Appendix 5-1: Annual Permit Report for the North Palm Beach County – Part 1 Project, G-160 and G-161 Components

Permit Report (Operational Year 2010)
Permit Numbers: EI 50-0128848-004 and EI-0244327-002

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SUMMARY

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

Table 1. Key permit-related information.

Project Name	G-160 / G-161
Permit Number	EL 50-0128848-004 and EL 026854-001
Issue and Expiration Date	Issue: March 7, 2003 Expiration: March 6, 2008 and Issue: May 15, 2006 Expiration: May 15, 2011
Project Phase	Completed
Permit Condition Requiring Annual Monitoring Report	Specific Condition 10
Relevant Period of Record	Jan. 1, 2010 – Dec. 31, 2010
Report Generator	Guy Germain ggermain@sfwmd.gov 561-682-6732
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Report Submitted to FDEP	March 16, 2011

Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Supporting Information on Hydrological Data for G-160
C	Loxahatchee Slough Restoration and G-160 Monitoring Plan Second Post Operational Field-based Vegetation Monitoring Report

INTRODUCTION

Environmental Resource Permits No. EI 50-0128848-004 and No. EI-0244327-002 issued by the Florida Department of Environmental Protection (FDEP) to the South Florida Water Management District (District) authorized the District to construct and operate the C-18 Canal Control Structure (G-160) Project and the G-161 Water Control Structure Phase II Project. Modified Specific Conditions 7 and 10, respectively, require 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, 2010–December 31, 2010. Because both structures operate concurrently and are designed to restore a more natural hydroperiod to the Loxahatchee Slough while increasing the flows to the Northwest Fork Loxahatchee River, the two reports are unified into a single document. This G-160/G-161 Projects Annual Report presents the results of the permit-mandated monitoring for the G-160 and G-161 structures during Operation Year 2010. The Environmental Resource Permit issued by the FDEP to the co-permittees, the District, and Palm Beach County for the construction and operation of the G-160 structure requires hydrologic and vegetation monitoring (vegetation monitoring is only required in the Loxahatchee Slough). The G-161 structure Environmental Resource Permitting (ERP) requires water quality, stage, and flow monitoring, as well as an expansion of the G-160 vegetation monitoring program into areas potentially impacted by the operation of the G-161 Project. Collectively, this report focuses on the monitoring outlined in the 5-Year Operation Monitoring Plan (Plan) for the G-161 Water Control Structure Phase (G-161 Project) to implement Specific Condition 9 (I) – (IV) of Permit No. EI-0244327-002. The G-160 vegetation monitoring report, prepared under separate cover by the Palm Beach County Department of Environmental Resources Management, is also included with this document.

The purpose of the G-161 monitoring program is to evaluate the results of the G-161 Project in achieving the desired objectives of restoring a more natural hydroperiod and flow to downstream wetlands, sloughs, ponds, and floodplains, and rivers, without impacting water quality relative to baseline conditions. It is also anticipated that restoring a more natural timing, magnitude, duration, and frequency of flow in the downstream flowing waters will also restore a more natural salinity gradient in the downstream system, with associated benefits for estuarine and marine flora and fauna. However, contribution of the G-161 Project to the restoration of natural hydroperiod to this system, individually or together with the related 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 structures are not anticipated to be realized until regional water is available in amounts adequate to provide restorative flows to the North West Fork of 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 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:

1. Continuous water level monitoring during operations at locations upstream and downstream of the G-161 structure via stage gauges with telemetry to support the calculation of the flow rate through the G-161 structure;
2. Expansion of the wet and dry season ground-level vegetation monitoring in Loxahatchee Slough under the G-160 ERP into the wetland areas of interest to evaluate the effect of Project-related hydrological changes on the vegetation community;
3. Upland, wetland, and aquatic wildlife observations incidental to ground-level vegetation monitoring;

4. Vegetation monitoring of the entire system via aerial photography with ground-truthing using those vegetation plots compared to the pre-construction baseline aerial photograph taken in 2005; and
5. Monthly water quality monitoring during periods of flow via grab sampling upstream of the G-161 structure and the Control 2 Pump Station to evaluate the status of and trends in post-operational water quality relative to pre-operational baseline.

The permit requires monitoring in areas that are expected to have an altered or enhanced hydroperiod as a result of regular operation of the G-161 structure. The District has monitored stage and flow per G-161 ERP Specific Condition 9(I) and monthly water quality monitoring per 9(IV) on the few occasions over the last three years when water was flowing through the G-161 structure. However, the general lack of availability of regional water precluded regular operation of the G-161 structure. Consequently, the co-permittees have been unable to monitor interior stages per 9(II), or vegetation per 9(III), and it was not possible to associate long-term changes in water stage, flow, or quality or vegetation in potentially impacted areas. Altered or enhanced hydroperiods have not been realized, negating the need to monitor at this time.

On February 18, 2011, the South Florida Water Management District (District) submitted an application to the Florida Department of Environmental Protection (FDEP) requesting temporary relief from Specific Condition 22 of CERPRA Permit No. 0188365-012, in the form of an exemption pursuant to Subsection 373.406(6), Florida Statues for the purpose of conducting a dry season operational pilot test. The test utilized the L-8 Reservoir as an alternative water supply source for the delivery of water to the Grassy Waters Preserve and Northwest Fork of the Loxahatchee River during the dry season (February–April) of 2011.

