Appendix 4-1: Annual Permit Report for Lake Okeechobee Water Control Structures Operation

Permit Report (May 1, 2013–April 30, 2014)
Permit Number: 0174552

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SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** lists key permit-related information associated with this report. **Table 2** lists the attachments included with this report. **Table A-1** in Attachment A lists specific pages, tables, graphs, and attachments where project status and annual reporting requirements are addressed. This annual report satisfies the reporting requirements specified in the permit.

Table 1. Key permit-related information.

Project Name:	Lake Okeechobee Operating Permit
Permit Number:	0174552-010
Issue and Expiration Dates:	Issued: 6/18/2007; Expires: 6/18/2012 *(A permit renewal request was submitted by the South Florida Water Management District to the FDEP on April 11, 2012, and is currently under review.)*
Project Phase:	Operation
Permit Specific Condition Requiring Annual Report:	16
Reporting Period:	May 1, 2013–April 30, 2014
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Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Water Quality and Hydrologic Data *(Note: Contains Attachments B1–B11)*

PROJECT STATUS

Total inflow to Lake Okeechobee in Water Year 2014 (May 1, 2013 to April 30, 2014) was over 2.8 million acre-feet (ac-ft). This was matched by discharge of 2.5 million ac-ft, primarily to the estuaries. Water levels in the lake began at 13.4 feet in May 2013, increasing to 16 feet in August, and, with the exception of a 0.3 ft reversal in late January to mid-February 2014, declined to 13.0 feet in April 2014. Of the 2,276 Class I/III measurements (turbidity, alkalinity, specific conductance, pH, percent dissolved oxygen (DO) saturation, and total iron) at the 24 locations, 196 excursions were observed. Phosphorus (P) loading was 609 metric tons (mt). Five-year average P loading to the lake was 442 mt, which exceeded the total maximum daily load (TMDL) of 140 mt by 302 mt.

CONCLUSIONS REGARDING PROJECT SUCCESS

The flow to Lake Okeechobee in WY2014 was 31 percent greater than WY2013. Because flow and load are closely related, the small increase in loads (seven percent) compared to the previous water year indicates progress in management practices that reduce phosphorus in the watershed.

PROBLEMS ENCOUNTERED

The current method to estimate flow at L-61E, HP-7, Inflow 1, Inflow 2, and Inflow 3 is to take the sum of positive flow days at C41H78 for each month and subtract S-71, G-207, L-61W flow (James 2011; see **Figure 1** for structure and station locations). Using this calculation method, flow in April 2014 was higher than expected for the dry weather conditions and adjacent structure flow (an estimated 8,000 ac-ft for L-61E, versus 1 ac-ft from S-71).

ACTIONS TO ADDRESS PROBLEMS

It is likely that eddies in the C-41 canal below the S-71 weir were measured at C41H78 as positive flow. These eddies could be a result of wind and wave driven backflow from the lake. South Florida Water Management District (District or SFWMD) staff will discuss to determine if better estimates can be obtained. Further analysis of the data—including stage, velocity, and direction at hourly, or better, time frames—may improve this estimate.

INTRODUCTION

PROJECT OVERVIEW

The Lake Okeechobee Operating Permit (0174552-001-GL) was issued under the authority of the Lake Okeechobee Protection Act, Chapter 373.4595, Florida Statutes (F.S.), and Title 62, F.A.C. This annual report is submitted by the SFWMD to the FDEP to fulfill the requirements of modifications 003, 006, 007, and 008 of the operating permit (0174552), and Specific Condition 16 ("Annual Monitoring Reports") of the permit.

The project involves the operation and maintenance of 34 water control structures that are owned or operated by the SFWMD and that discharge into or from Lake Okeechobee (see **Figure 1**). Discharges and flows authorized by this permit are into or from Lake Okeechobee, a Class I water body, pursuant to Rule 62-302.400, Florida Administrative Code (F.A.C).

This report includes two sections: *Monitoring Data*, which includes records and general descriptions of data collected to meet the requirements of this permit for WY2014 (May 1, 2013–April 30, 2014), and *Performance Evaluation*, which includes an analysis of these data for Florida Class I water quality exceedances, total phosphorus (TP) loads, applicable records from the ambient pesticide monitoring data, and data collected through the Lake Okeechobee Research and Monitoring Program.

PERMIT HISTORY

The original Lake Okeechobee Operating permit and all modifications issued to SFWMD are as follows:

- 0174552-001-GL, issued June 18, 2007, expired June 18, 2012; this is the original permit for the Lake Okeechobee Water Control Structures.
- 0174552-002, withdrawn.
- 0174552-003, issued December 21, 2007, authorized an extension until May 31, 2008, for completing installation of instrumentation at permit monitoring sites S-154C, CU-5 and CU-5A; monitoring at the newly constructed Harney Pond Canal monitoring site (C41H78) in lieu of the monitoring required at Inflow 1, Inflow 2, Inflow 3, HP-7, and L-61E; and the addition of a provision for the testing of temporary structure modifications and temporary pumps, per review and approval of the FDEP.
- 0174552-004, issued May 16, 2008, authorized the SFWMD to operate an auxiliary water supply pump station consisting of three temporary pumps at the S-72 Tailwater weir along the C-40 Canal about 4 miles upstream of Lake Okeechobee.
- 0174552-005, issued June 12, 2009, added a provision for the siphoning operation at the S-2 and S-3 pump stations to supplement flow from the temporary forward pumps at S-351 and S-354 and to more closely simulate those flows that would otherwise be provided when gravity flow is possible, and corrected the addresses listed in Specific Condition 2 to reflect the FDEP's address in Tallahassee, Florida, and the email address RPPS_Comp@dep.state.fl.us.
- 0174552-006-EM, issued September 17, 2009, had the following changes:
  - Change in the duration column for grab samples at S-2 and S-3 listed in **Table 3**
  - Changed parameter column for grab samples at S-2 and S-3 to include pH, temperature, specific conductance, DO, and all chemical parameters in **Table 4**
  - Replaced biological oxygen demand with total organic carbon in **Table 4**

  - Modified monitoring requirements for calcium and chlorophyll *a* in **Table 4**
  - Modified parameters for sites S-351, S-354, G-207, and S-208 listed in **Table 4**
- 0174552-007, issued July 21, 2010, authorized a change in chlorophyll *a* monitoring locations and clarified event reporting and interagency coordination requirements included in Specific Conditions 6.E.1, 6.E.2, and 6.E.3.
- 0174552-008, issued September 16, 2011, authorized maintenance and upgrade activities to structures S-129, S-131, S-133, and S-134, and a change in the Lake Okeechobee Regulation Study Schedule.
- 0174552-009, permit application withdrawn.
- 0174552-010, issued December 16, 2011, reduced monitoring for pesticides at specific locations around Lake Okeechobee.

Table 3. Water quality monitoring for S-2 and S-3 flood control backpumping as updated in permit modification 0174552-006-EM.

Site	Type	Duration	Parameters
S-2	Auto-sampler composite flow proportional (ACF)[1]	Event[2] duration	Total phosphorus (TP) and total nitrogen (TN)[3] only
S-2	Grab	Event duration ≤ 72 hours: collect one sample for nutrients (TP and TN) and all chemical parameters listed in **Table 4** within 24 hours of initiation of pumping operations. Event duration >72 hours: collect one sample during first 24 hours, and then every 72 hours.	Physical parameters: pH, temperature, conductance, and dissolved oxygen Chemical parameters: all chemical parameters listed in **Table 4**.
S-3	ACF[1]	Event[2] duration	TP and TN[3] only
S-3	Grab	Event duration ≤ 72 hours: collect one sample for nutrients (TP and TN) and all chemical parameters listed in **Table 4** within 24 hours of initiation of pumping operations. Event duration >72 hours: collect one sample during first 24 hours, and then every 72 hours.	Physical parameters: pH, temperature, conductance, and dissolved oxygen Chemical parameters: all chemical parameters listed in **Table 4**.

[1] Flow-proportional composite sampler.

[2] An event is defined as continuous or intermittent pumping activity separated by a cessation of 72 hours or greater.

[3] TN = total Kjeldahl nitrogen + nitrate + nitrite.

MONITORING DATA

WATER QUALITY

Water quality data, including qualified data, collected at Lake Okeechobee structures (**Figure 1**; **Table 5**) were retrieved from the SFWMD's hydrometeorological and water quality database, DBHYDRO (SFWMD, 2014a), and included with this report as Attachment B1. These records include analytical results of grab or in situ samples taken throughout the year for 18 parameters required in the permit (**Table 4**). Daily flow data (Attachment B2) and daily rainfall data (Attachment B3) also were reported. The water quality information in Attachment B incorporates all data required by the permit.

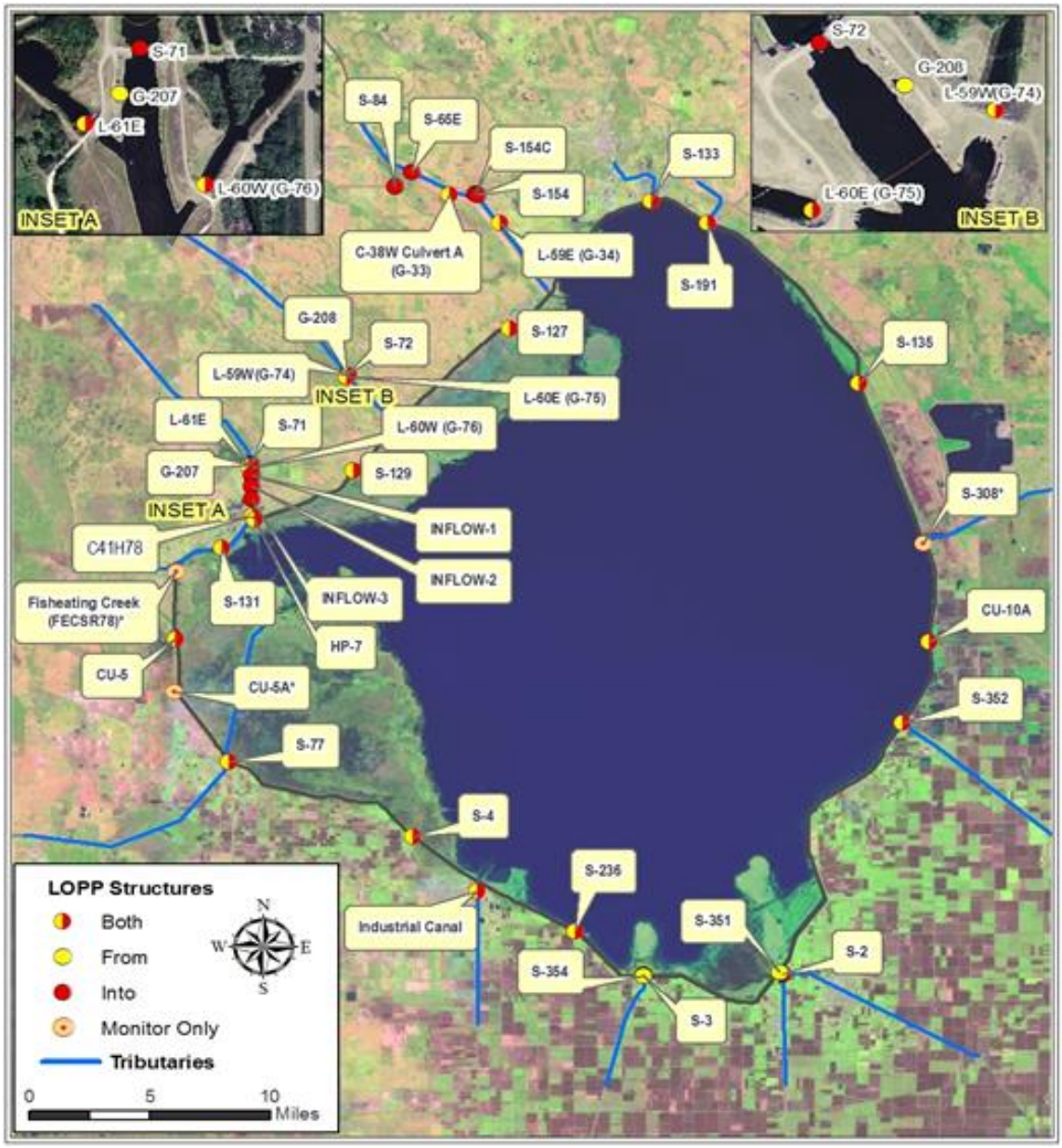

Figure 1. Structures included in the Lake Okeechobee Operating Permit.

