

Appendix 5-1: Annual Permit Report for the Loxahatchee River Watershed Restoration Project, G-160 and G-161 Components

Permit Report (January 1, 2014–December 31, 2014)
Permit Numbers: EI 50-0128848 and EI 50-0244327

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SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting requirements, **Table 1** lists key permit-related information associated with this report. **Table 2** lists attachments included with this report. **Tables A-1** and **A-2** in Attachment A list the 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 Names:	C-18 Canal Control Structure Project (G-160 Project) G-161 Water Control Structure Phase II Project (G-161 Project)
Permit Numbers:	EI 50-0128848, EI 50-0244327
Issue and Expiration Dates:	
Permit # EI 50-0128848-007:	Issued: 11/15/2013; Expires: N/A (in Operation Phase)
Permit # EI 50-0244327-005:	Issued: 6/13/2014; Expires: N/A (in Operation Phase)
Project Phase:	Operation
Permit Specific Condition Requiring Annual Report:	10
Reporting Period:	January 1, 2014–December 31, 2014
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Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Water Quality Data
C	Hydrologic Data

PROJECT STATUS

The C-18 Canal Control Structure Project (G-160 Project) and the G-161 Water Control Structure Phase II Project (G-161 Project) are in the operational phase. This report provides an evaluation of the permit required monitoring results for the reporting period, which begins on January 1, 2014 and ends on December 31, 2014.

CONCLUSIONS REGARDING PROJECT SUCCESS

The success of the project was very good during the reporting period. Water quality was significantly better at the Grassy Water Preserve outflow (station G161) than at the City of West Palm Beach inflow station on the M canal (station L8.M CNL) (**Figure 1**). Nutrients were much lower at G161 with total phosphorus averaging 0.010 milligrams per liter (mg/L), versus 0.119 mg/L at L8.M CNL. Total nitrogen averaged 0.83 mg/L at G161 and 1.36 mg/L at L8.M CNL. Dissolved oxygen complied with Class III criteria at L8.M CNL, but did not at G161. Turbidity at L8.M CNL ranged from 3.6 to 65.0 nephelometric turbidity units (NTU) with an average of 23.8 NTU. Out of eight sampling events during the reporting period, only one turbidity sample had a value above 29 NTU. The state Class III standard is ≤ 29 NTUs above background conditions. All other applicable parameters complied with the Class III criteria. See **Table 7** for all water quality results.

Rainfall was above average during the dry season in the Loxahatchee Slough. Stage in the slough was maintained between 15.5 and 17.5 feet National Geodetic Vertical Datum of 1929 (ft NGVD29) (**Figure 3**) during the reporting period.

PROBLEMS ENCOUNTERED

No problems occurred during the reporting period.

ACTIONS TO ADDRESS PROBLEMS

No problems occurred during the reporting period.

INTRODUCTION

PROJECT OVERVIEW

Environmental Resource Permits EI 50-0128848 and EI 50-0244327, issued by the FDEP to the South Florida Water Management District (District or SFWMD), authorized the District to construct and operate the G-160 and the G-161 projects, respectively. Specific Condition 7 of the G-160 permit (EM 50-0128848-006) requires the District to submit an annual report within 75 days of the end of each year of operation. The reporting period for this report is

January 1, 2014–December 31, 2014. Because both structures are able to be operated concurrently, and are designed to restore a more natural hydroperiod to the Loxahatchee Slough while increasing the flows to the Northwest Fork of the Loxahatchee River, the two reports are consolidated into this single document. This annual report presents results of permit-mandated monitoring for the G-160 and G-161 structures during the reporting period.

G-160

The G-160 structure allows stages in the C-18 canal to be increased, in accordance with specific hydraulic conditions and zones, to meet the recommended target stages within the Loxahatchee Slough necessary to maintain the ecological integrity of the slough's vegetative communities. The Loxahatchee Slough is a historical tributary component of the Loxahatchee River, providing important base and wet season flows. When supplemental water is available from implementation of Comprehensive Everglades Restoration Plan projects, G-160 will allow the maintenance of a permanent water pool in the Loxahatchee Slough between 15.5 and 17.5 ft NGVD29 with maximum water levels up to 17.8 ft NGVD29 for rainfall-driven conditions. The structure is to be effectively operated so that during rainfall events, when stages upstream of the G-160 structure rise to an elevation of 16.8 ft NGVD29, the structure is opened to allow stages to recede, and is closed once they reach an elevation of 16.2 ft NGVD29. Gradual reduction of the stage upstream of G-160 should occur through the dry season to compensate for gradual drawdown of the slough to 15.5 ft NGVD29 toward the end of May.