On February 28, 2011, the FDEP authorized a temporary deviation from the permit requirement to allow water from the L-8 Reservoir to be delivered eastward into the Grassy Waters Preserve for eventual delivery north to the Northwest Fork (NW Fork) of the Loxahatchee River for a limited duration of time (30 consecutive or non-consecutive days). This includes the G-160 and G-2161 structures. On March, 29, 2011, the District provided the FDEP with initial water quality results from the pilot operational test and requested an additional 30-day (consecutive or non-consecutive) extension of the test to collect additional information necessary for the design and planning aspects associated with the Loxahatchee River Watershed Restoration Project. In accordance with the requirements of Section 373.406(6), Florida Statutes, the FDEP reviewed this information on April, 4, 2011, and granted the District an extension of the operational test for an additional 30 days. Until the reservoir is fully operational and able to consistently deliver water from the regional system to maintain hydroperiod depths and durations as well as provide restorative flows to the river, it is unlikely that significant vegetative changes or changes in wildlife usage will be realized. It is expected that next year's annual report will summarize the results of the flow-way testing and associated water stage, flow, and quality and vegetation monitoring; quantify changes between the pre-operational baseline and operational Wetland Rapid Assessment Procedure (WRAP) scores; and evaluate the implications of the monitoring results for changes to the Interim Operation Plan and the 5-Year Operation Monitoring Plan.

MONITORING STATION LOCATIONS

Table 3 gives a description and location of the water quality and flow monitoring sites used in this report. **Figure 1** shows the monitoring locations in the Grassy Waters Preserve and Loxahatchee Slough areas. This figure also shows the natural areas to be restored by the 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, water catchment area (Grassy Waters Preserve), Loxahatchee Slough, Northwest Fork of the Loxahatchee River, and Loxahatchee Estuary.

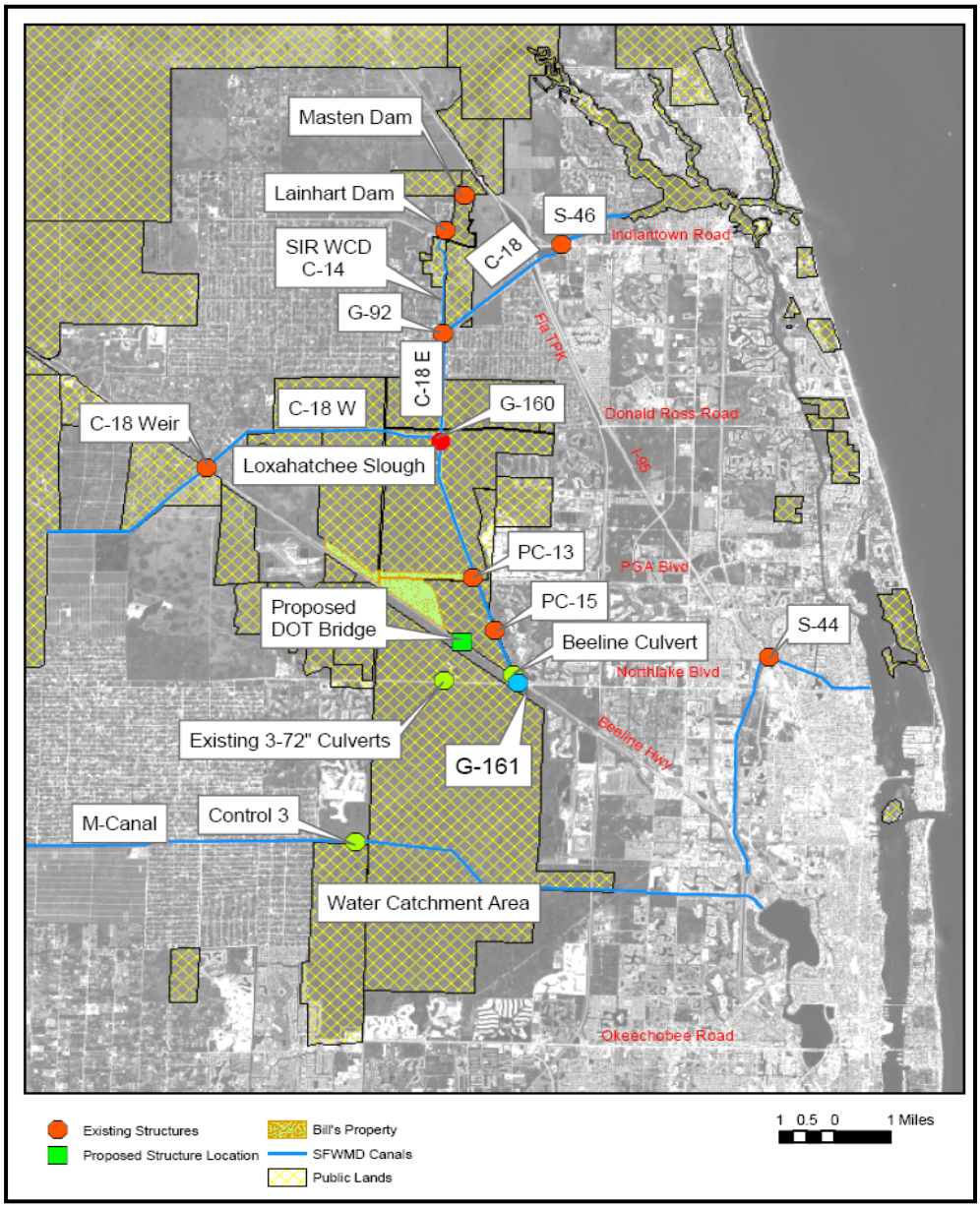


Figure 1. Site map showing G-161, G-160, and other structures in the vicinity.