Table 4. Water quality and hydrologic parameters monitored for the Lake Okeechobee Operating Permit, and attachments to this report where associated data are provided.

Parameter Name	Parameter Description	Units	Sample Type	Sampling Frequency	Structures Sampled[1,2]	Attachment
ALK	Alkalinity	mg/L	G	BI-W if flowing, M if not flowing	ALL	B1
TOC	Total Organic Carbon	mg/L	G	BI-W if flowing, M if not flowing	S-308, S-77	B1
CHLA	Chlorophyll *a*	µg/L	G	BI-W if flowing, M if not flowing	S-308, S-77	B1
NH4	Dissolved Ammonia	mg/L	G	BI-W if flowing, M if not flowing	ALL	B1
DO	Dissolved Oxygen	mg/L	IN SITU	BI-W if flowing, M if not flowing	ALL	B1
PH	pH	SU	IN SITU	BI-W if flowing, M if not flowing	ALL	B1
SCOND	Specific Conductance	µS/cm	IN SITU	BI-W if flowing, M if not flowing	ALL	B1
TEMP	Temperature	°C	IN SITU	BI-W if flowing, M if not flowing	ALL	B1
TURB	Turbidity	NTU	G	BI-W if flowing, M if not flowing	ALL	B1
TKN	Total Kjeldahl Nitrogen	mg/L	G	BI-W if flowing, M if not flowing	ALL	B1
			ACF	W if flowing	G-207, G-208	B1
TP	Total Phosphorus	mg/L	G	BI-W if flowing, M if not flowing	ALL, FECSR78, S-77, S-308, CU-5A	B1
			ACF	W if flowing, M if not flowing	S-351, S-354	B1
			ACF	W if flowing	G-207, G-208	B1
TN	Total Nitrogen	mg/L	CAL	BI-W if flowing, M if not flowing	ALL	B1
			CAL	W if flowing, M if not flowing	S-351, S-354	B1
			CAL	W if flowing	G-207, G-208	B1
NOX	Nitrate + Nitrite	mg/L	G	BI-W if flowing, M if not flowing	ALL	B1
			ACF	W if flowing	G-207, G-208	B1
SRP	Soluble Reactive Phosphorus	mg/L	G	BI-W if flowing, M if not flowing	ALL	B1
TFE	Total Iron	µg/L	G	Q	ALL	B1
TSS	Total Suspended Solids	mg/L	G	BI-W if flowing, M if not flowing	ALL	B1
FLOW	Flow	cfs	PR	DAV	ALL (pumps)	B2
	Flow	cfs	CAL	DAV	ALL (culverts or gates), FECSR78, S-77, S-308, CU-5A	B2
RAIN	Rainfall Volume	inches	RG	DAC	Rainfall Sampling Station	B3

Key to Abbreviations

ALL – structures owned and operated by the District, as specified in **Table 5**.
ACF – flow-proportional composite sampler
BI-W – biweekly
CAL – calculated
cfs – cubic feet per second
DAC – daily accumulation
DAV – daily average
G – grab sample
IN SITU – measured with probe on-site
M – monthly
mg/L – milligrams per liter
NTU – nephelometric turbidity units
µg/L – micrograms per liter
µS/cm – microsiemens per centimeter
PR – pump records
Q – quarterly
RG – rain gauge
SU – standard units

[1] C41H78 (Harney Pond Canal) monitoring station is the representative monitoring site for HP-7, Inflow-1, Inflow-2, Inflow-3, and L-61E.
[2] S-72 weir auxiliary water pump station monitoring is conducted at both S-72 and G-208.

Table 5. Structures monitored for the Lake Okeechobee Operating Permit.

Structure	Into/From	DBHYDRO Inflow Direction[5]	Structure Description	Latitude	Longitude
S-2	Into	-	Four unit pump station, 3,600 cubic feet per second (cfs)	26 41 58.81	80 42 48.09
S-3	Into	-	Three unit pump station, 2,670 cfs	26 41 56.24	80 48 26.21
S-4	Both	+	Three unit pump station, 2,805 cfs	26 47 24.64	80 57 42.43
S-65E	Into	+	Gated spillway with six cable operated vertical lift gates, lock structure with sector gates	27 13 31.16	80 57 45.22
S-71	Into	+	Gated spillway, three stem operated vertical lift gates	27 02 03.19	81 04 15.23
S-72[4]	Into	+	Gated spillway, two stem operated vertical lift gates	27 05 35.18	81 00 21.22
S-84	Into	+	Gated spillway with two vertical lift gates	27 12 58.16	80 58 24.22
S-127	Both	+	Five unit pump station, 625 cfs, plus gated spillway/lock	27 07 21.56	80 53 45.41
S-129	Both	+	Three unit pump station, 375 cfs, plus gated spillway	27 01 48.19	81 00 05.22
S-131	Both	+	Two unit pump station, 250 cfs, plus gated spillway, lock	26 58 45.23	81 05 24.72
S-133	Both	+	Five unit pump station, 625 cfs, plus outlet structure	27 12 23.92	80 48 02.59
S-135	Both	+	Four unit pump station, 500 cfs, plus spillway and lock	27 05 12.71	80 39 40.14
S-154C	Into	+	Concrete pipe culvert, one barrel, with gate	27 12 39.58	80 55 11.38
S-154	Into	+	Reinforced concrete box culvert, two barrels, sluice gate	27 12 38.82	80 55 06.24
S-191	Both	+	Gated spillway with three cable operated vertical lift gates	27 11 31.17	80 45 45.20
S-236	Both	+	Three unit pump station, 255 cfs, plus outlet	26 43 40.41	80 51 10.12
S-351[1]	Both	-	Gated spillway with three vertical lift gates	26 42 03.00	80 42 54.96
S-352[1]	Both	-	Gated spillway with two vertical lift gates	26 51 50.61	80 37 56.65
S-354[1]	Both	-	Gated spillway with two vertical lift gates	26 41 55.96	80 48 26.25
CU-5	Both	+	Three barrel corrugated metal pipe, slide gates	26 53 06.93	81 07 18.23
CU-10A	Both	-	Five barrel corrugated metal pipe	26 55 01.45	80 36 51.33
C-38W Culvert A (G-33)	Both	+	Pipe inflow under levee	27 12 39.00	80 56 11.69
G-207	From	-	One unit pump station, 135 cfs	27 1 59.54	81 04 17.36
G-208[4]	From	-	One unit pump station, 135 cfs	27 5 32.65	81 00 20.04

Table 5. Continued.

Structure	Into/From	DBHYDRO Inflow Direction[5]	Structure Description	Latitude	Longitude
S-72 Weir Auxiliary Water Supply Pump Station[4]	From	-	Three unit pump station	27 03 59.36	80 58 41.07
L-59E (G-34)	Both	+	Three barrel culvert	27 11 31.17	80 54 11.21
L-59W(G-74)	Both	+	Two barrel gated culvert	27 06 26.18	80 59 57.22
L-60E (G-75)	Both	+	Two barrel gated culvert	27 05 05.18	81 01 27.22
L-60W (G-76)	Both	+	Two barrel gated culvert	27 01 58.19	81 03 06.23
C41H78[2]	Both	+	Canal downstream of G-207, Inflow-1, Inflow-2, Inflow-3, HP-7, L-61E and S-71	26 59 51.52	81 04 05.90
INDUSCAN	Both	-	Represents flows at S-310	26 45 14.00	80 55 07.22
L-61E[2]	Both	Not available (NA)	Two barrel culvert with flashboards	27 01 59.19	81 05 17.23
HP-7[2,3]	Both	NA	Single barrel culvert with flap gate with winch	27 00 00.00	81 04 10.00
Inflow-1[2,3]	Into	NA	Single barrel culvert with flap gate, on Harney Pond Canal downstream of S-71	27 01 36.53	81 04 12.49
Inflow-2[2,3]	Into	NA	Single barrel culvert with flap gate, on Harney Pond Canal	27 01 10.77	81 04 12.20
Inflow-3[2,3]	Into	NA	Single barrel culvert with flap gate, on Harney Pond Canal	27 00 41.13	81 04 11.74

[1] Structures have the ability to incorporate the use of temporary forward pumps (see Specific Condition 4) for discharging water from Lake Okeechobee during periods of low water levels.

[2] C41H78 site is used to estimate required inflow and water quality at Inflow-1, Inflow-2, Inflow-3, HP-7, and L-61E, per Modification 0174552-006-EM, dated September 17, 2009.

[3] Locations are approximate and are not owned or operated by the SFWMD.

[4] S-72 weir auxiliary water pump station monitoring is conducted at both S-72 and G-208.

[5] + Flow to the lake is a positive number, - flow to the lake is a negative number

FLOW AND STAGE DATA

Daily flow data for permitted structures are provided in Attachment B2. Additional flow information for structures not included in the permit (FECRSR78, S-77, S-308, CU-5A, CU-10, CU-4, CU-12, and CU-12A), but which contribute loads and flows to Lake Okeechobee, also are provided in Attachment B2. All flow data were retrieved from DBHYDRO on June 18, 2014 (SFWMD, 2014a). Updates and revisions may occur after this time, but will not be reflected in this report.

Structures S-2 and S-351, and structures S-3 and S-354, share common preferred flow data. Flow into the lake at these locations occurs through the S-2 and S-3 pump stations, while flow out of the lake occurs at spillways S-351 and S-354, by gravity flow or temporary forward pumps.

One backpumping after action report for S-2 was submitted in WY2014. This occurred in June, due to a storm event (See **Table A-1**, specific condition 6E(3)). Small amounts of backpumping between 50 and 900 ac-ft occurred in other months at S-3 and S-2. These were for pump maintenance. After action reports are not required for these events (FDEP, 2007).