G-161

The G-161 structure allows water to be released from Grassy Waters Preserve under Northlake Boulevard into a constructed flow-way through the triangle formed by the area to the west of the intersection of Northlake Boulevard and Beeline Highway (State Road 710). The water flows northward to a culvert that conveys it under the Beeline Highway to the C-18 canal upstream of the G-160 structure.

The purpose of the G-161 Project monitoring program is to evaluate results of the project in achieving the desired objectives of restoring a more natural hydroperiod to downstream wetlands, sloughs, ponds, floodplains, and rivers, without impacting water quality, relative to baseline conditions. It is anticipated that restoring a more natural hydroperiod will result in a more natural salinity gradient in the downstream system, with associated benefits for estuarine and marine flora and fauna. However, the contribution of the G-161 Project to the restoration of a more natural hydroperiod in this system, individually or together with the G-160 Project, is constrained by regional water availability. Operating schedules may still be controlled or influenced by other local government regulations or permits. Full benefits of the G-160 and G-161 projects are not anticipated to be realized until regional water is available in amounts adequate to provide restorative flows to the Northwest Fork of the Loxahatchee River.

To the extent practicable and appropriate, the G-161 Project monitoring program is carried out in coordination with the adjacent G-160 Project monitoring program using the same methods, procedures, and reporting format. This is intended to ensure comparability of results and continuity of data interpretation, while avoiding duplicative efforts.

Specifically, the monitoring plan provides for the following:

- Continuous water level monitoring during operations at locations upstream (station G161_H) and downstream (station G161_T) of the G-161 structure via stage gauges with telemetry to support the calculation of the flow rate through the G-161 structure
- Monthly water quality monitoring during periods of flow by grab sampling upstream of the G-161 structure (station G-161_H) and Control 2 Pump Station (station L8.M)

CNL) to evaluate the status of and trends in post-operational water quality relative to the pre-operational baseline

The permit requires monitoring in areas that are expected to have an altered or enhanced hydropattern as a result of regular operation of the G-161 structure. The District has monitored stage and flow per Specific Condition 9 (I) of the G-161 Project permit, and monthly water quality monitoring per Specific Condition 9 (IV) of the permit, on the few occasions in past years when water was flowing through the G-161 structure. In 2012, the L-8 Reservoir was identified as a key component in the Restoration Strategies Regional Water Quality Plan, to be used as a flow equalization basin for the eastern flow path to improve water quality discharged to the Everglades Protection Area. Prior to completion of the eastern flow path projects, only limited water deliveries are expected to be available from the reservoir to the Loxahatchee River. However, alternative storage sites need to be identified to provide a more permanent source of regional water. Until alternative storage sites are identified and able to consistently deliver water from the regional system to maintain an acceptable hydropattern that provides restorative flows to the river, it is unlikely that significant vegetative changes or changes in wildlife usage will be realized.

PERMIT HISTORY

The original Environmental Resource Permit and all modifications issued to the District are as follows:

G-160

- EI 50-0128848-004, issued March 7, 2003, with an expiration date of March 6, 2008, was the original permit.
- EI 50-0128848-005, issued February 14, 2007, was a modification of the original permit.
- EI 50-0128848-006, issued February 24, 2011, was a modification that changed the annual reporting deadline from 45 days after the end of the previous year to 75 days after.
- EI 50-0128848-007, issued November 15, 2013, was a modification.

G-161

- EI 50-0244327-002, issued May 15, 2006, with an expiration date of May 15, 2011, was the original permit.
- EI 50-0244327-003, issued February 24, 2011, was a modification that changed the annual reporting deadline from 45 days after the end of the previous year to 75 days after.
- EI 50-0244327-005, issued June 13, 2014, was a minor modification that authorized the revised, updated interim operational plan for the G-161 structure.

