schedule.



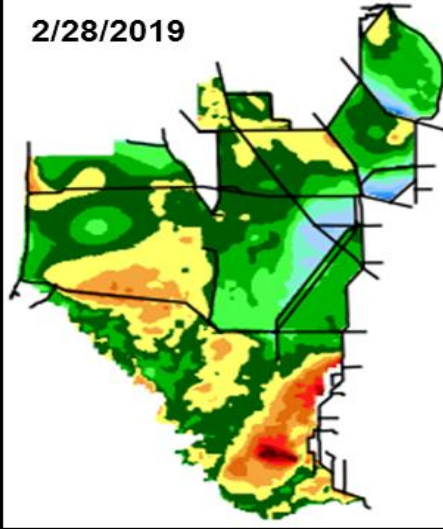
Water Depths and Changes: The WDAT tool for spatial interpolation of depth monthly snapshots indicates a gradual drying from north to south in WCA-3A. WCA-1 and WCA-2A depths look slightly elevated from a month ago. Depth conditions in the western basins look to be relatively stable. Conditions to the south are drying. WDAT difference output indicates that water depths decreased gradually across the entirety of WCA-3A and a majority of WCA-1 and 2A during the last month. The “1 Year” inset shows the difference between current depth conditions and those a year ago. Currently, there are greater depths across most of the Everglades system as last year’s unusual depths influenced by Hurricane Irma returned to a more typical seasonal condition. The western basins are significantly deeper than one year ago, as is eastern WCA-2A.

**SFWDAT Water Depth Monthly Snapshots**

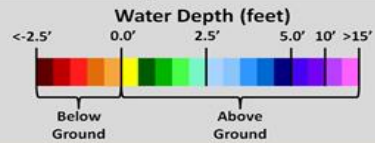
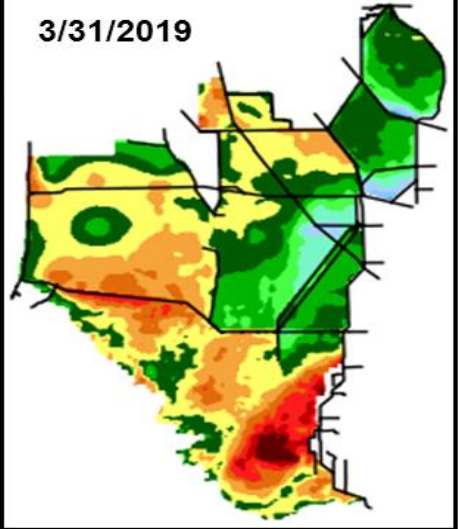
1/31/2019