During WY2014, inflow to Lake Okeechobee was approximately 2.8 million ac-ft (**Table 6**). This is more than the baseline period (1991–2005) of 2.5 million ac-ft (SFWMD et al., 2011). The largest inflows during WY2014 were from S-65E, S-84, CU-5, and S-71. Inflows to Lake Okeechobee were higher than baseline flows to the lake from June to August, with a very large flow in July that made up approximately one-third of the annual flow (**Figure 2**). This wet period was followed by a very dry October to January. The months of February to April were also drier, but closer to the baseline than the previous months.

Despite efforts to improve the calculated combined flow from L-61E, HP7, and inflows 1, 2, and 3, it is apparent that the uncertainty of these flows is still quite large. This is best exemplified by the estimate for April flow, the largest monthly estimate of the year at L-61E (8000 ac-ft), which occurred in a dry month when measured flows upstream (S-71, L-60W) were small (1 and 86 acre-ft, respectively). Since the calculated flow is only based on positive flows measured at C41H78 (see James, 2011), it is possible that eddies in the canal were inadvertently measured as positive flow. These could be a result of wind-driven backflow from the lake. Further analysis of the data (including stage, velocity, and direction) may improve this estimate.

Lake stage was 13.4 feet National Geodetic Vertical Datum of 1929 (ft NGVD) on May 1, 2013 (**Figure 3**). Stage increased nearly half a foot in June, in response to the storm event that resulted in backpumping at S-2. This was followed by a larger, two-foot increase starting in July and ending at 16.04 feet on August 10, 2013. Inflows to the lake declined after September (**Figure 2**), as rainfall declined. This resulted in decreasing lake stage though the remainder of the water year, with one exception—a reversal of 0.29 feet from 13.76 feet on January 29 to 14.05 feet on February 14, 2014 (**Figure 3**). The lake stage ended at 13.07 feet on April 30, 2014.

Outflow from Lake Okeechobee in WY2014 was 2.5 million ac-ft (**Table 7**). Nearly half of the discharge was through S-77, primarily for regulatory releases from July to October. Base flow and regulatory releases to the Water Conservation Areas occurred from October 2013 to April 2014. Discharges through S-308 were only 18 percent of the total outflows, primarily in July and August. Discharges south through S-351, S-352, and S-354 occurred primarily from October to April, and made up 24 percent of the total outflow from Lake Okeechobee.

Table 6. Monthly inflow to Lake Okeechobee by structure in ac-ft for WY2014

Region	Structure	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	Total
East	L-8 (CU-10A)	1,289	11,464	11,478	0	77	0	0	0	268	0	0	3,622	28,198
	S-308[2]	1,547	1,424	0	0	1,291	454	1,490	1,277	9,822	5,760	4,090	1,085	28,240
	Total	2,836	12,888	11,478	0	1,368	454	1,490	1,277	10,090	5,760	4,090	4,707	56,438
North	C41H78[3]	6,284	38,851	78,016	32,323	28,747	5,736	1,995	4,386	2,745	5,608	3,723	8,127	216,541
	C-38W Culvert A (G-33)	415	584	1,231	1,285	1,134	281	0	0	0	0	0	0	4,931
	CU-5	0	0	6,774	1,301	624	187	0	0	0	0	0	0	8,886
	Fisheating Creek-Lakeport	827	24,286	168,218	82,149	77,784	31,924	2,694	976	603	2,233	1,387	1,053	394,134
	L-59E (G-34)	321	692	2,214	2,484	3,390	1,514	0	0	0	0	0	0	10,615
	L-59W(G-74)	365	5,811	12,331	3,499	3,132	202	0	0	321	2,047	2,340	1,773	31,822
	L-60E (G-75)	67	704	4,278	863	326	14	0	0	0	37	0	0	6,290
	L-60W (G-76)	671	392	1,336	458	239	25	10	39	33	0	46	86	3,335
	L-61E, HP-7, Inflow 1, 2, 3 [1,2,3]	0	2,202	4,563	1,338	0	0	1,788	4,101	1,330	4,543	2,448	8,056	30,369
	S-127	138	701	6,025	4,442	2,423	750	0	190	507	825	708	72	16,781
	S-129	178	1,288	8,468	2,433	2,097	389	74	46	84	438	213	0	15,708
	S-131	283	1,611	4,622	2,046	1,535	390	61	99	96	302	232	58	11,334
	S-133	421	3,515	5,585	6,333	4,077	864	385	293	136	632	404	9	22,655
	S-135	692	2,291	7,599	4,585	5,442	1,556	485	364	330	2,501	0	0	25,847
	S-154	0	652	6,576	11,198	9,167	2,925	0	0	0	0	0	0	30,518
	S-154C	72	281	740	489	1,158	122	62	62	87	75	53	15	3,217
	S-191	771	6,803	40,817	33,254	23,991	2,622	88	72	0	250	0	0	108,667
	S-65E	42,438	90,793	412,535	293,824	160,676	51,595	17,502	13,880	17,426	62,006	54,240	67,400	1,284,314
	S-71	5,705	36,271	72,117	30,541	31,191	5,749	200	259	1,396	1,078	1,257	1	185,764
	S-72	2,032	7,598	25,555	9,488	10,109	1,430	0	0	57	625	468	0	57,363
	S-84	17,544	54,797	152,986	84,118	82,339	22,725	8,387	265	0	10,612	1,560	1,355	436,686
	Total[5]	72,941	241,273	944,571	576,127	420,833	125,264	31,735	20,647	22,405	88,204	65,357	79,879	2,689,237

Table 6. Continued.

Region	Structure	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	Total
South	CU-10[1,2]	0	0	0	0	0	0	0	0	0	0	0	0	0
	CU-12[1,2]	0	0	0	0	0	0	0	0	0	0	0	0	0
	CU-12A[1,2]	0	0	0	0	0	0	0	0	0	0	0	0	0
	CU-4A[1,2]	0	0	0	0	0	0	0	0	0	0	0	0	0
	Industrial Canal	1,147	5,368	7,733	147	61	33	0	12	422	1,489	1,389	716	18,516
	S-2 (S-351)	52	24,480	788	316	249	104	0	0	0	0	0	0	25,989
	S-236	0	0	0	0	0	0	0	0	0	0	0	0	0
	S-3 (S-354)	0	89	822	83	217	132	0	0	0	53	0	0	1,396
	S-352	0	0	0	0	0	0	0	0	0	0	0	0	0
	S-4	511	7,343	10,868	3,985	2,624	995	203	281	997	5,502	2,261	445	36,016
	Total	1,710	37,280	20,210	4,531	3,152	1,265	203	292	1,419	7,044	3,650	1,161	81,918
West	CU-5A[2]	74	158	0	0	0	0	0	0	0	0	311	0	543
	S-77[2]	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	74	158	0	0	0	0	0	0	0	0	311	0	543
Total*		77,562	291,599	976,260	580,658	425,353	126,984	33,427	22,217	33,913	101,008	73,408	85,747	2,828,135

[1] Included in other permits

[2] Provides flows and loads to lake; not owned or operated by the SFWMD.

[3] Calculated as specified in the 2011 Annual Permit Report for Lake Okeechobee Water Control Structures Operation (James, 2011)

[4] NA – Not available

[5] Does not include C41H78 flows

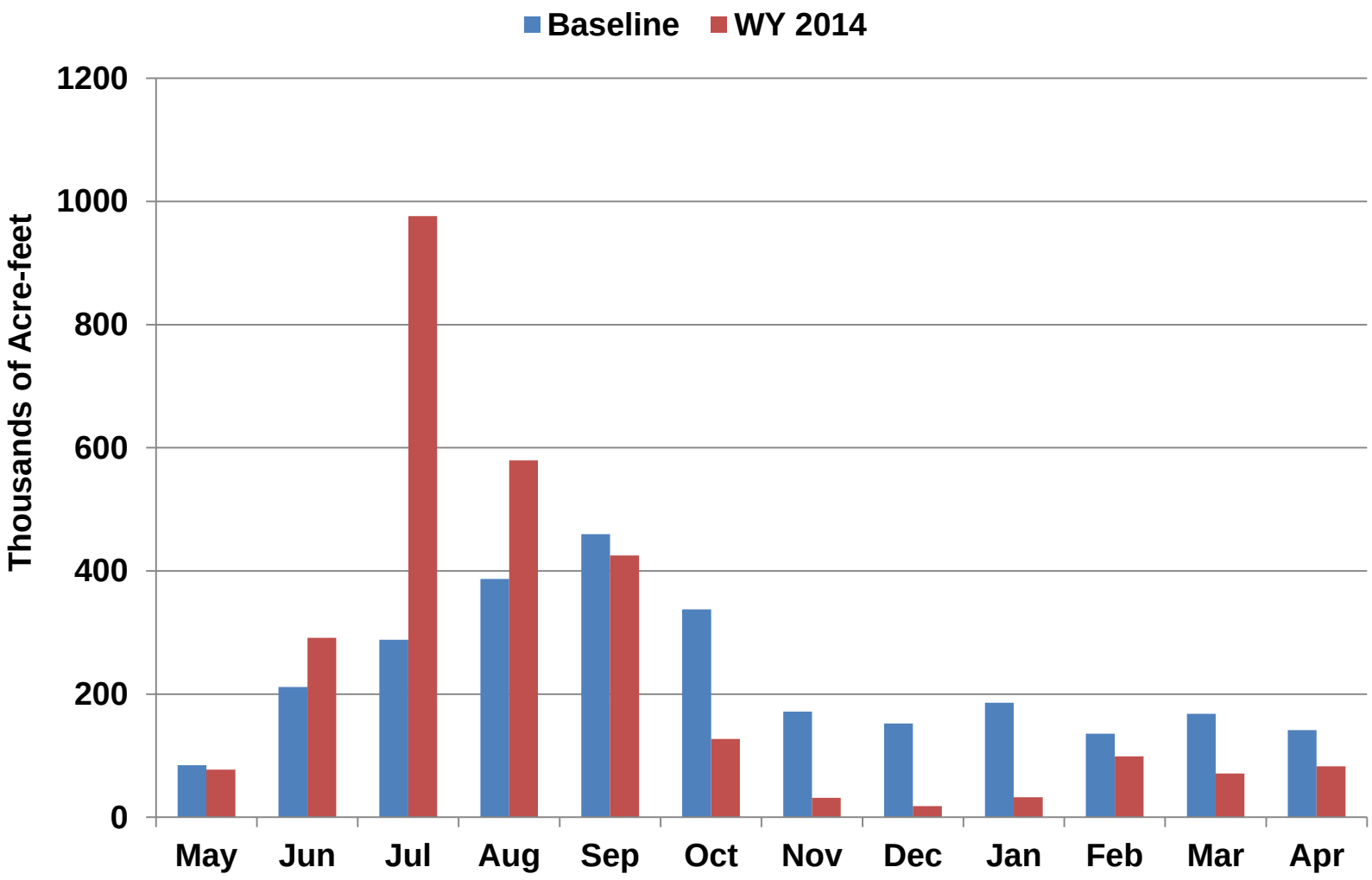

Figure 2. Flow to Lake Okeechobee by month for the baseline period (1991–2005) and WY2014.