MONITORING STATION LOCATIONS

Tables 3 and **4** list the locations and coordinates of water quality, flow, and rainfall monitoring stations used in this report. **Figure 1** shows monitoring sites in Grassy Waters Preserve and Loxahatchee Slough. The figure also shows the natural areas to be restored by operation of these structures in conjunction with the availability of regional water of sufficient quantity and quality to provide for restorative flows. Other relevant structures and environmental features include the G-92 culvert, S-46 spillway, Grassy Waters Preserve, Loxahatchee Slough, Northwest Fork of the Loxahatchee River, and Loxahatchee Estuary.

Table 3. G-160 and G-161 project monitoring locations.

Station	Location	Latitude	Longitude
G161	Northlake Boulevard West of State Road 710 Outflow for Grassy Waters Preserve	264837.399	800923.471
G160	C-18 Canal Loxahatchee Slough	265245.884	801036.712
S46	Coastal Structure on the C-18 Canal	265605.757	800828.086
L8.M CNL	City of West Palm Beach Control 2 Pump Station on M Canal	264515.634	802044.794

Table 4. G-160 and G-161 project rainfall monitoring locations.

Station	Location	Latitude	Longitude
SIRG	South Indian River	265426.206	801130.153
S46	South West Fork Loxahatchee River, North of Indiantown Road	265606.890	800828.450
C18W	Canal 18 West	265219.209	801442.158