Table 3. Monitoring locations.

Sampling Station	Station Location	Coordinates	
		Latitude	Longitude
G-161	North Lake Blvd west of SR 710 Outflow for Grassy Waters	264836.386	800923.390
G-160	C-18 Canal Loxahatchee Slough	265245.8	801035.6
S-46	Coastal Structure on the C-18 Canal	265603.203	800830.147
G-92	C-18 Canal about 2.2 miles SE of Turnpike	265439.205	801031.151
L8.M CNL	City of WPB Control 2 pump station on M-Canal	264519.710	802044.450

2010 OPERATION OF G-160, G-161 AND S-46

During the 2010 dry season (November 2009–April 2010) the District experienced above-average rainfall at two of the three rainfall recorders in the area, ranging from 19.13 inches to 28.61 inches; average rainfall was approximately 22 inches.

Beginning on June 1, 2009, the stage upstream of the G-160 structure was raised to elevation 16.5 feet National Geodetic Vertical Datum (ft NGVD) to maintain stages within the Loxahatchee Slough that were consistent with the proposed slough hydroperiod. The stage upstream of the G-160 structure remained at elevation 16.5 ft NGVD through December 31, 2009. Target Slough stages range from a low of 15.29 ft NGVD in May 2010, increasing to 17.12 ft NGVD in October 2010. The structure is effectively operated so that during rainfall events, when stages upstream of the G-160 structure rise to elevation 16.8 ft NGVD, the structure is opened to allow the stages to recede and is closed once they reach elevation 16.2ft NGVD. Graphic representation of G-160 operation and associated slough stages are shown in **Figure 3**. Flows through G-161, G-160, S-46, and at Lainhart Dam are shown in **Figure 4**. Relevant data are included in Attachment B.

Water quality samples were collected at G-161 and the city of West Palm Beach Control 2 Pump Station in association with the structure operation to comply with the permit requirement to conduct water quality collection and analysis monthly during periods of flow for the following parameters identified in the table under Specific Condition 9(IV) of the G-161 ERP: temperature, dissolved oxygen, specific conductance, pH, and turbidity in the field using electrophysicochemical methods and total suspended solids, ammonia, total Kjeldahl nitrogen, total nitrogen, orthophosphorus, total phosphorus, nitrite-nitrate, chlorides, calcium, and sulfate using a National Environmental Laboratory Accreditation Conference (NELAC) certified laboratory and quantitative analytical methods approved by the FDEP for this purpose.

The G-160 structure allows stages in the C-18 canal to be increased in accordance with specific hydraulic conditions and zones, so as to meet the recommended target stages within the Loxahatchee Slough that are necessary to maintain the ecological integrity of the slough vegetative communities. The Loxahatchee Slough is an historic tributary component to the Loxahatchee River, providing important base and wet season flows. When supplemental water is available from the CERP project, G-160 will allow the maintenance of a permanent water pool in the Loxahatchee Slough, between 15.5 ft and 17.5 ft NGVD, with maximum water levels up to 17.8 ft NGVD for rainfall driven conditions.

In addition to the G-160 structure, there are multiple project culverts associated with the C-18 Canal, located both along the east and the west side of the canal. The east side culverts include PC-12, located approximately ¾ mile south of the G-160 structure, and PC-14, located just north of PGA Boulevard. Several discharge points and control structures are associated with the Loxahatchee Preserve, south of PGA Boulevard.

Taylor Engineering, under contract with the South Florida Water Management District completed a modeling study to evaluate the potential impacts of G-160 operation on existing resources in the C-18 basin. The study simulated a combination of event based and hydroperiod models to assess the capability of the C-18 canal and associated basins to maintain flood control and long-term hydroperiod target elevations, under several project scenarios and the existing condition for the 10, 25 and 100 year storm events. The modeling scenarios included operational schedules where the G-160 gates were fully opened during rainfall events (Schedule A) or operated such that they open when the upstream stage exceeds 16.2 ft and closed at 15.5 ft NGVD (Schedule B). The model results showed that operation of the structure to maintain slough stages while simultaneously opening the PC culvert connections (removing the flashboard controls, thus increasing connectivity between the sub basins and the canal) will allow an improved hydroperiod in Loxahatchee Slough East without adversely impacting other sub-basins. This modeling effort was the basis of the operational schedule established for the G-160 structure.