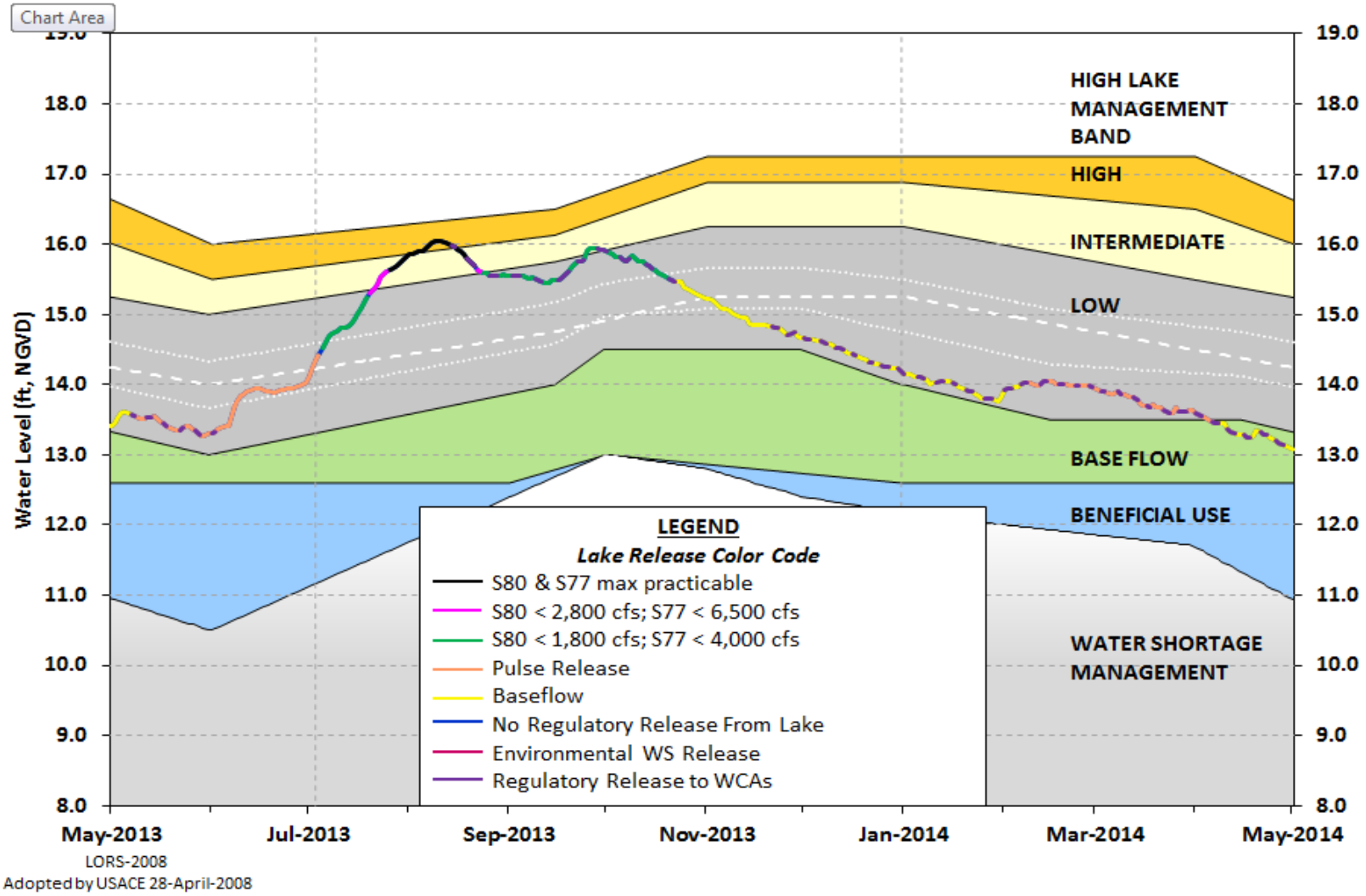

Figure 3. Lake Okeechobee stage values in feet National Geodetic Vertical Datum of 1929 (ft NGVD) for WY2014 and the 2008 Lake Okeechobee Regulation Schedule (2008 LORS).
[Note: cfs – cubic feet per second; max – maximum; WCA – Water Conservation Area; WS – Water Supply]

Table 7. Monthly discharge flow in ac-ft from Lake Okeechobee for WY2014.

Station	May 2013	June 2013	July 2013	August 2013	Sep. 2013	Oct. 2013	Nov. 2013	Dec. 2013	Jan. 2014	Feb. 2014	March 2014	April 2014	Total
CU-10A	10230.74	278.88	3347.5	29839.34	18329.26	24,254	22,274	18,744	15,269	11,436	13,549	7,793	175,344
CU-5	0	0	0	0	0	0	0	0	0	0	0	0	0
CU-5A[2]	2,562	2,986	5,720	8,600	8458.18	9054.94	7,005	5,524	3,999	3,299	2,334	651	60,193
G-207	12.87	13.34	0	13.95	0	13.86	2.93	13.42	13.63	12.8	28.3	15.85	140.95
G-208	13.66	13.77	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	27.43
Industrial Canal	1,330	60.77	117	1,261	265.86	2572.03	3,595	3,805	3,333	911	3,644	4,862	25,756
S-127	0	0	0	0	0	0	0	0	0	0	0	0	0
S-129	0	0	0	0	0	0	0	0	0	0	0	0	0
S-131	0	0	0	0	0	0	0	0	0	0	0	0	0
S-135	0	0	0	0	0	0	0	0	0	0	0	0	0
S-308[2]	6,509	13,210	103039.3	215087.6	40,530	42,093	8,020	2,740	718	489	2,114	10,094	444,645
S-351[1]	5,586	0	1.07	6700.9	0	19,437	30,767	39,026	20,278	11,063	18,238	32,255	183,352
S-352[1]	2,687	0	0	26,051	12,910	45,936	15,067	13,759	6504.97	0	8,010	31,798	162,724
S-354[1]	10,131	58.33	0	4315.81	0.2	4,956	35,152	68,400	61,620	4,807	27,708	32,672	249,820
S-77[2]	42,811	34,223	256,624	351788.2	187,240	111,648	42,958	41,119	36,385	27,691	49,287	43,821	1,225,595
Total	81,873	50,843	368,848	643,658	267,733	259,965	164,841	193,132	148,120	59,709	124,912	163,962	2,527,597

[1] Structures have the ability to incorporate the use of temporary forward pumps for discharging water from Lake Okeechobee during periods of low water levels.

[2] Provides flows and loads from the lake; not owned or operated by the SFWMD.

[3] ND – no data.

RAINFALL

Daily rainfall measurements collected from the stations used to report Lake Okeechobee Basin rainfall (SFWMD, 2014b; Attachment B3) were used for consistency with Chapter 2 of the *2014 South Florida Environmental Report – Volume I* (Abtew and Ciuca, 2014). In addition, NEXRAD estimates for the Lake Okeechobee region and District-wide were also included (SFWMD, 2014c). Rainfall estimates for the Lake Okeechobee Basin and District-wide were 2.6 and 1.1 inches above the 30-year average. For the Lake Okeechobee region, the first three months of the water year exceeded average rainfall by 7.3 inches. Drier to near-normal rainfall amounts occurred in the succeeding months (**Table 8**). The driest months (October through December) all had less than two inches of rainfall, contributing to the lake level decline from November to December, and from February to April. District-wide NEXRAD estimates also indicated drier-than-normal conditions from November to March, which contributed to lake level decline.

Table 8. Lake Okeechobee monthly rainfall averages (in inches) for the rainfall station network, and Lake Okeechobee and District-wide NEXRAD estimates for WY2014 compared to the 30-year period (calendar years 1981–2010).

Month	*Lake Okeechobee*				*District-wide*		
	WY2014 NEXRAD Estimate	1981–2010 Average	WY2014 Rainfall Network	Difference[1]	1981–2010 Average	WY2014 NEXRAD Estimate	Difference[2]
May	4.8	3.3	5.1	1.8	3.9	6.2	2.3
June	10.4	7.0	8.8	1.8	8.3	7.5	-0.8
July	9.2	6.0	9.7	3.7	7.0	6.0	-1.0
August	5.6	6.7	5.7	-1.0	7.8	11.5	3.7
September	6.4	5.6	5.9	0.3	6.8	6.6	-0.2
October	1.5	3	1.3	-1.7	3.8	5.3	1.5
November	0.8	1.9	0.9	-1.0	2.4	0.3	-2.1
December	0.4	1.6	0.4	-1.2	1.9	1.9	0.0
January	2.5	1.7	2.6	0.9	1.9	0.6	-1.3
February	1.9	2.1	2.1	0.0	2.3	1.9	-0.4
March	2.3	3.2	2.3	-0.9	3.1	1.1	-2.0
April	2.0	2.2	2.0	-0.2	2.5	3.9	1.4
Total	**47.9**	**44.3**	**46.9**	**2.6**	**51.7**	**52.8**	**1.1**

[1] Difference between 1981–2010 average and WY2014 rainfall network.

[2] Difference between 1981–2010 average and WY2014 NEXRAD estimates.

PERFORMANCE EVALUATION

CLASS I WATER QUALITY ANALYSIS

The parameters included in the Lake Okeechobee Operating Permit with Florida Class I criteria are alkalinity, percent DO saturation, pH, specific conductance, total iron, and turbidity (**Table 9**). Permit modification 0174552-006-EM replaced biochemical oxygen demand with total organic carbon, which does not have a Class I criterion. The turbidity criterion of 32.3 nephelometric turbidity units (NTU) was based on natural background values, as described in the 2009 annual permit report (Unsell, 2009). The criterion for specific conductance was set to 1,275 microsiemens per centimeter (µS/cm), because this was greater than the 50-percent above background value (Unsell, 2009).

The Class I criterion for DO has been changed for streams from not less than 5 milligrams per liter (mg/L) to a daily DO saturation not less than 38 percent for the Peninsula and Everglades (62-302.533, F.A.C.; State of Florida, 2013). Percent DO saturation was calculated for each DO-temperature pair using the equation listed on page 60 of the FDEP technical support document (FDEP, 2012). Because only instantaneous readings were available, this value was compared to a standard based on a Time-of-Day-Specific Translation of the Daily Average DO Criterion (62-303.320(3)(c), F.A.C.). To meet this criterion, no more than 10 percent of samples of a given stream may be below the 38 percent DO saturation for the Peninsula and Everglades bioregion (62-302.533, F.A.C.; State of Florida, 2013).

Table 9. Class I criteria values for Lake Okeechobee monitoring.