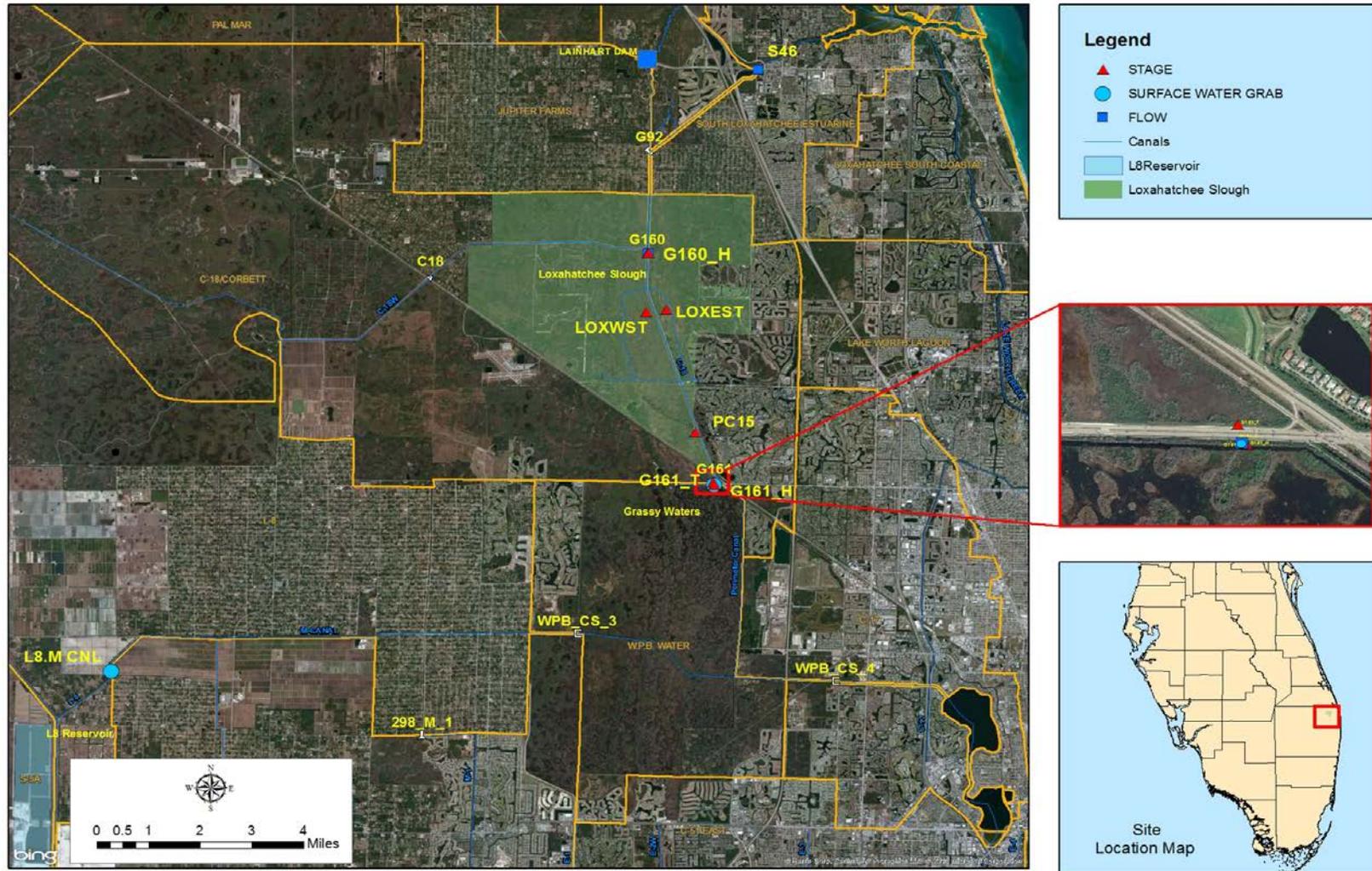


Figure 1. Location of G-160 and G-161 project monitoring sites.

HYDROLOGIC MONITORING

In 2009, the FDEP directed the District to begin incrementally raising water levels upstream of the G-160 structure in compliance with the interim operating plan that was a component of the permit. The District responded by indicating that the G-160 headwater (upstream) would be increased to 16.5 ft NGVD29 at the beginning of the 2009 wet season, and agreed to install and monitor seepage wells adjacent to the communities for two years following the increase in stage to determine if seepage concerns were warranted. The participating agencies (SFWMD, Northern Palm Beach County Improvement District, Southern Indian River Water Control District, and City of Palm Beach Gardens) met over several months in late 2009 to determine the location and number of wells to be installed. As a result, fourteen groundwater monitoring wells were installed (six shallow/deep pairs at strategic locations near community boundaries north of PGA Boulevard, and two individual shallow wells in Palm Beach Gardens, adjacent to Grassy Waters Preserve) (**Figure 2**) between January and March 2010. Data collection began in April 2010, and was completed in March 2013. The full data set has undergone quality assurance/quality control validation and has been loaded into the District's DBHYDRO database. Analysis of the full data set is continuing.

During the 2014 dry season (November 2013–May 2014), the District experienced above average rainfall (32.51, 27.87, and 30.86 inches) at each of the three rainfall recorders in the area, SIRG, C18W_R, and S46_R, respectively (see **Table 4** for location information). The dry season period of record (November–May each year from 1997 to 2014) rainfall average for these three sites is 19.68 inches.

Stages at the G-161 and G-160 structures and associated sloughs are shown in **Figure 3**. Stage data were missing from June 16 to August 27, 2014, during the rebuilding of station C18PC15. Flows through the G-161, G-160, and S-46 structures, and at Lainhart Dam are shown in **Figure 4**. Average, minimum, and maximum flow results are presented in **Table 5**. The average daily dry season flow over Lainhart Dam was 104 cubic feet per second (cfs). Wet season average daily flow over the dam was 198 cfs. Hydrologic data are included in Attachment C.



Figure 2. Groundwater monitoring wells near structures G-160 and G-161.