Several communities are located on the east side of the C-18 canal, within the historic Loxahatchee Slough. These include Old Marsh, East Point, Mirasol and the city of Palm Beach Gardens. These communities are served by the Northern Palm Beach County Improvement District (NPBCID), a Chapter 298 District that provides storm water management and other necessary public services. Palm Beach Country Estates is located north and east of the east Loxahatchee slough, and is served by the South Indian River Water Control District (SIRWCD). Though accepting the results of the Taylor Engineering modeling effort, NPBCID, SIRWCD and the city of Palm Beach Gardens expressed concerns with the proposed operational schedule for the structure, specifically in terms of what additional seepage might be expected with the elevated stage in the C-18 canal and concurrent slough stages, and what affect that seepage could have on specific roads within the developments, as well as to soil storage relationships within the developments. There were also concerns raised regarding whether or not increased seepage would occur through the northern and eastern SIRWCD berms that separate the Loxahatchee Slough from the Palm Beach Country Estates subdivision. In response to these concerns, the agencies entered into a 4-party agreement in 2005, in which the SFWMD agreed to maintain the G-160 stage at 15.0 ft NGVD in the dry season and 15.5 ft NGVD in the wet season for a period of 5 years, while executing a second agreement with NPBCID to assess the issues of concern and determine if specific mitigation measures were necessary to offset seepage related impacts. With this second agreement, survey and geotechnical data related to roadways, berms and facilities within the communities were collected, and a seepage curve was constructed (see **Figure 2**).

In 2009, FDEP directed the SFWMD to begin incrementally raising the G-160 structure in compliance with the interim operating plan that was component to the permit. SFWMD responded and indicated that G-160 headwater would be increased to 16.5 ft NGVD with the beginning of the 2009 wet season. SFWMD also agreed to install and monitor seepage wells adjacent to the communities for a period of two years following the increase in stage to determine if seepage concerns were valid. The representative agencies (SFWMD, NPBCID, SIRWCD 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 (6 shallow/deep pairs at strategic locations near community boundaries north of PGA Boulevard and two individual shallow wells in Palm Beach Gardens adjacent to the Preserve)(see **Figure 2**) between January and March, 2010. Data collection began in April 2010 and will continue until September 2012. A preliminary analysis and interim report will be conducted in late 2011.

The flashboard riser elevations for the project culverts on the east and west side of the C-18 canal are currently set at elevation 16.9 ft NGVD. In late 2010 slough elevations were at or slightly below the target. Although there was opportunity to lower the boards early in the 2010–2011 dry season to provide supplemental dry season flows to the NW Fork, doing so would have accelerated the slough dry down, and further compromised the slough hydroperiod for the

duration of the dry season. Any potential changes to the operational protocol in the absence of adequate regional water available from the L-8 reservoir needs to consider maintaining slough levels within the target hydroperiod to the greatest extent possible. The city of West Palm Beach does monitor apple snail populations; however, because of the lack of regional water availability which has resulted in non-consistent and irregular operation of the G-161 structure, vegetation plot data were not collected by the city because vegetation changes are not expected until full operation of the system. Unfortunately, a formal request to suspend the monitoring was not submitted. In the future, SFWMD proposes that landscape level monitoring should offset need for localized vegetation monitoring. Aerial photography was collected in early 2011, and a landscape level of analysis is underway that can be used as a baseline for future operation.

Figure 2. Groundwater monitoring wells.

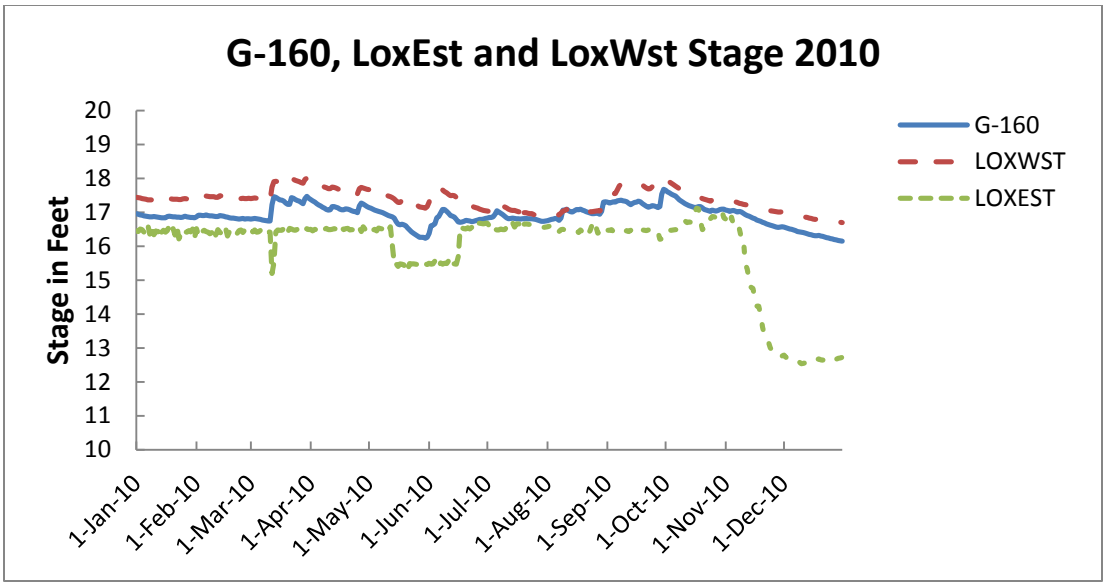


Figure 3. G-160 operation and Loxahatchee Slough stages (at LoxWst and LoxEst).