Parameter Name	Parameter Description	Units	Criteria
ALK	Alkalinity	mg/L	≥ 20
DO%	Percent Dissolved Oxygen Saturation	%	> 38% (daily average)
pH	pH	standard units	6 – 8.5
SCOND	Specific Conductance	µS/cm	≤ 1,275
TFE	Total Iron	micrograms per liter (µg/L)	≤ 1,000
TURB	Turbidity	NTU	≤ 32.3 (≤ 29 + 3.3 natural background)

A binomial hypothesis test was used to determine if there was a greater than 10 percent excursion rate of Class I standards (H0: $f \leq 0.10$; HA: $f \geq 0.10$; Weaver and Payne, 2005; Unsell, 2009). This excursion rate is given a category of concern (**Table 10**). All flow and structure sample sets contained fewer than 28 samples for WY2014 (the cutoff at which the type II error rate is greater than 20 percent for the binomial test). Therefore, a preliminary evaluation was used based on the percent of excursions greater than 20 percent ("concern" or C), between 0 and 20 percent ("potential concern" or PC), and 0 percent ("no concern" or NC). To accommodate the new DO saturation regulation, with less than 28 samples if there were 10 percent or more excursions, then the category was set to "concern" or $C^{\#}$.

To evaluate the excursion rate more accurately, a ten-year period of record (WY2005–WY2014) was included for the binomial hypothesis testing. The categories for the tests were the same as above, with the addition of "minimal concern" or MC. The category statistics were C (HA: $f \geq 0.10$), PC (HA: $0.05 \leq f < 0.10$), MC (HA: $0 < f < 0.05$), NC (H0: f=0), and ND (no data) (**Table 10**). An evaluation of these data—mean, maximum, minimum, number of samples, standard deviation, median, 25th and 75th percentiles, and number of exceedances from Florida Class I standards—were determined for each structure, for each given flow period, for the ten-year period (Attachment B8). Since pH is a log-based value, means and standard deviations were not calculated but were listed as "N/A" (not applicable). Levels of concern for each Class I parameter are discussed in separate sections for each measured variable.

Table 10. Excursion categories for Class I water quality tests (adapted from Weaver and Payne, 2005).

Excursion Category	Class I Water Quality Binomial Test	Preliminary Analysis of Class I Water Quality Percent Exceedances (less than 28 samples)	
		Other Parameters	DO Saturation
Concern	> 10%	> 20%	> 10%
Potential Concern	5 to 10%	> 0% and < 20%	> 0% and < 10%
Minimal Concern	0% < and < 5%	NA[1]	NA[1]
No Concern	0%	0%	0%

[1] Minimal Concern category is not calculated for sample sets less than 28 due to statistical uncertainty.

Water quality data for each station was separated into three categories based on flow direction (inflow, no-flow, and outflow or reverse flow). These categories were determined from daily flow measurements, when available (Attachment B2), or from visual inspection records (Attachment B1). Of the 30 structures where water quality is measured to fulfill permit requirements, four primarily outflow structures (G-207, G-208, S-351, and S-354) are only monitored for flow, nitrogen, and phosphorus (modification 6 of the permit). These four structures were eliminated from the Class I analyses, but can be found in previous reports (James and Sharfstein, 2014). Of the 26 inflow structures that are included in this analysis, one (S-352) was not included in the inflow analyses because there have been few days of inflow in the last decade, and no samples measured during inflow events. In WY2014, there were no days of inflow at S-236; therefore, no samples were taken under this condition (**Table 11**). For no-flow events, three stations (CU-10A, INDUSCAN and S-65E) were not sampled because there was flow at these locations for all days of WY2014 (**Table 12**). For the outflow (reverse flow) conditions, five (L-59W, L-60E, L-60W, S-127 and S-135) of the ten structures were not sampled because there were no outflows at these locations in WY2014 (**Table 13**). An additional structure, C-38W, only had four days of reverse flow (flow away from the lake) with no samples taken during these events; therefore, it was not included in this table.

All results not meeting data quality objectives specified by the FDEP in Chapter 62-160, F.A.C. were removed from this analysis. All measurements below the detection limit were set to half of the detection limit. The mean, maximum, minimum, number of samples, standard deviation, median, 25th and 75th percentiles, and number of exceedances from Florida Class I standards were determined for each structure for each given flow period (Attachments B4 through B6). Samples that exceeded the Class I criteria were tabulated (Attachment B7).

Alkalinity

Of the 24 structures sampled for alkalinity during inflow events, one structure (S-84) was defined as "potential concern" and 23 as "no concern" (**Table 11**). Of the 207 measurements, two excursions were found (Attachment B4). For the ten-year period, 18 structures were classified as "no concern", two (S65-E and S-72) as "minimal concern", and five (L-59E, L-59W, L-60E, S-71, and S-84) as "concern" (**Table 11**; Attachment B8). Low alkalinity was associated with basins in the Indian Prairie, which may indicate natural conditions with more acidic soils from wetlands. Further investigation is needed to confirm this assertion.

Of the 23 structures sampled during no-flow events, one structure (S-84) was defined as "potential concern" (**Table 12**; Attachment B5), and all others were categorized as "no-concern". Of the 179 samples taken during no-flow events, one excursion was found. For the ten-year period of analysis, 23 structures were classified as "no concern", three (L-59W, S-71, and S-72) as "minimal concern", and one (S-84) as "potential concern" (**Table 12**; Attachment B8).

Of the 50 alkalinity samples taken at the five structures during outflow events in WY2014, no excursions were found (**Table 13**, Attachment B6). For the ten-year period of record, no excursions were found at the ten stations (**Table 13**; Attachment B8).

Percent Dissolved Oxygen Saturation

Of the 24 structures where DO and temperature were measured, and percent DO saturation could be calculated during inflow events in WY2014, four (S-127, S-131, S-135, and S-3) were classified as "no concern", one (S-84) as "potential concern", and all others as "concern" (**Table 11**; Attachment B4). Of the 207 measurements during inflow events, 88 did not meet the percent DO saturation Class I criterion (Attachment B4).

Factors other than high temperature could result in the high exceedance of the percent DO saturation criteria. These include high dissolved organic carbon, high microbial activity, high respiration of plants during low light conditions, and/or laminar flow of water in the canals that prevents turbulent mixing of the water with air. Further research is needed to determine the key factors. Management practices to meet the proposed numeric nutrient criteria may reduce organic carbon input to the tributaries. Other practices to increase turbulence of the canal flow (e.g., baffle boxes or mechanical mixing) also may improve DO conditions. For the ten-year period of record, one structure (S-135) was classified as "potential concern", and the other 24 as "concern" (**Table 11**; Attachment B8).

Table 11. Levels of concern[1] for Class I parameters at Lake Okeechobee structures during WY2014 inflow events.

Station	Alkalinity	Percent Saturation of Dissolved Oxygen	pH	Specific Conductivity	Total Iron	Turbidity
C38W	NC/NC*	C/C#	NC/NC*	C/C*	PC*/NC*	NC/NC*
C41H78	NC/NC*	C/C#	NC/NC*	NC/NC*	NC*/NC*	NC/NC*
CU-10A	NC/NC*	C/C#	NC/NC*	C/PC*	C*/ND	C/NC*
CU-5	NC*/NC*	C#/C#	NC*/NC*	NC*/NC*	NC*/NC*	NC*/NC*
INDUSCAN	NC/NC*	C/C#	NC/NC*	NC/NC*	PC*/NC*	C/NC*
L59E	C/NC*	C/C#	NC/NC*	C/NC*	C*/C*	NC/NC*
L59W	C/NC*	C/C#	NC/NC*	NC/NC*	C*/C*	NC/NC*
L60E	C/NC*	C/C#	NC/NC*	NC/NC*	NC*/NC*	NC/NC*
L60W	NC/NC*	C/C#	NC/NC*	NC/NC*	NC*/NC*	NC/NC*
S127	NC*/NC*	C#/NC*	NC*/NC*	NC*/NC*	NC*/NC*	NC*/NC*
S129	NC*/NC*	C/C#	NC/NC*	NC/NC*	NC*/NC*	NC/NC*
S131	NC*/NC*	C/NC*	NC/NC*	NC/NC*	NC*/NC*	NC/NC*
S133	NC*/NC*	C#/C#	NC*/NC*	NC*/NC*	NC*/NC*	PC*/NC*
S135	NC*/NC*	PC*/NC*	NC*/NC*	NC*/NC*	NC*/NC*	NC*/NC*
S154	NC/NC*	C/C#	NC/NC*	C/NC*	C*/C*	NC/NC*
S154C	NC/NC*	C/C#	NC/NC*	C/C*	PC*/C*	MC/NC*
S191	NC/NC*	C/C#	MC/NC*	NC/NC*	NC*/NC*	NC/NC*
S2	NC*/NC*	C/C#	NC/NC*	C/C*	PC*/NC*	PC*/NC*
S236	NC*/ND	C#/ND	NC*/ND	C*/ND	NC*/ND	NC*/ND
S3	NC*/NC*	C#/NC*	NC*/NC*	PC*/C*	NC*/NC*	NC*/NC*
S4	NC/NC*	C/C#	NC/NC*	C/PC*	NC*/NC*	NC/NC*
S65E	MC/NC	C/C	MC/C	NC/NC	PC/NC*	NC/NC
S71	C/NC*	C/C#	NC/NC*	NC/NC*	NC*/NC*	NC/NC*
S72	MC/NC*	C/C#	NC/NC*	NC/NC*	PC*/NC*	NC/NC*
S84	C/PC*	C/PC*	C/PC*	MC/NC*	PC*/NC*	MC/NC*

[1] C - concern; PC - potential concern; MC - minimal concern; NC - no concern; and ND - Not Determined (no data)

* - Less than 28 samples preliminary test used

- Less than 28 samples and more than 10 percent of the Percent Saturation of Dissolved Oxygen do not meet the criteria.

Listing before '/' is for WY2005–WY2014, after '/' is for WY2014

Table 12. Levels of concern[1] for Class I parameters at Lake Okeechobee structures during WY2014 no-flow events.