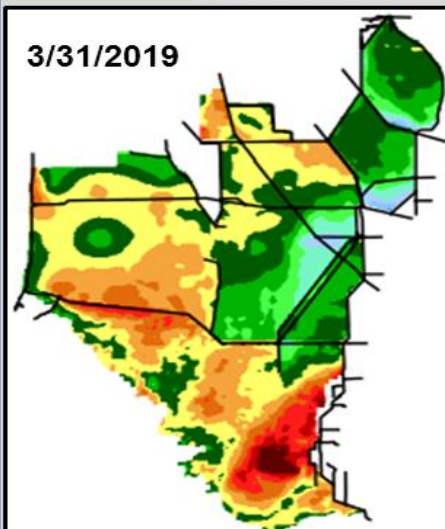
2/28/2019



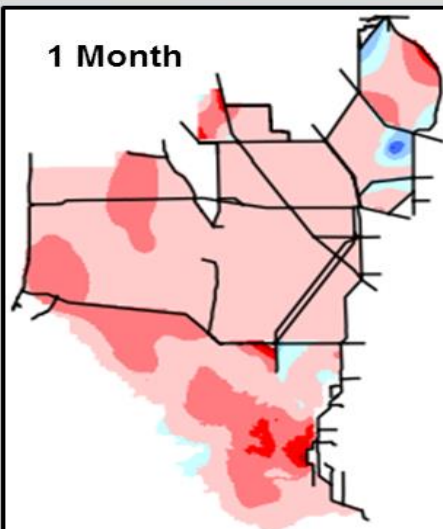
3/31/2019

**South Florida Water Depth Assessment Tool (SFWDAT)****SFWDAT Everglades Difference Maps (Present – Past)**

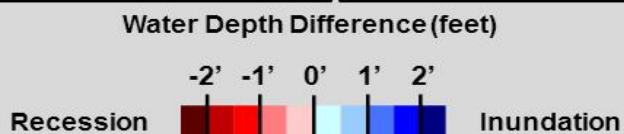
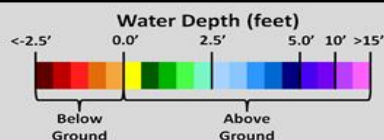
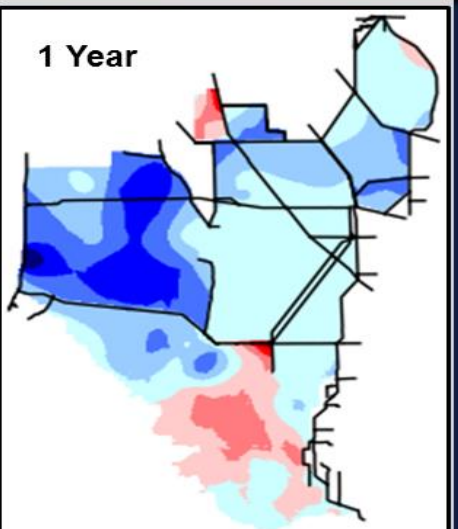
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1 Month

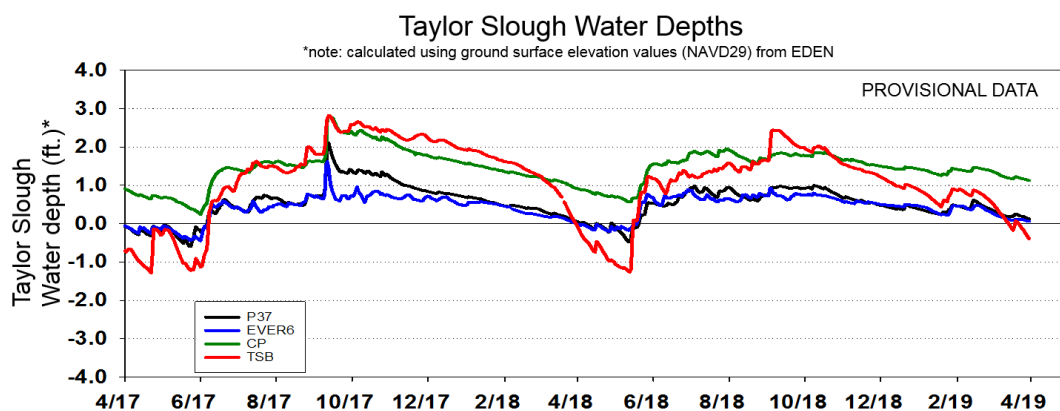
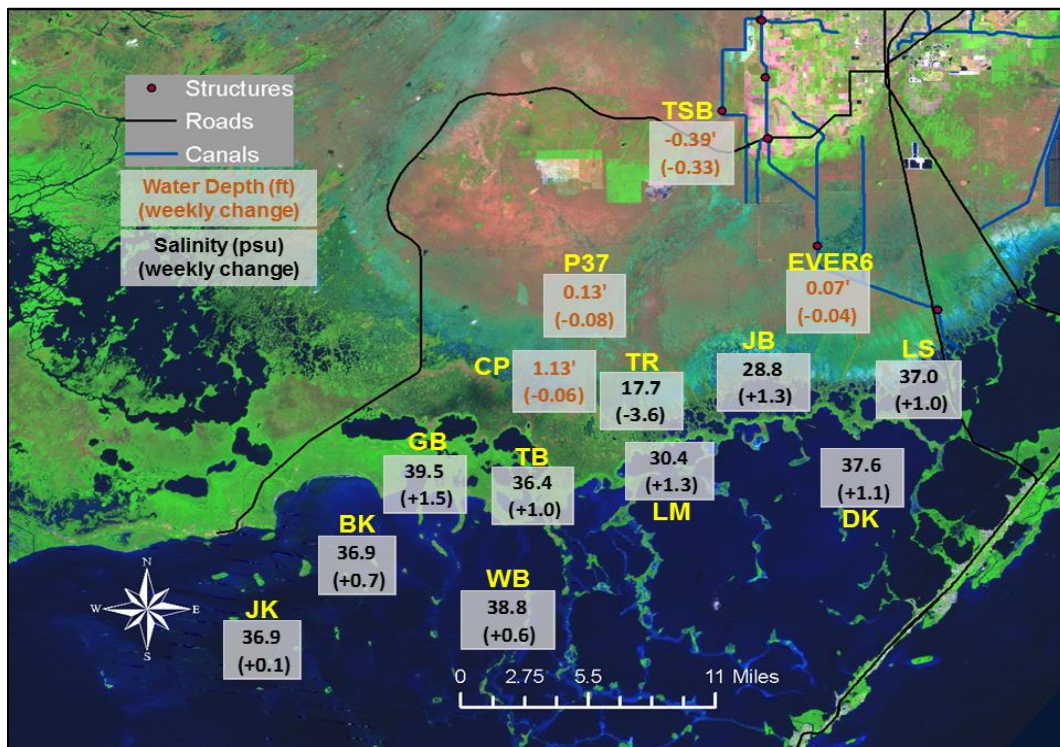