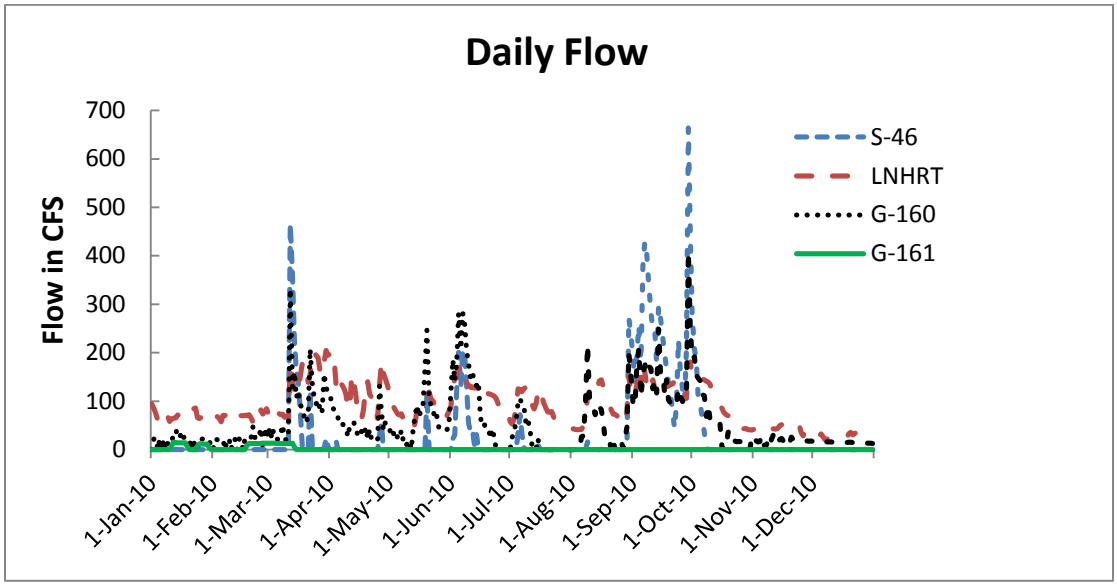


Figure 4. Daily flow at G-160, G-161, Lainhart Dam, and S-46.

Specific Condition 6 of Environmental Resource Permit No. EI 50-0128848-004 requires that the District evaluate the effect of operating the G-160 structure on flow at S-46, G-160, G-161, LNHRT, and S-46 flows for calendar year 2010 are shown in **Figure 4**.

Specific Condition 9.IV of Environmental Resource Permit No. EI-026854-001 requires that the District report flow through G-161 and Control 2 Pump Station as average, minimum, and maximum monthly flows. This is shown in **Table 4**.

Table 4. Monthly flow data in cubic feet per second (cfs).

Month	G-161 Avg	G-161 Min	G-161 Max	CWPB2 Avg	CWPB2 Min	CWPB2 Max
Jan	5.805	0	14.947	47.653	0	14.947
Feb	4.825	0	13.062	53.68	0	151.36
Mar	5.524	0	13.188	45.596	0	150.69
Apr	0.004	0	0.06	0.003	0	0.09
May	0.001	0	0.039	52.261	0	149.41
Jun	0.001	0	0.022	19.979	0	148.75
Jul	0.0001	0	0.004	122.274	0	150.84
Aug	0.004	0	0.122	48.527	0	146.89
Sep	0.0006	0	0.009	12.609	0	155.08
Oct	0 *	0	0 *	129.396	0	154.69
Nov	0 *	0	0 *	110.499	0	152.49
Dec	0.0008 *	0	0.02 *	116.373	0.34	184.84

* Contains missing data

VEGETATION MONITORING

The pre-operational baseline vegetation conditions in the Loxahatchee Slough were defined by the semiannual monitoring conducted in the wet and dry seasons from 2002 to 2007 by Palm Beach County. The annual reports, the Baseline Report, and 5-Year Report have been previously submitted to the FDEP for purposes of defining pre-operational baseline vegetation conditions in the Loxahatchee Slough, taking into account seasonal and inter-annual variability. Concurrently with the increase in stage elevation at the G-160 structure beginning June 1, 2009, Palm Beach County reinitiated the wet and dry season monitoring of vegetation in the Loxahatchee Slough (see **Attachment C**). The data collected by the county during the 2010 wet season monitoring event are shown in **Table 5**. As specified in the FDEP-approved 5-Year Operation Monitoring Plan for the G-161 Project, semiannual vegetation monitoring and apple snail egg cluster observations within the Grassy Waters Preserve (GWP) will be initiated when regional water of adequate quantity and quality is available to be delivered through the G-161 structure. This will meet the intent of the monitoring plan to ensure that changes in water quality or quantity brought about by the delivery of regional water through the GWP and G-161 to for deliveries to the Northwest Fork of the Loxahatchee River are not adversely affecting the preferred prey of the endangered snail kite. Also the GIS-based analysis of the vegetation associated with the G-160/161 structures was not completed in 2010, because of budget and personnel constraints. However, it was conducted in March and April 2011, and the results will be included in the next annual permit report.

Table 5. Summary of wet season 2010 survey (provided by Palm Beach County).