Station	Alkalinity	Percent Saturation of Dissolved Oxygen	pH	Specific Conductivity	Total Iron	Turbidity
C-38W	NC/NC*	C/NC*	C/NC*	C/C*	NC/NC*	C/NC*
C41H78	NC*/NC*	C#/NC*	NC*/NC*	NC*/NC*	ND/ND	NC*/NC*
CU-10A	NC*/ND	C#/ND	NC*/ND	NC*/ND	NC*/ND	C*/ND
CU-5	NC/NC*	C/C#	NC/NC*	NC/NC*	PC/NC*	MC/NC*
INDUSCAN	NC*/ND	NC*/ND	NC*/ND	NC*/ND	ND/ND	NC*/ND
L-59E	NC/NC*	C/C#	MC/NC*	C/NC*	NC/NC*	MC/NC*
L-59W	MC/NC*	C/C#	MC/NC*	NC/NC*	NC/NC*	NC/NC*
L-60E	NC/NC*	C/C#	MC/NC*	NC/NC*	PC*/NC*	NC/NC*
L-60W	NC/NC*	C/C#	MC/NC*	NC/NC*	NC*/NC*	NC/NC*
S-127	NC/NC*	C/NC*	NC/NC*	C/NC*	NC/NC*	NC/NC*
S-129	NC/NC*	MC/NC*	NC/NC*	NC/NC*	NC/NC*	NC/NC*
S-131	NC/NC*	PC/NC*	MC/NC*	NC/NC*	NC/NC*	NC/NC*
S-133	NC/NC*	C/NC*	MC/NC*	NC/NC*	C/NC*	NC/NC*
S-135	NC/NC*	MC/NC*	MC/NC*	NC/NC*	NC*/NC*	MC/NC*
S-154	NC/NC*	PC/PC*	MC/NC*	C/PC*	C/C*	MC/NC*
S-154C	NC/NC*	C/C#	NC/NC*	C/C*	NC*/ND	PC/NC*
S-191	NC/NC*	MC/NC*	MC/PC*	MC/NC*	NC*/NC*	NC/NC*
S-2	NC/NC*	C/C#	MC/NC*	C/C*	C/NC*	C/NC*
S-236	NC/NC*	C/C#	NC/NC*	C/C*	NC/NC*	NC/NC*
S-3	NC/NC*	C/PC*	NC/NC*	C/PC*	C/NC*	C/NC*
S-352	NC/NC*	MC/NC*	MC/NC*	NC/NC*	C*/NC*	C/C*
S-4	NC/NC*	MC/NC*	MC/PC*	MC/NC*	NC/NC*	MC/NC*
S-65E	NC*/ND	PC*/ND	NC*/ND	NC*/ND	NC*/ND	NC*/ND
S-71	MC/NC*	C/NC*	MC/NC*	NC/NC*	NC*/NC*	NC/NC*
S-72	MC/NC*	C/C#	MC/NC*	NC/NC*	NC/NC*	NC/NC*
S-84	PC/PC*	MC/NC*	MC/NC*	NC/NC*	PC*/ND	MC/NC*

[1] C - concern; PC - potential concern; MC - minimal concern; NC - no concern; and ND - Not Determined

* - less than 28 samples preliminary test used.

- less than 28 samples, and more than 10 percent of the percent saturation of DO, do not meet the criteria.

Listing before '/' is for WY2005–WY2014. Listing after '/' is for WY2014.

Table 13. Levels of concern[1] for Class I parameters at Lake Okeechobee structures during WY2014 outflow events.

Station	Alkalinity	Percent Saturation of Dissolved Oxygen	pH	Specific Conductance	Total Iron	Turbidity
C41H78	NC/NC*	C/C#	NC/NC*	NC/NC*	NC*/NC*	NC/NC*
CU-10A	NC/NC*	MC/NC*	MC/NC*	MC/NC*	C*/C*	C/C*
CU-5	NC*/NC*	C#/NC*	NC*/NC*	NC*/NC*	NC*/ND	NC*/NC*
INDUSCAN	NC/NC*	C/NC*	MC/NC*	NC/NC*	C/NC*	C/NC*
L-59W	NC*/ND	NC*/ND	NC*/ND	NC*/ND	ND/ND	NC*/ND
L-60E	NC*/ND	NC*/ND	NC*/ND	NC*/ND	ND/ND	NC*/ND
L-60W	NC*/ND	C#/ND	NC*/ND	NC*/ND	NC*/ND	NC*/ND
S-127	NC*/ND	NC*/ND	NC*/ND	NC*/ND	NC*/ND	NC*/ND
S-135	NC*/ND	NC*/ND	PC*/ND	NC*/ND	NC*/ND	PC*/ND
S-352	NC/NC*	NC/NC*	MC/NC*	NC/NC*	C*/C*	C/C*

[1] C – concern; PC – potential concern; MC – minimal concern; NC – no concern; and ND – no data.
* Less than 28 samples preliminary test used.
# - less than 28 samples and more than 10 percent of the percent saturation of dissolved oxygen do not meet the criteria.
Listing before "/" is for WY2005–WY2014. Listing after "/" is for WY2014.

Of the 23 structures where percent DO saturation was calculated during no-flow events, eleven were classified as "no concern", two (S-3 and S-154) as "potential concern", and nine (CU-5, L-59E, L-59W, L-60E, L-60W, S-154C, S-2, S-236, and S-72) as "concern" (**Table 12**; Attachment B5). Of the 177 samples taken during no-flow events, 19 were below the percent DO saturation Class I criterion (Attachment B5). For the ten-year analysis, one structure (INDUSCAN) was classified as "no concern", six (S-129, S-135, S-191, S-352, S-4 and S-84) as "minimal concern, three (S-131, S-154 and S-65E) as "potential concern", and 16 as "concern" (**Table 12**; Attachment B8).

Of the five structures where percent DO saturation was calculated during outflow events, four (CU-10A, CU-5, INDUSCAN, and S-352) were classified as "no concern", and one (C41H78) as "concern" (**Table 13**; Attachment B6). Of the 48 samples taken during outflow events, one was below the percent DO saturation Class I criterion. For the ten-year analysis, four (C41H78, CU-5, INDUSCAN, and L-60W) were classified as "concern", one (CU-10A) as "minimal concern", one (S-354) as "potential concern", and five (L-59W, L-60E, S-127, S-135, and S-352) as "no concern" (**Table 13**; Attachment B8). As with inflow events, the low DO may be due to various factors, as noted above.

pH

Of the 24 structures where pH was measured during inflow events, 22 were classified as "no concern", one (S-84) as "potential concern" and one (S-65E) as "concern" (**Table 11**). Of the 208 measurements taken during inflow events, there were two excursions (Attachment B4). For the ten-year period, 22 structures were classified as "no concern", two (S-191 and S-65E) as "minimal concern", and one (S-84) as "concern" (**Table 11**; Attachment B8). Excursions at S-191 were below pH 6.0. At S-65E, some were above pH 8.5, and others were below pH 6.0. The excursions at S-84 were all above pH 8.5.

Of the 23 structures where pH was measured during no-flow events, two (S-191 and S-4) were classified as "potential concern", and the rest were classified as "no concern" (**Table 12**). Of the 179 samples taken during no-flow events, two were outside the pH criteria range, above 8.5 (Attachment B5). For the ten-year period, there were 10 structures listed as "no concern", 15 as "minimal concern", and one as "concern" (C-38W) (**Table 12**; Attachment B8). Of the structures listed as "minimal concern", three (S-72, S-84, and S-191) had excursions above the 8.5 pH criterion and below the 6.0 pH criterion, while excursions at the other structures were above the pH 8.5 criterion. The concern at C-38W was for pH samples above 8.5, which may have been caused by high groundwater inflows or algal blooms.

No excursions were found in the 50 pH measurements at five structures during outflow events in WY2014 (**Table 13**; Attachment B6). For the ten-year period, nine structures were classified as "no concern", one structure (CU-10A) was classified as "minimal concern" (**Table 13**; Attachment B8). The pH excursions at all of these structures exceeded the pH 8.5 criterion.

Specific Conductance

Of the 24 structures measured for specific conductance during inflow events, 18 were classified as "no concern", two (CU-10A and S-4) as "potential concern", and four (C-38W, S154C, S-2 and S-3) as "concern" (**Table 11**). Of the 208 samples taken during inflow events, 33 exceeded the conductance criterion (Attachment B4). For the ten-year period of record, 15 were classified as "no concern", one (S-84) as "minimal concern", one (S-3) as "potential concern", and eight (C-38W, CU-10A, L-59E, S-154, S-154C, S-2, S-236, and S-4) as "concern" (**Table 11**; Attachment B8). High conductance is likely a result of groundwater seepage.

Of the 23 structures measured for specific conductance during no-flow events, 17 were classified as "no concern", two (S-154 and S-3) as "potential concern", and four (C-38W, S-154C, S-2, and S-236) as "concern" (**Table 12**). Of the 179 samples taken during no-flow conditions, 16 exceeded the conductance criterion (Attachment B5). For the ten-year period of record, 16 structures were classified as "no concern", two (S-191 and S-4) as "minimal concern", and eight (C-38W, L-59E, S-127, S-154, S-154C, S-2, S-236, and S-3) as "concern" (**Table 12**; Attachment B8). Similar to inflow conditions, high conductance was likely a result of groundwater seepage.

No excursions were found in the 50 specific conductance measurements at five structures during outflow events in WY2014, (**Table 13**; Attachment B6). For the ten-year period, nine structures were classified as "no concern", and one (CU-10A) as "minimal concern" (**Table 13**; Attachment B8).

Total Iron

The Class I criterion specifies that total iron shall not exceed 1 mg/L. While not toxic at this level, the criterion is primarily to prevent staining in clothes washing (Environmental Health Laboratory, 2010). Currently, only one local municipality, the City of Okeechobee, uses lake water for part of its water supply. This parameter is only measured quarterly. Therefore, the binomial test could only be performed on a few structures with accuracy for the ten-year period.

Of the 23 structures sampled for total iron during inflow events in WY2014, four (L-59E, L59W, S-154 and S-154C) were classified as "concern" the other nineteen as "no concern" (**Table 11**; Attachment B4). CU-10A was not sampled during inflow events. Of the 43 samples taken during inflow events, 4 exceeded the total iron criterion (Attachment B4). For the ten-year period of record, 14 structures were classified as "no concern", seven (C-38W, INDUSCAN, S-154C, S-2, S-65E, S-72 and S-84) as "potential concern", and four (CU-10A, L-59E, L-59W and S-154) as "concern" (**Table 11**; Attachment B8). Iron occurs naturally in soils and

groundwater of the Lake Okeechobee watershed resulting in the high concentrations (FDEP, 2009).

Of the 20 structures sampled for total iron during no-flow events, 19 were classified as "no concern", and one (S-154) as "concern" (**Table 12**). Four (C41H78, S-154C, S-65E, and S-84) other structures were not sampled during no-flow events. Of the 45 samples taken during no-flow periods, only one at S-154 exceeded the iron standard (Attachment B5). For the ten-year period, 18 structures were classified as "no concern", three (CU-5, L-60E, and S-84) as "potential concern", and five (S-133, S-154, S-2, S-3, and S-352) as concern. Iron has not been measured in the last ten years during no flow conditions at C41H78 or INDUSCAN. Iron concerns at S-133, S-154, S-2, S-3, and S-352 may be attributed to groundwater seepage.

Of the four structures sampled for total iron during outflow events, two structures (C41H78 and INDUSCAN) were classified as "no concern", two (CU-10A and S-352) as "concern", and one (CU-5) was not sampled (**Table 13**). Of the ten samples taken during outflow periods, four exceeded the criterion for iron (Attachment B6). For the ten-year period, five structures (C41H78, CU-5, L-60W, S-127, and S-135) were classified as "no concern", three (CU-10A, INDUSCAN, and S-352) as "concern", and two (L-60E and L-59W) were not measured (**Table 13**; Attachment B8). Two of the "concerns", S-352 and CU-10A, may be attributed to the proximity of the structures to the open waters of the lake, which are relatively high in iron (FDEP, 2009).

Turbidity

The Class I turbidity criterion for Lake Okeechobee tributaries is 32.3 NTU. The exceedance value was based on 29 NTU, plus a background value of 3.3 NTU, which was determined based on the median value of turbidity in lake tributaries from 1990 to 2000 (Unsell, 2009).