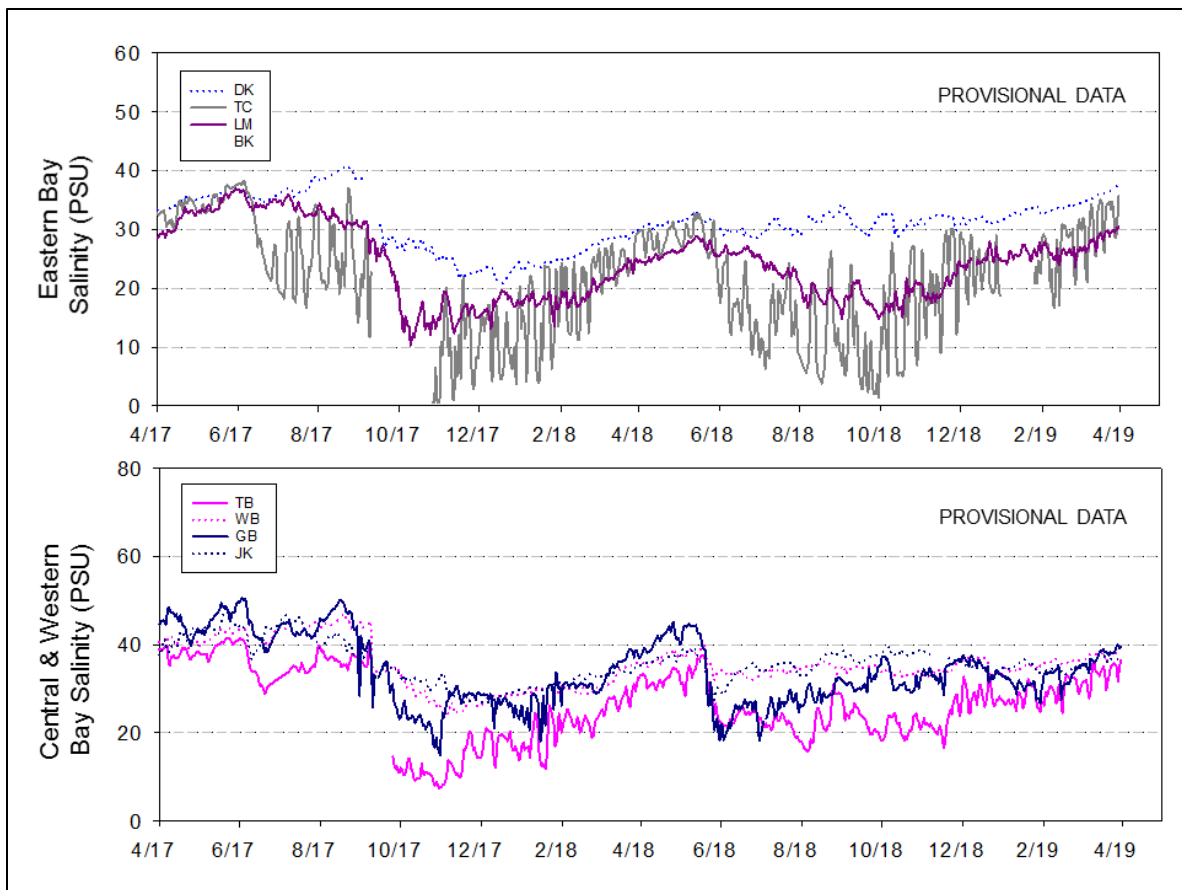
1 Year

**South Florida Water Depth Assessment Tool (SFWDAT)**

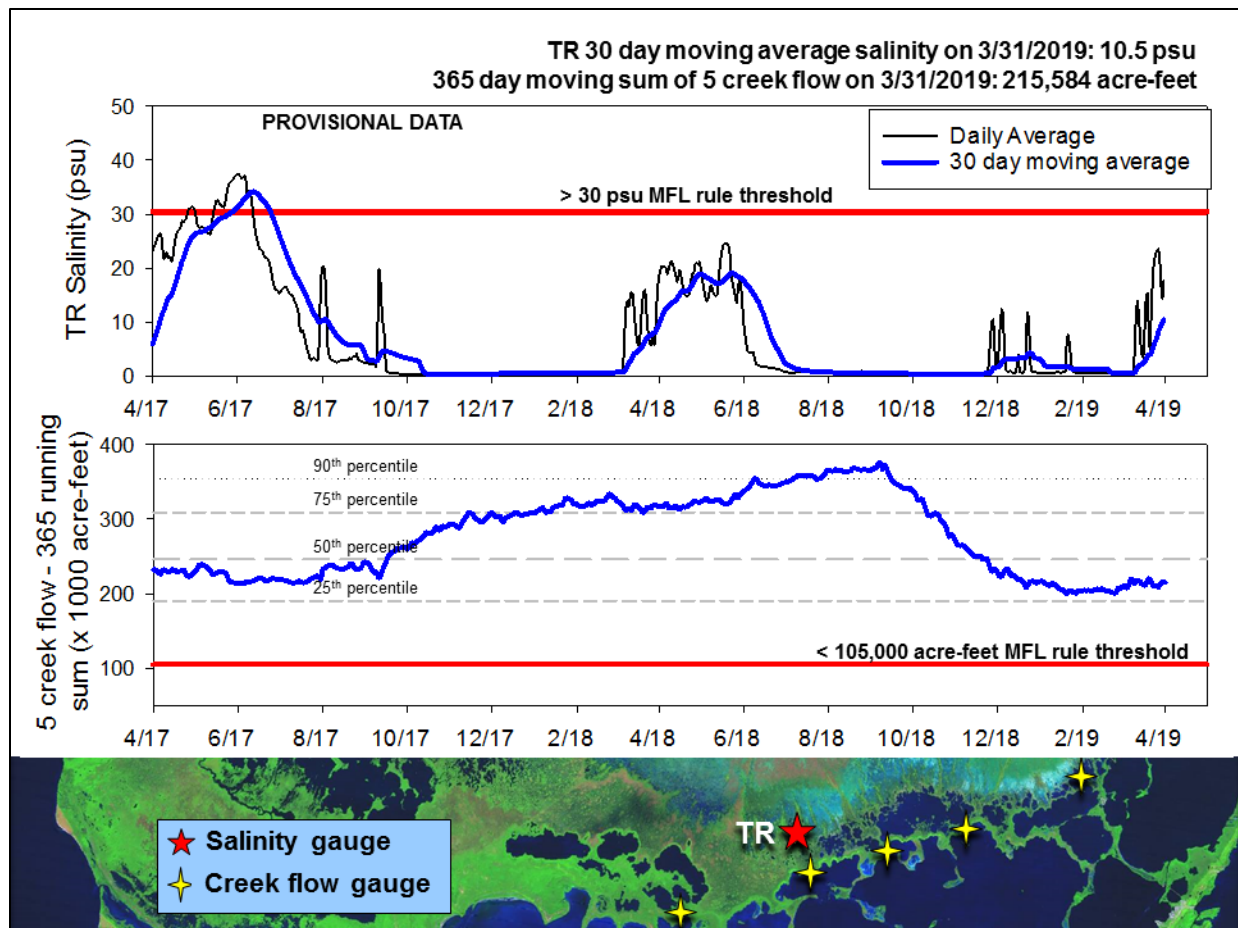
Taylor Slough Water Levels: An average of 0.1 inches of rain fell on Taylor Slough and eastern Florida Bay causing water levels to decrease by 0.11 feet over the week on average. Water depths averaged 0.24 feet across Taylor Slough by Sunday. Conditions are 2.8 inches above average for this time of year and maintaining the typical gradient for this time of year (difference from historical average is similar in north and south).