Monitoring Station	Vegetative Community Type	Dominant Plant Species	Average Number of Individuals per Quadrat (*s* = Sample Standard Deviation)	Cover Class (DAUB)	Average Water Depth at Station (inches)
1	Swale	Herbaceous 1. *Eleocharis cellulosa* Shrub 1. *Cephalanthus occidentalis* Canopy No canopy layer	 198 (***s***=33.5) 1 (***s***=1.7) n/a	 2 0.3 n/a	25.7
2	Swale	Herbaceous 1. *Eleocharis cellulosa* 2. *Rhynchospora tracyi* Shrub 1. *Taxodium distichum* Canopy No canopy layer	 294 (***s***=55.9) 3 (***s***=3.5) 0.3 (***s***=0.6) n/a	 2.3 0.7 0.3 n/a	22.3
3	Swale	Herbaceous 1. *Eleocharis cellulosa* 2. *Fuirena scirpoides* Shrub No shrub layer Canopy No canopy layer	 179 (***s***=41.8) 15 (***s***=18.9) n/a n/a	 2 0.7 n/a n/a	24
4	Hydric Hammock	Herbaceous 1. *Psychotria nervosa* 2. *Blechnum serrulatum* Shrub 1. *Psychotria nervosa* 2. *Urena lobata* Canopy 1. *Sabal palmetto* 2. *Psychotria nervosa*	 9 (***s***=15.6) 6 (***s***=6.0) 12 (***s***=13.9) 6 (***s***=10.4) 6 (***s***=3.8) 4 (***s***=5.5)	 0.3 0.7 1.0 0.3 1.7 0.7	0 (Dry)
5	Wet Flatwoods	Herbaceous 1. *Dichanthelium commutatum* 2. *Blechnum serrulatum* Shrub 1. *Rapanea punctata* 2. *Serenoa repens* Canopy 1. *Pinus elliottii* var. *densa* 2. *Rapanea punctata*	 10 (***s***=10.3) 3 (***s***=4.9) 4 (***s***=5.8) 1 (***s***=2.3) 4 (***s***=3.1) 16 (***s***=17.6)	 0.7 0.3 1.0 0.3 1.3 1.3	0.7

WETLAND MITIGATION AREA

The wetland mitigation area was planted in November 2006, replanted in April 2007 in response to inadequate survival of transplants, primarily due to the drought, and monitored quarterly from May 2007 through May 2008 to evaluate plant survival and exotic presence relative to a pre-operational baseline survey conducted in February 2007. Issues regarding excessive deposition of plant biomass and sediments that were observed in the engineered channel between G-161 and the Beeline Highway Culvert will be addressed by evaluating options for permanent sediment and vegetation traps at the upstream end of the G-161 structure. The associated spread of undesirable wetland and upland plants will be controlled and corrected by the city of West Palm Beach under the two-party Memorandum of Understanding with the District. Subsequently, the city of West Palm Beach implemented exotic species control measures in and adjacent to the G-161 flow-way channel pursuant to its responsibility for routine maintenance of the G-161 Project on October 26, 2009. An inspection by District and FDEP staff on October 29, 2009, confirmed both the survival of greater than 80 percent of the planted species and less than 5 percent incursion of exotic plant species when the treated areas responded to the control measures over the next several months. The follow-up co-inspection completed in November 2010 showed similar results. Palm Beach County is controlling the exotic species in areas potentially impacted by the operation of the G-160 structure.

WATER QUALITY

The permit requires that the District collect and analyze water quality at the Control 2 Pump (L8.M CNL) station and at G-161 structure monthly during periods of flow. Water quality results are shown in **Table 6**. None of the results in **Table 6** exceeded any Class III criteria. There is a noticeable difference in results between the Control 2 Pump Station and G-161 (which are 15.3 miles apart), with G-161 having much lower concentrations. This may be partially attributable to natural physical, chemical, and biological processes of assimilation during the passage through the M Canal and the perimeter canal, and, due to the dilution of flow of Control 2 Pump origin with overflow from the GWP into the perimeter canal. In the absence of a source of chloride to the M Canal and GWP perimeter canal between the Control 2 Pump Station and GWP, and assuming chloride is a conservative tracer, the Control 2 Pump flow is being diluted two to three times by the time it reaches G-161. However, the differences in sulfate concentrations suggest that GWP is a predominantly rainfall-driven system with little influence of Control 2 Pump water from M Canal overflow on its interior water quality under these drought conditions and that the flow of perimeter canal water feeding G-161 is dominated by GWP overflow and not Control 2 Pump Station flow. These relationships are likely to change when the flow through G-161 is increased during the flow-way test, with water supplied primarily by the L-8 Reservoir Project. (Note that the flow-way test is now under way since March 2011, and the associated results will be summarized in the 2011 operating year report, planned to be completed in March 2012.)

Table 6. Water quality results from G-161 and Control 2 Pump Station.