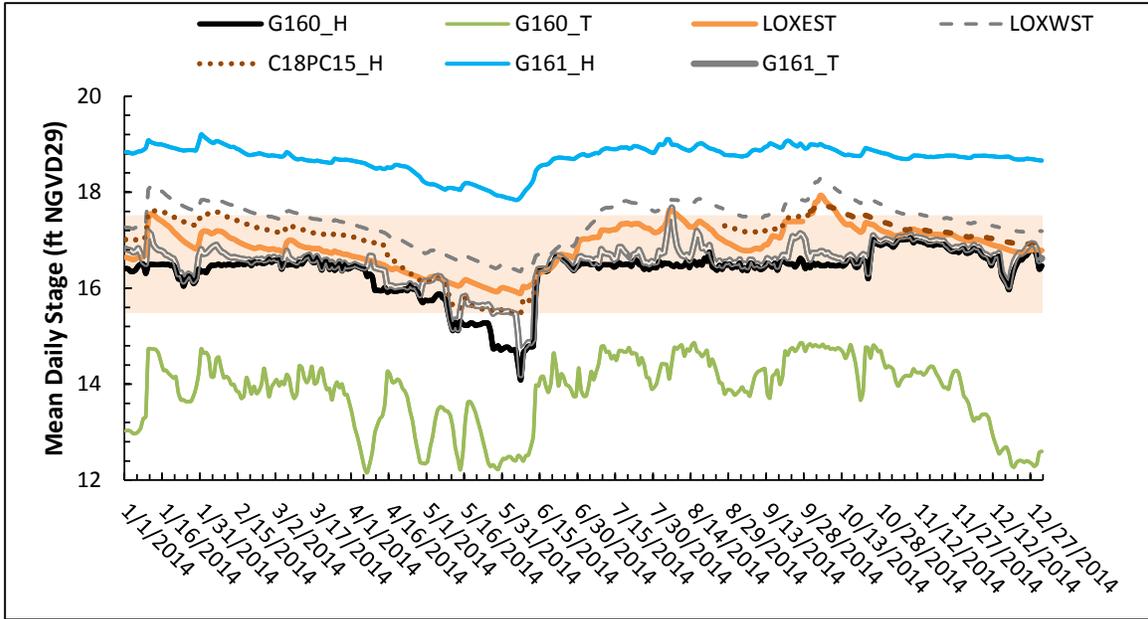


Figure 3. 2014 mean daily stage at stations G160_H, G160_T, LOXEST, LOXWST, C18PC15HW, G161_H, and G161_T. Note: The shaded area indicates the range between minimum and maximum stages at Loxahatchee Slough.

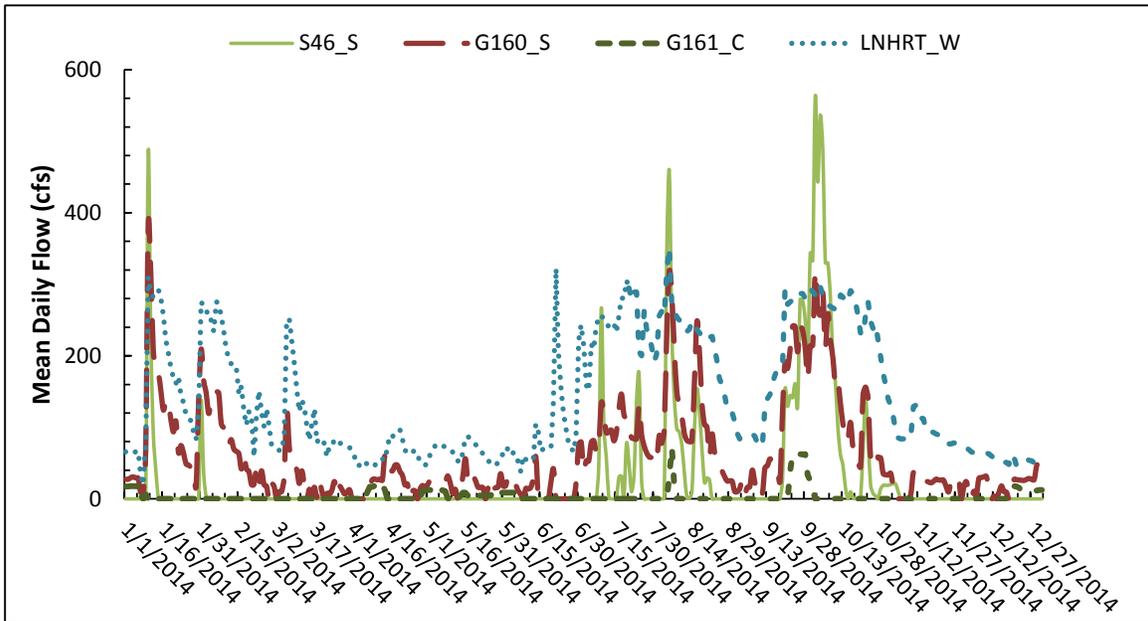


Figure 4. 2014 mean daily flow at the S-46, G-160, and G-161 structures, and Lainhart Dam.