Of the 24 structures sampled for turbidity during inflow events, all were classified as "no concern" (**Table 11**). Of the 207 samples taken, none exceeded the criterion (Attachment B4). For the ten-year period, 19 structures were classified as "no concern", two (S-154C and S-84) as "minimal concern", two (S-133 and S-2) as "potential concern", and two (CU-10A and INDUSCAN) as "concern" (**Table 11**; Attachment B8). Turbidity concerns in CU-10A and the INDUSCAN may be due to runoff from agricultural lands, as well as resuspended sediments that have accumulated in the bottom of the canals during inflow events. Further investigation would be needed to confirm these explanations.

Of the 23 structures sampled for turbidity during no-flow events, 22 were classified as "no concern", and one (S-352) as "concern" (**Table 12**). Of the 179 samples taken during no-flow events, four samples at S-352 exceeded the criterion for turbidity (Attachment B5). For the ten-year period, 14 structures were classified as "no concern", six (CU-5, L-59E, S-135, S-154, S-4, and S-84) as "minimal concern", one (S-154C) as "potential concern", and five (C-38W, CU-10A, S-2, S-3, and S-352) as "concern" (**Table 12**; Attachment B8). Turbidity concerns at S-2, S-3, S-352, CU-10A, and C-38W may be related to accumulation of sediments in the bottom of the canals.

Of the five structures sampled for turbidity during outflow events, three structures (C41H78, CU-5, and INDUSCAN) were classified as "no concern", and two (CU-10A and S-352) as "concern" (**Table 13**). Of the 50 samples taken during outflow events, 19 exceeded the criteria for turbidity (Attachment B6). For the ten-year period, six structures were classified as "no concern", one (S-135) as "potential concern", and three (CU-10A, INDUSCAN, and S-352) were classified as "concern" (**Table 13**; Attachment B8). Turbidity concerns at S-352 and CU-10A during outflow could be attributed to their location, which is near the open, turbid waters of the lake. The INDUSCAN location is not as close to open water; however, it could be affected by

sediments entrained from a nearby launching basin located between the Roland Martin Marina and the Herbert Hoover Dike.

TOTAL PHOSPHORUS LOADS

The WY2014 TP load to Lake Okeechobee was 609 mt, which included an estimated 35 mt from atmospheric deposition (FDEP, 2001; **Table 14**). Most of the surface load came from the north region (538 mt), followed by south (25 mt), east (11 mt), and west (0.1 mt). Target loads based on the TMDL were exceeded by 459.7 mt in the northern region, 15.2 mt in the south region, and 0.05 mt in the west region. Loads from the east region were below the target. Overall, the WY2014 TP load was greater than WY2013 by 7 percent (**Table 15**). This increase in load is less than expected, because flow, which is a major driver of loads, was 31 percent greater in WY2014 than WY2013 (**Table 14**). Despite this lower-than-expected load to the lake in WY2014, the current year's load exceeds the lake's TMDL of 140 mt by 469 mt. The five-year (WY2010–WY2014) average TP load to Lake Okeechobee is 442 mt per year, which exceeds the TMDL by 302 mt (**Table 15**).

This five-year average includes one regional drought that lasted from December 2010 to October 2011. During this period, flow and load to the lake were reduced substantially compared to the 1991–2005 baseline of 2.5 million ac-ft and 546 mt TP (SFWMD et al., 2011) (**Tables 15** and **16**). The overall average flow in the past five years was 2.06 million ac-ft, which is 0.44 million ac-ft below the baseline (**Table 16**). Further analysis is presented in Volume I, Chapter 8 of this report, which documents water flow, TP load, and TP mean flow-weighted concentrations in each Lake Okeechobee sub-watershed.

Table 14. WY2014 TP loads in mt for each structure by month.

Region	Structure	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	Total	Target Loads	Above Target
East	L-8(C10A)	0.2	1.9	1.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.9	4.9		
	S-308	0.2	0.2	0.0	0.0	0.2	0.1	0.4	0.3	2.3	1.1	1.0	0.4	6.2		
	Total	0.4	2.1	1.8	0.0	0.2	0.1	0.4	0.3	2.4	1.1	1.0	1.3	11.1	16.8	0.0
North	C41H78	0.6	16.7	26.4	9.4	7.1	0.3	0.0	0.0	0.0	0.3	0.2	0.4	61.4		
	C-38W	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5		
	CU-5	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5		
	FECR	0.2	15.3	56.0	14.1	10.1	5.3	0.3	0.1	0.1	0.4	0.3	0.2	102.6		
	L-61E	0.0	0.9	1.5	0.4	0.0	0.0	0.3	0.6	0.1	0.4	0.3	0.7	5.2		
	L-59E	0.1	0.2	0.8	0.8	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	2.8		
	L-59W	0.1	2.1	6.7	1.9	0.8	0.0	0.0	0.0	0.0	0.2	0.3	0.2	12.4		
	L-60E	0.0	0.2	1.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9		
	L-60W	0.1	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5		
	S-127	0.0	0.2	1.3	0.9	0.4	0.1	0.0	0.0	0.1	0.1	0.1	0.0	3.2		
	S-129	0.0	0.1	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0		
	S-131	0.0	0.1	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1		
	S-133	0.1	0.6	1.5	2.1	1.3	0.3	0.1	0.1	0.0	0.2	0.1	0.0	6.4		
	S-135	0.0	0.1	0.7	0.5	0.5	0.1	0.0	0.0	0.0	0.2	0.0	0.0	2.2		
	S-154	0.0	0.2	5.1	8.9	3.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	19.5		
	S-154C	0.1	0.2	0.7	0.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.4		
	S-191	0.1	3.5	31.7	26.2	13.6	1.8	0.1	0.0	0.0	0.1	0.0	0.0	77.1		
	S-65E	3.0	16.7	79.7	32.6	17.9	6.0	1.1	0.7	1.1	4.2	5.2	4.4	172.9		
	S-71	0.5	17.3	27.3	9.4	7.5	1.2	0.0	0.0	0.1	0.1	0.1	0.0	63.8		
	S-72	0.3	2.4	9.7	2.5	2.5	0.3	0.0	0.0	0.0	0.1	0.1	0.0	17.9		
	S-84	1.3	3.7	16.1	10.4	9.7	1.8	0.6	0.0	0.0	0.7	0.1	0.1	44.4		
	Total*	5.9	64.0	242.2	112.0	70.2	19.0	2.5	1.8	1.7	6.8	6.6	5.6	538.3	78.6	459.7

Table 14. Continued.

Region	Structure	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	Total	Target Loads	Above Target
South	CU-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	CU-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	CU-12A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	CU-4A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	INDS	0.2	0.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	2.9		
	S-2	0.0	6.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4		
	S-236	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	S-3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2		
	S-352	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	S-4	0.1	4.4	5.2	1.6	0.8	0.2	0.0	0.1	0.2	2.0	0.6	0.1	15.3		
	Total	0.3	11.2	7.0	1.7	0.9	0.3	0.0	0.1	0.2	2.1	0.7	0.2	24.7	9.6	15.2
West	CU-5A	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00		
	S-77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Total	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.06	0.01	0.05
Total	Surface*	6.6	77.4	251.0	113.7	71.2	19.4	2.9	2.2	4.3	10.0	8.3	7.0	574.18	105.0	474.92
	Atmospheric Deposition													35.0	35.0	
	Sum*													609.18	140.0	469.18

* Does not include C41H78

Table 15. TP loads in mt to Lake Okeechobee, WY2010-WY2014.

Water Year	North	East	South	West	Atmospheric Deposition*	Total
2010	393	17	21	12	35	478
2011	136	2	4	1	35	178
2012	278	16	10	38	35	377
2013	467	37	29	0.4	35	569
2014	538	11	25	0.1	35	609
Average	363	17	18	10	35	442
Percent of total	82%	4%	4%	2%	8%	100%

*35 mt per year from atmospheric deposition (FDEP, 2001).

Table 16. Surface flows in millions of ac-ft to Lake Okeechobee, WY2010–WY2014.

Water Year	North	East	South	West	Total
2010	2.14	0.09	0.09	0.09	2.41
2011	0.89	0.01	0.03	0.02	0.95
2012	1.62	0.09	0.04	0.2	1.95
2013	1.85	0.2	0.09	0.01	2.15
2014	2.7	0.06	0.08	0.00	2.83
Average	1.84	0.09	0.07	0.06	2.06
Percent total	89%	4%	3%	3%	100%

PESTICIDE MONITORING PROGRAM

The District maintains a pesticide monitoring program to meet various permit and other mandated requirements, including Class I (drinking water) criteria of Chapter 62-302, F.A.C. On a quarterly basis for water, and an annual/semi-annual basis for sediments, samples are measured for 73 pesticides and their breakdown products at sites throughout the District region (Pfeuffer, 2013a, b, c; 2014). The Lake Okeechobee Water Control Structures Operations permit minor modification 0174552-010, dated December 16, 2011, eliminated sediment sampling at S-65E, S-191, and FECSR78. Additionally, sediment sampling was reduced to an annual frequency at S-2, S-3, and S-4 for only ametryn, chlordane, DDD, DDE, and DDT analysis. Additional information on the pesticide monitoring program can be found on the District's website at www.sfwmd.gov.

For Lake Okeechobee, pesticides are monitored at S-65E, S-191, Fisheating Creek (FECSR78), S-2, S-3, and S-4 (Attachments B9 and B10). In the four surface water sampling events (June, September, and October 2013, and January 2014), 2,4-D, ametryn, atrazine, atrazine breakdown product, bentazon, DDE-p,p', dieldrin, diuron, hexazinone, imidacloprid, metolachlor, and metribuzin were detected in at least one sample (**Table 17**).

The observed concentration of each compound is compared to the appropriate criterion outlined in Rule 62-302.530, F.A.C. If a pesticide compound is not specifically listed, acute and chronic toxicity criteria are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50 percent of the test organisms in 96 hours, using the lowest technical grade effective concentration (EC_{50}) or lethal concentration (LC_{50}). The EC_{50} is a concentration at which 50 percent of the aquatic species tested exhibit a toxic effect short of mortality within a short (acute) exposure period. The LC_{50} technical grade is a concentration at which 50 percent of the aquatic animals tested die within a short (acute) exposure period. These criteria are determined using data from the summarized literature for the species significant to the indigenous aquatic community (62-302.200, F.A.C.). These values are listed for the water flea (*Daphnia magna*), which is the most susceptible test organism for these pesticides (**Table 17**). The dieldrin concentration detected exceeds the 62-302, F.A.C. Class III surface water quality maximum concentration standard of 0.0019 micrograms per liter (µg/L). This is the first network-wide surface water detection of dieldrin since 2006. Prior to that, the only detection occurred in 1990. For this sampling event, the water sample contained suspended matter. The suspended matter could provide a sink for additional residues, which are then removed by the whole water extraction process used by the laboratory. However, the pulsed nature of agricultural runoff releases to the canal system precludes drawing any conclusions about the effects of long-term average exposures. Based on excursion categories recommended for the Everglades Protection Area (Weaver and Payne, 2005), any site where a pesticide was detected is to be labeled as a potential concern.