Station ID	Date	Temp Deg.C	D.O. mg/L	Sp. Cond µS/cm	pH Units	Turb NTU
G161	1/12/2010	9.75	7.59	147	6.3	1.8
G161	2/22/2010	19.6	6.65	188	6.9	1.2
G161	3/3/2010	15.9	5.99	182	6.8	0.8
L8.M CNL	1/12/2010	13.3	9.01	479	7	3.9
L8.M CNL	2/22/2010	19.2	8.6	480	7.8	9.5
L8.M CNL	3/3/2010	15.8	8.62	747	7.9	22.6

Station ID	Date	TSS *mg/L*	NOx *mg/L*	TKN *mg/L*	NH4 *mg/L*	TN *mg/L*
G161	1/12/2010	<3	<0.005	0.7	0.01	0.7
G161	2/22/2010	<3	<0.005	0.82	0.009	0.82
G161	3/3/2010	<3	0.007	0.85	0.014	0.857
L8.M CNL	1/12/2010	<3	0.032	0.92	0.064	0.952
L8.M CNL	2/22/2010	9	0.179	1.42	0.017	1.599
L8.M CNL	3/3/2010	27	0.436	1.65	0.144	2.086

Station ID	Date	SO4 mg/L	OPO4 mg/L	TPO4 mg/L	CL mg/L	Ca mg/L
G161	1/12/2010	3.1	<0.002	0.006	26	10.9
G161	2/22/2010	1.9	<0.002	0.008	29.5	12.8
G161	3/3/2010	6.1	<0.002	0.01	31.5	15
L8.M CNL	1/12/2010	28.7	0.014	0.045	53.4	50.6
L8.M CNL	2/22/2010	21.6	0.024	0.083	53.2	52.6
L8.M CNL	3/3/2010	42.5	0.043	0.128	102	62.5

Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented for the G-160 project (Environmental Resource Permit: EI 50-0128848-004) in this report.

Specific Condition	Description & Frequency	Applicable Phase	Action & Frequency	Reported in 2012 SFER			
				Table	Narrative	Figure	Attachment
1	Authorized Construction	Construction	N/A		3		
2	Interim Operation	Interim Operation			3,4,6,7,8,11	2	
3	Stage Control Elevations		Operated as required.		6,7		
4	Continuous Stage Monitoring	Interim Operation	Monitoring conducted as required.		3,6	2	
5	Vegetation Monitoring for Loxahatchee Slough		Monitoring conducted as required.		3,4,8,12,14		C
6	Operational Monitoring of S-46 & Annual Operational Evaluation Report		Report developed and included as part of annual permit report (see specific condition 7, below).	4	5,11	3,4	
7	Annual Monitoring Reports		Report developed and submitted on time.				
8	Water Reservation/Allocation		Complied with, as required.				
9	Construction Best Management Practices: Turbidity & Erosion Control	Only during Construction	N/A				
10	Drawings and Attachments		N/A				B, C
11	Compliance with Specific Conditions		Complied with, as required.		3,4,6,11		
12	Compliance with General Conditions		N/A				

Table A-2. Specific conditions, actions taken, and cross-references presented for the G-161 project (Environmental Resource Permit: EI-026854-001) in this report.

Specific Condition	Description	Applicable Phase	Action & Frequency	Reported in 2012 SFER			
				Table	Narrative	Figure	Attachment
1	Authorized Construction		N/A		3		
2	Authorized Interim Operation	Interim Operation			3,4,6,7,8,11	2	
3	Construction Limits		N/A		3		
4	Fencing off Wetlands		During construction only				
5	Construction Best Management Practices: Turbidity & Erosion Control	Only during Construction	N/A				
6	Turbidity Monitoring	Only during Construction	N/A		6		
7	Turbidity Monitoring Reports	Only during Construction	N/A				
8	Wetland Mitigation Planting Area		N/A	5			C
9	5-Year Operation Monitoring Plan		Monitoring conducted as required.		3,4		
9 I	Continuous Water Level Monitoring		Monitoring conducted as required.		3,6	2	
9 II	Hydrological Monitoring		N/A	3,4		3,4	
9 III	Vegetative Monitoring		Monitoring conducted as required.		3,4,7,8,12,14		C
9 IV	Water Quality Monitoring at G-161 and at Control 2 Pump Station		Monitoring conducted as required.	6	3,4	1	B
10	Annual Monitoring Reports		Report developed and submitted on time.				
11	Water Reservation/Allocation		Complied with, as required.				
12	Drawings and Attachments		N/A				A,B,C
13	Compliance with Specific Conditions		Complied with, as required.		3,4,6,11		A
14	Compliance with General Conditions		N/A				

Attachment B: Supporting Information on Hydrologic Data for G-160 for Calendar Year 2010

This project information is required by Specific Condition 27, 28 and 30(b) for STA-1W/STA-1E and STA-3/4, and Specific Condition25(b)3 and 28(b) for STA2 and STA-5/STA-6 for the Everglades Forever Act Permits and the Administrative Order for STA-5/6 under the Findings of Fact number 20 for each of the above mentioned STAs, and is available upon request

Attachment C: Loxahatchee Slough Restoration and G-160 Monitoring Plan Second Post Operational Field-Based Vegetation Monitoring Report

Note: This document, dated February 2011, was prepared by the Palm Beach County Department of Environmental Resources Management for the South Florida Water Management District and Florida Department of Environmental Protection.