Table 5. Monthly G-160 and G-161 project flow data in cfs for 2014.

Month	G-161 Avg	G-161 Min	G-161 Max	G-160 Avg	G-160 Min	G-160 Max	S-46 Avg	S-46 Min	S-46 Max	LNHRT Avg	LNHRT Min	LNHRT Max	L8.M CNL Avg*	L8.M CNL Min*	L8.M CNL Max*
January	3.8	0	17.7	101.2	9	383.6	31.8	0	484.5	155.8	20	310	82.2	0	143.5
February	0	0	0	73.6	0	165.7	1.5	0	37.6	174.9	59	276	81.9	0	147.1
March	0	0	0	21.6	0	127.1	0	0	0.4	106.6	59	252	123.9	0	146.8
April	5.1	0	18.1	21.6	0	61.6	0	0	0.1	62.9	47	96	113.5	0	144.1
May	6.7	0	12.5	21.5	0	56.2	0	0	0	65.5	47	87	134.7	111.7	140.4
June	1.6	0	8.7	14.1	0	75.4	0.1	0	1.6	93.6	38	322	131.8	78.1	144.6
July	0	0	0.1	85.9	40.3	146.6	33.8	0	266.5	239.3	151	305	10.8	0	98.4
August	4	0	72.1	111.7	10.4	318.1	65.2	0	459	222	108	351	---	----	---
September	15.7	0	63.3	98.4	7.4	241.1	74.1	0.	343.6	177.9	73	294	0	0	0.3
October	0.4	0	12.7	133.9	33.5	316.9	138.8	0	562.7	254.6	140	297	20.9	0	115.8
November	0	0	0	18.3	0	36.7	2.4	0	21.3	92.9	72	131	107	86.4	121.4
December	5.5	0	17.8	20.1	0	49.6	0	0	0	56.8	46	71	133.1	103.9	145.8

Note:

Blue shaded rows indicate the wet season (June–October).

Avg – Average

LNHRT – Lainhart Dam

Min – Minimum

Max – Maximum

* Flow data are missing from July 17 to September 15, 2014, and December 26 to 31, 2014, due to field measurement technical issues at L8.M CNL.

WATER QUALITY

The G-161 Project permit requires that the District collect and analyze water quality at the L8.M CNL and G161 stations monthly during periods of flow. Surface water quality criteria specified in Chapter 62-302.530, Florida Administrative Code are shown in **Table 6**. Water quality results are summarized in **Table 7** and included in Attachment B.

Overall, there is a marked difference in the results between the L8.M CNL and G161 stations, which are 15.3 miles apart. G161 had much lower concentrations than L8.M CNL for all measured parameters (**Table 7**). The average total phosphorus concentration observed at G161 was 10 parts per billion (ppb), and the average observed at the M canal was 119 ppb. Nutrient levels observed at the G-161 discharge structure appear low compared to levels expected in the interior marsh. The average dissolved oxygen level at G161 was also low, 2.9 mg/L, a typical concentration expected for marshes. In the eight dissolved oxygen samples measured during the reporting period at G161, the dissolved oxygen percent saturations ranged from 24.6 to 45.4 percent. Based on percent saturation data, more than 10 percent of measured dissolved oxygen values were below the 38 percent saturation threshold for Class III waters in the South Florida Ecoregion. Turbidity at L8.M CNL ranged from 3.6 to 65.0 NTU, with an average of 23.8 NTU. Out of eight samples collected during the reporting period, only one had a turbidity level above the Class III criterion. The higher turbidity and nutrient levels observed at L8.M CNL are comparable to water quality in the L-8 canal, which receives discharges from Lake Okeechobee. This was the main difference between water quality within Grassy Waters Preserve and regional water quality.

Table 6. Surface water quality criteria specified in Chapter 62-302.530, Florida Administrative Code.