Florida Bay Salinities: Average salinity in Florida Bay increased 1 psu from last week with individual station changes remaining less than 1.5 psu. Daily average salinities ranged from 29 psu in the northeast to 39 psu in the central bay area and are still about 4.5 psu above average for this time of year.





Florida Bay MFL: Salinity in the mangrove zone peaked at 24 psu before decreasing to 18 psu. The 30-day moving increased to 10.5 psu as a result. The weekly cumulative flow from the five creeks denoted by yellow stars on the map totaled about 1,000 acre-feet but negative flows persisted for the last 3 days. At this time of year, there is very little gravity driven downstream flow. The 365-day moving sum of flow from the five creeks (tracked as part of the Florida Bay MFL criteria) has increased slightly to 215,584 acre-feet (less than the long-term average of 257,628 acre-feet but above the 25th percentile). Creek flow is provisional data from the USGS and is highly variable.



Water Management Recommendations

Keeping rainfall runoff within the Everglades system, distributing it equally across the WCAs, and moving it south through the system when possible remains ecologically beneficial as the WCAs are at or near average stages for this time of year. Very low numbers of wading birds have been noted foraging in the WCAs and expectations are for lower than average nesting success. Discharges into WCA-3A North continue to have ecological benefit as white ibis began nesting over the last few weeks at the Alley North colony within that basin. WCA-2A has the potential to support nesting colonies in WCA-1 and WCA-3A. A careful recession is recommended in WCA-2A with the goal to reach suitable wading bird foraging depths within the next month and not too fast as to over drain the area. More specific recommendations appear in the summary table below. The red text represents new or modified information or recommendations.

SFWMD Everglades Ecological Recommendations, April 2nd, 2019 (red is new)

Area	Weekly change	Recommendation	Reasons
WCA-1	Stage decreased by 0.11'	Maintain depths at regulation schedule. Manage recession rates not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week.	Protect upstream/downstream habitat and wildlife.
WCA-2A	Stage decreased by 0.06'	Maintain depths at regulation schedule. Maintain recession rates, not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week.	Protect conditions that provide wading bird foraging habitat later into the nesting season.
WCA-2B	Stage decreased by 0.07'	Maintain depths at regulation schedule. Maintain recession rates to the extent possible.	Protect upstream/downstream habitat and wildlife.
WCA-3A NE	Stage decreased by 0.09'	Maintain depths at regulation schedule. Maintain recession rates, not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week.	Protect habitat including peat soil development and wildlife. Protect conditions that provide wading bird foraging habitat later into the nesting season.
WCA-3A NW	Stage decreased by 0.14'	Maintain depths at regulation schedule. Moderate recession rates not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week.	
Central WCA-3A S	Stage decreased by 0.11'	Maintain depths at regulation schedule. Moderate recession rates not to exceed the recommended max rate for optimal wading bird foraging of -0.09 ft per week.	Protect tree islands, upstream/downstream habitat and wildlife. Protect conditions that provide wading bird foraging habitat later into the nesting season.
Southern WCA-3A S	Stage decreased by 0.10'		
WCA-3B	Stage decreased by 0.07'	Maintain depths at regulation schedule. Moderate recession rates to the extent possible.	Protect upstream/downstream habitat and wildlife.
ENP-SRS	Stage decreased by 0.11'	Make discharges to the Park according to the 2012 WCP rainfall plan.	Protect upstream/downstream habitat and wildlife.
Taylor Slough	Stage changes ranged from -0.33' to -0.04'	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 +0.1 to +1.5 psu	Move water southward as possible	When available, provide freshwater to maintain low salinity buffer and promote water movement.