Sediment samples showed detectable concentrations of two different pesticides (**Table 18**). Sediment concentrations are compared to freshwater sediment quality assessment guidelines (MacDonald Environmental Sciences, Ltd. and United States Geological Survey, 2003). A value below the threshold effect concentration (TEC) should not have a harmful effect on sediment-dwelling organisms. Values above the probable effect concentration (PEC) demonstrate that harmful effects to sediment-dwelling organisms are likely to be frequently, or always, observed.

DDD (Dichlorodiphenyldichloroethane) was only detected at S-4, while DDE (dichlorodiphenyldichloroethylene [2, 2-bis (4-chlorophenyl)-1, 1-dichloroethene]) was detected at S-2 and S-4. Both of these are breakdown products of DDT, a popular insecticide for which the U.S. Environmental Protection Agency cancelled all uses in 1973. The large volume of DDT used, the persistence of DDT, DDE, and DDD, and the large hydrophobicity of these compounds

Table 17. Pesticide residues in µg/L above the method detection limit found in surface water samples collected by SFWMD at Lake Okeechobee sampling sites in June, September, and October 2013, and January 2014 (from Pfeuffer, 2013a, b, c, 2014), and chronic toxicity values for the water flea (*Daphnia magna*). Bentazon analysis started during the September 2013 sampling event.

Site	Date	Flow	2,4-D	Ametryn	Atrazine	Atrazine Desethyl	Bentazon	DDE-p,p'	Dieldrin	Diuron	Hexa-zinone	Imida-cloprid	Metola-chlor	Metri-buzin
FECSR78	6/10/2013	Y	0.051	BDL	0.013 [a]	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	9/17/2013	Y	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.058 [a]	BDL	BDL	BDL
	10/10/2013	Y	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1/30/2014	N	BDL	BDL	0.031 [a]	BDL	0.0032 [a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-65E	6/10/2013	Y	0.0039 [a]	BDL	0.023 [a]	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	9/17/2013	Y	0.013 [b]	BDL	0.10 [b]	BDL	0.031 [b]	BDL	BDL	BDL	BDL	0.010 [b]	BDL	BDL
	10/10/2013	Y	0.009 [b]	BDL	BDL	BDL	0.0050 [ab]	BDL	BDL	BDL	BDL	0.010 [ab]	BDL	BDL
	1/28/2014	N	0.015 [b]	BDL	0.021 [ab]	BDL	0.011 [b]	BDL	BDL	BDL	BDL	0.0078 [ab]	BDL	BDL
S-191	6/10/2013	N	0.12	BDL	0.047	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	9/17/2013	Y	0.049	BDL	BDL	BDL	0.0027 [a]	BDL	BDL	BDL	0.047 [a]	BDL	BDL	BDL
	10/10/2013	N	0.0089 [a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1/30/2014	N	0.040	BDL	0.010 [a]	BDL	0.0029 [a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-2	6/10/2013	Y	0.13	0.048	0.62	0.090	NA	BDL	BDL	BDL	BDL	BDL	0.58	0.24
	9/17/2013	N	0.0076 [a]	0.091	0.16	BDL	0.031	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	10/10/2013	N	0.94	0.15	0.72	BDL	0.025	0.0060 [a]	0.0053 [a]	BDL	BDL	BDL	BDL	BDL
	1/30/2014	N	0.0041 [a]	0.011 [a]	0.15	0.012 [a]	0.0048 [a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-3	6/10/2013	N	0.086	0.052	0.42	0.045	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	9/17/2013	N	0.17	0.039	0.81	0.028 [a]	0.019	BDL	BDL	BDL	BDL	BDL	1.1	BDL
	10/10/2013	N	0.36	0.026 [a]	0.22	BDL	0.0078 [a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1/30/2014	N	BDL	BDL	0.16	0.031 [a]	0.0050 [a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL
S-4	6/10/2013	N	0.10 [b]	0.066	0.42	0.062	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	9/17/2013	N	0.25	0.036 [a]	0.062	BDL	0.0062 [a]	BDL	BDL	0.0026 [a]	0.076 [a]	0.0066 [a]	BDL	BDL
	10/10/2013	N	0.098	0.028 [a]	0.23	BDL	0.0082 [a]	BDL	BDL	0.0022 [a]	BDL	0.0043 [a]	BDL	BDL
	1/30/2014	N	0.0099 [a]	BDL	0.17	0.025 [a]	0.0055 [a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chronic toxicity of ***Daphnia magna***			1,250 [c]	1,400 [c]	345 [c]	NA	5,000 [d]	NA	NA	70	7,580 [c]	4,260	1,175 [c]	210 [e]

Note:

N – No; Y – Yes; BDL – Result is below the method detection limit; and NA – Not available.

[a] Value reported is greater than or equal to the method detection limit and less than the practical quantitation limit.

[b] Results are the average of replicate samples.

[c] U.S. Environmental Protection Agency (1991)

[d] U.S. Environmental Protection Agency (1994)

[e] U.S. Environmental Protection Agency (1998)

Table 18. Pesticide residues (in micrograms per kilogram dry weight above the method detection limit) found in sediment samples collected on January 30, 2014, by the SFWMD at Lake Okeechobee sampling sites (Pfeuffer, 2014).

Site	DDD-p,p'	DDE-p,p'
S-2	BDL	6.2 [a]
S-4	6 [ab]	30 [a]

BDL - result is below the method detection limit.

[a] Value reported is greater than or equal to the method detection limit and less than the practical quantitation limit.

[b] Results are the average of replicate samples.

account for their frequent detections in sediments. The latter attribute also results in a significant bioconcentration factor. In sufficient quantities, these residues have reproductive effects in wildlife, and carcinogenic effects in many mammals.

The DDD sediment concentration detected was 6 micrograms per kilogram (µg/kg). Any concentration below the TEC (4.9 µg/kg) should not impact sediment-dwelling organisms, while concentrations above the PEC (28 µg/kg) frequently, or always, have the possibility for impacting sediment-dwelling organisms. The sediment concentration detected at S-4 was less than the PEC, and did not exceed the level of concern.

DDE values ranged from 6.2 to 30 µg/kg in these sediments. The TEC is 3.2 µg/kg, and the PEC is 31 µg/kg, for DDE in freshwater sediments. The DDE concentrations detected did not exceed the PEC.

IN-LAKE WATER QUALITY MONITORING

The District sampled 26 locations during WY2014 to monitor water quality in all ecological regions of Lake Okeechobee (**Figure 4**). The effects of nutrient loading, high and low water levels, droughts, and hurricanes on trends and changes in water quality have been evaluated using this information (Havens and James, 2005; James and Havens, 2005; James et al., 2008, 2011a, b). Volume I, Chapter 8 of this report includes a detailed evaluation of these WY2014 data. All water quality data collected at the in-lake sampling sites (**Figure 4**) was downloaded from DBHYDRO (SFWMD, 2014a), as presented in Attachment B11. These records include analytical results of grab samples for the 16 water quality parameters listed in **Table 4**.

Figure 4. Active water quality monitoring stations in Lake Okeechobee.

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the Lake Okeechobee Operating Permit (NEEP permit 0174552-010).

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2015 SFER in: *(All references are to Volume III, except where noted as "V1" for Volume I - Chapter 8, and "LOPP" for the 2011 Lake Okeechobee Protection Plan Update [SFWMD et al., 2011])*			
				Narrative (page #s)	**Figure**	**Table**	**Attachment**
6E(3)	Operations at the S-2 and S-3 structures – event reporting and coordination – after action reports	Operations	After action report was submitted on July 22, 2013, within 45 days of the associated flood control backpumping event.	9			
9A	Implementation of the Lake Okeechobee Protection Plan	Operations	Ongoing implementation of the Lake Okeechobee Protection Plan to meet Lake Okeechobee total maximum daily load by 2015	V1: 8-1 to 8-48	V1: 8-1 to 8-13	V1: 8-1 to 8-14	
9B	Annual compliance evaluation by region	Operations	Completed annual compliance evaluation (by region), as required	24		14,15	
16	Annual monitoring reports	Operations	Completed and submitted annual report (this document), as required	All	All	All	All
16 A	Water quality data	Operations	Data records include all applicable laboratory information specified in Rule 62-160.340(2), F.A.C.	5 – 8	1	3 – 5	B1
16 A1	Date, location and time of sampling or measurements	Operations	Reported as required		1		B1
16 A2	Person responsible for performing the sampling or measurements	Operations	Reported as required				B1
16 A3	Dates analyses were performed or appropriate code as required by Chapter 62-160, F.A.C.	Operations	Reported as required				B1
16 A4	Laboratory/person responsible for performing the analyses	Operations	Reported as required				B1
16 A5	Analytical methods used, including method detection limits and practical quantitation limits	Operations	Reported as required				B1
16 A6	Results of such analyses, including appropriate data qualifiers, and all compounds detected	Operations	Reported as required				B1
16 A7	Depth of sampling (for grab samples)	Operations	Reported as required				B1

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2015 SFER in: *(All references are to Volume III, except where noted as "V1" for Volume I - Chapter 8, and "LOPP" for the 2011 Lake Okeechobee Protection Plan Update [SFWMD et al., 2011])*			
				Narrative (page #s)	**Figure**	**Table**	**Attachment**
16 B	Performance evaluation: with the raw data, the permittee must submit an evaluation of the water quality monitoring data collected	Operations	Evaluated raw water quality data and included in report	16 – 31		9 –18	B4 – B11
16 B1	The analysis shall include the identification of exceedances of water quality criteria, other than phosphorus, as well as the frequency of exceedances	Operations	Performed exceedance analyses and included all required information in report	16 – 24		9 –13	B4 – B8
16 B2	The permittee shall determine the annual TP loading to Lake Okeechobee	Operations	Calculated TP loads and included in report, as required	24; V1: 8-27 to 8-34,8-51 to 8-54	V1: 8-16 to 8-18	14 – 15; V1: 8-4,8-6, 8-8, 8-16	
16 B3	The permittee shall report the five-year rolling average of phosphorus loading to Lake Okeechobee	Operations	Reported five-year rolling average total phosphorus loads, as required	24; V1: 8-27		15, V1: 8-4	
16 B4	The permittee shall provide the data from their ambient pesticide and herbicide monitoring program that is applicable to Lake Okeechobee	Operations	Provided pesticide and herbicide monitoring data, as required	28 – 30		17 – 18	B9, B10
16 B5	The permittee shall provide data collected within Lake Okeechobee under the Lake Okeechobee Research and Monitoring Program	Operations	Provided Lake Okeechobee Research and Monitoring Program data, as required	30; V1: 8-48 to 8-54	4; V1: 8-14, 8-16 to 8-20	V1: 8-15 to 8-17	B11
21	Permit modifications for the 3-Year Updates to the Lake Okeechobee Protection Plan	Operations	Modification 0174552-010 in effect. Procedure to authorize structure improvements and maintenance added (3c). Also includes changes in responsible persons, programs, offices, and regulation schedule.	1; LOPP			

Attachment B: Water Quality and Hydrologic Data

This project information is required by Specific Condition 16 of the Lake Okeechobee Operating Permit (0174552-010), and is available upon request.