Parameter	Units	Florida Class III Criteria ^a
Dissolved Oxygen	%	Not more than 10 percent of daily average percent dissolved oxygen saturation values less than 38 percent saturation.
Specific Conductance	µS/cm	Not > 50 percent of background or > 1,275 µS/cm, whichever is greater
pH		Not < 6.0 or > 8.5
Turbidity	NTU	≤ 29 NTU above background conditions
Chlorides	mg/L	≤ 250

µS/cm – microsiemens per centimeter

mg/L – milligrams per liter

NTU – nephelometric turbidity units

^a Because this is a freshwater system, the background concentration for specific conductance is assumed to be less than 1,275 µS/cm, and the turbidity cannot exceed 29 NTU above background conditions.

Table 7. Water quality results for stations G161 and L8.M CNL (January–December 2014).

Parameter (Units)	Number of Observations	Mean \pm Standard Deviation	Minimum	Median	Maximum	Excursion ^a
STATION G161						
Water Temperature (°C)	8	25.1 \pm 3.6	18.5	26.9	29.4	--
Dissolved Oxygen (mg/L)	8	2.9 \pm 0.6	1.9	3.0	3.7	Y (4)*
Percent Saturation, DO (%) ^b	8	35.5% \pm 6.4%	24.6%	34.9%	45.4%	
Specific Conductance (μ S/cm)	8	287 \pm 156	176	217	581	N
pH	8	6.9 \pm 0.3	6.5	6.9	7.3	N
Turbidity (NTU)	8	1.0 \pm 0.5	0.4	1.0	1.8	N
Total Suspended Solids (mg/L)	8	3	<3	3	3	--
Calcium (mg/L)	8	18.7 \pm 6.1	12.8	16.9	30.5	--
Chloride (mg/L)	8	41.6 \pm 20.3	26.8	33.6	87.4	N
Sulfate (mg/L)	8	5.9 \pm 8.1	0.4	3.0	25.2	--
Ammonia, Total (mg as N/L)	8	0.016 \pm 0.007	0.007	0.016	0.027	--
Nitrate + Nitrite (mg as N/L)	7	0.005	<0.005	0.005	0.005	--
Total Kjeldahl Nitrogen (mg/L) ^c	4	0.89 \pm 0.21	0.61	0.94	1.07	--
Total Nitrogen (mg/L)	8	0.83 \pm 0.16	0.62	0.82	1.07	--
Soluble Reactive Phosphorus (mg/L)	8	0.002	<0.002	0.002	0.002	--
Total Phosphorus (mg/L)	8	0.010 \pm 0.002	0.007	0.010	0.013	--
STATION L8.M CNL						
Water Temperature (°C)	8	24.9 \pm 4.0	17.6	26.6	29.4	--
Dissolved Oxygen (mg/L)	8	6.3 \pm 1.3	3.9	6.5	8.4	N
Percent Saturation, DO (%)	8	74.9% \pm 12.6%	49.0%	76.8%	88.4%	
Specific Conductance (μ S/cm)	8	753 \pm 286	440	756	1132	N
pH	8	7.6 \pm 0.2	7.3	7.6	7.9	N
Turbidity (NTU)	8	23.8 \pm 21.2	3.6	21.6	65.0	Y (1)
Total Suspended Solids (mg/L)	8	18 \pm 13	5	16	43	--
Calcium (mg/L)	8	64.5 \pm 21.2	41.9	60.4	98.9	--
Chloride (mg/L)	8	107.8 \pm 64.9	51.1	86.4	211.0	N
Sulfate (mg/L)	8	44.3 \pm 26.5	25.2	29.9	89.5	--
Ammonia, Total (mg as N/L)	8	0.066 \pm 0.071	0.009	0.049	0.236	--
Nitrate + Nitrite (mg as N/L)	8	0.198 \pm 0.157	<0.005	0.269	0.374	--
Total Kjeldahl Nitrogen (mg/L) ^c	4	1.26 \pm 0.06	1.20	1.25	1.35	--
Total Nitrogen (mg/L)	8	1.36 \pm 0.29	0.94	1.45	1.72	--
Soluble Reactive Phosphorus (mg/L)	8	0.036 \pm 0.022	<0.002	0.044	0.060	--
Total Phosphorus (mg/L)	8	0.119 \pm 0.044	0.048	0.123	0.179	--

°C – degrees Celsius

 μ S/cm – microsiemens per centimeter

mg/L – milligrams per liter

N/L – nitrogen per liter

NTU – nephelometric turbidity units

^a Y – yes; N – no; value in parentheses is number of excursions^b Percent saturation^c Total Kjeldahl nitrogen was no longer analyzed after July 2014, because the District laboratory started analyzing total nitrogen directly instead of total Kjeldahl nitrogen being used to calculate total nitrogen. For 2014, total nitrogen was calculated from January to July, and from August to December, it was measured directly.

* Dissolved oxygen excursions were determined based on the % dissolved oxygen saturation calculations provided in Attachment B.

Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the G-160 Project (Environmental Resource Permit EI 50-0128848).

Specific Condition	Description	Applicable Phase	Action Taken	Reported in 2016 SFER Vol. III, App. 5-1 in:			
				Narrative (page #s)	Figure	Table	Attachment
1	Authorized Construction	Construction	Not applicable				
2	Interim Operation	Operation	Not applicable				
3	Stage Control Elevations	Operation	Operated as required	3-4			
4	Continuous Stage Monitoring	Operation	Stage monitoring conducted as required	3-4, 7	1, 3		C
5	Vegetation Monitoring for Loxahatchee Slough	Operation	Not applicable				
6	Operational Monitoring of S-46 & Annual Operational Evaluation Report	Operation	Report developed and included as part of annual permit report (see Specific Condition 7, below)				
7	Annual Monitoring Reports	Operation	Report developed and submitted on time				
8	Water Reservation/Allocation	Operation	Complied with as required				
9	Construction Best Management Practices: Turbidity & Erosion Control	Construction	Not applicable				
10	Drawings and Attachments	Operation	Not applicable				
11	Compliance with Specific Conditions	Operation	Complied with as required	All	All	All	All
12	Compliance with General Conditions	Operation	Complied with as required	All	All	All	All

Table A-2. Specific conditions, actions taken, and cross-references presented in this report for the G-161 Project (Environmental Resource Permit EI 50-0244327).

Specific Condition	Description	Applicable Phase	Action Taken	Reported in 201 SFER Vol. III, App. 5-1 in:			
				Narrative (page #s)	Figure	Table	Attachment
1	Authorized Construction	Construction	Not applicable				
2	Authorized Interim Operation	Operation	Operated as required	8			
3	Construction Limits	Construction	Not applicable				
4	Fencing off Wetlands	Construction	Not applicable				
5	Construction Best Management Practices: Turbidity & Erosion Control	Construction	Not applicable				
6	Turbidity Monitoring	Construction	Not applicable				
7	Turbidity Monitoring Reports	Construction	Not applicable				
9	5-Year Operation Monitoring Plan	Operation	Monitoring was conducted as required	3			
9 I	Continuous Water Level Monitoring	Operation	Monitoring was conducted as required	3-4, 7	1, 3		
9 II	Hydrological Monitoring	Operation	Not applicable	3-4, 7	3-4	5	C
9 III	Vegetative Monitoring	Operation	Not applicable				
9 IV	Water Quality Monitoring at G-161 and at L8.M CNL Station	Operation	Monitoring was conducted as required	3-4,11	1	6-7	B
10	Annual Monitoring Reports	Operation	Report developed and submitted on time				
11	Water Reservation/Allocation	Operation	Complied with as required				
12	Drawings and Attachments	Operation	Not applicable				
13	Compliance with Specific Conditions	Operation	Complied with as required	All	All	All	All
14	Compliance with General Conditions	Operation	Complied with as required	All	All	All	All

Attachment B: Water Quality Data

This project information is required by Specific Condition 7 of the G-160 Project permit (EI 50-0128848), and Specific Conditions 9 and 10 of the G-161 Project permit (EI 50-0244327), and is available upon request.

Attachment C: Hydrologic Data

This project information is required by Specific Conditions 4 and 7 of the G-160 Project permit (EI 50-0128848), and Specific Conditions 9 and 10 of the G-161 Project permit (EI 50-0244327), and is available upon request.