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Second Post Operation Field-based Vegetation Monitoring Report

Prepared for:

The South Florida Water Management District

and

The Florida Department of Environmental Protection

February 2011

Prepared by:

Palm Beach County
Department of Environmental Resources Management

Executive Summary

A mutually agreeable arrangement was reached between Palm Beach County's Department of Environmental Resources Management (County) and the South Florida Water Management District (SFWMD) with regard to the execution of the Loxahatchee Slough Restoration and G-160 Monitoring Plan (Plan). The Plan requires that the County conduct baseline (current) and post-construction/operation (G-160 Structure) vegetation and hydrological monitoring within the Loxahatchee Slough Natural Area (Slough). The purpose of the monitoring plan is to determine the effectiveness of the first tier improvements completed under the North Palm Beach County Comprehensive Water Management Plan and to provide a measure of success in achieving restoration targets. The results are expected to provide the SFWMD with beneficial information that will allow adjustments to the operation of the G-160 Structure to most effectively meet the Plan's objectives. The work includes two approaches to monitoring vegetation, a field-based site-specific component and a GIS-based landscape-level analysis. This report presents the findings from the field-based component of the vegetation surveys and hydrological data collection conducted during the dry season (between February 1 and March 15) and wet season (between August 1 and September 15) of 2010. It represents the second year of post operation monitoring that will be combined with the landscape-level monitoring summary report prepared by the SFWMD.

The field-based vegetation and hydrological monitoring involves the collection of data from a total of five field stations. At each station, three rectangular nested vegetation quadrats, one staff gauge, and one photopoint were established. Vegetation parameters measured within the quadrats are species composition, density (total/unit area), cover [Daubenmire Cover Class (1-6)], and qualitative descriptions. The staff gauges are used to obtain water elevations relative to sea level (NGVD). The depth of the water within the quadrats is also measured. The photopoints were established to take a composite panoramic photograph of the vegetation at each station from the same location, angle, and perspective during each survey event.

Stations 1-3 are situated in swale communities dominated by spikerush (*Eleocharis cellulosa*) with very little shrub layer and virtually no canopy layer. Station 4 is a mature hydric hammock dominated by wild coffee (*Psychotria nervosa*) and swamp fern (*Blechnum serrulatum*) in the understory, and cabbage palm (*Sabal palmetto*) and laurel oak (*Quercus laurifolia*) in the canopy layer. The herbaceous layer is very sparse and severely damaged (tilled) by feral hogs (*Sus scrofa*). Station 5 is comprised of wet flatwoods where the herbaceous layer is highly variable, the shrub layer is dominated by cabbage palms and myrsine (*Rapanea punctata*), and the canopy is dominated by slash pine (*Pinus elliottii* var. *densa*). Surface water is generally not present at Stations 4 and 5 during the wet or dry seasons, however during the 2009 and 2010 wet season monitoring, Station 4 was saturated in 2009 and Station 5 had standing water at one of the plots in 2009 and 2010.

Panoramic photographs were taken at each of the five stations, as well as two additional locations that lie west and east of the hammock to give both quantitative (shrub and herbaceous layer heights) and qualitative representations of the vegetative community types. One change to note is in the photos of Station 4 (Hydric Hammock), there is a surge in shrub vegetation after Sept. 2004. This is attributed to the loss of canopy after the hurricanes of 2004 (Frances and Jeanne) and 2005 (Wilma) that affected Palm Beach County. Photopoint 6 appears to show the early stages of pine and wax myrtle mortality.

Another point of note is that the 2010 dry season was wetter than normal which may have attributed to the water levels reaching their highest levels during the 2010 wet season. Stations 1-3 averaged 18 inches of surface water in the 2010 dry season and 24 inches in the 2010 wet season. Station 4 was dry during both monitoring events and Station 5 was dry during the dry season but averaged 0.7 inches in the 2010 wet season. The 2009 and 2010 wet season monitoring events are the only years that Station 5 (Wet Flatwoods) had any measurable standing water. This is quite notable since there was below normal rainfall in the months of Aug., Sept., and October 2009, with no tropical storms or large low pressure systems affecting the region.

Introduction

The extant areas of the Loxahatchee Slough are comprised of approximately 16,000 acres of pine flatwoods, swale, wet prairies, hydric hammock, strand swamp, slough, dome swamp, depression marsh, and disturbed areas within the County-owned Hungryland Slough Natural Area (approximately 3,000 acres) and the Loxahatchee Slough Natural Area (approximately 12,836 acres) (Figure 1). The Loxahatchee Slough contains the headwaters of the Loxahatchee River, one of Florida's two federally designated Wild and Scenic Rivers. The site is one of the most ecologically diverse tracts of protected land in Palm Beach County, including nine distinct habitat types, the largest oak hammock and swale/slough in the County, and 63 federally or state-listed species of plants and animals (Gann *et al.*, 2001). The hydrology of the Loxahatchee Slough has been severely altered through the construction of drainage canals, flood protection berms, and increased anthropogenic water consumption. Overdrainage and hydroperiod alterations have contributed to the establishment of invasive exotic plant species such as melaleuca (*Melaleuca quinquenervia*), Old-world climbing fern (*Lygodium microphyllum*), and Brazilian pepper (*Schinus terebinthifolius*), which has led to decreases in habitat quality for native flora and fauna.

In order to increase water control and restore the historic hydroperiod to the Slough, in 2003 the G-160 structure was constructed in the C-18 canal immediately south of the intersection with its western leg, the C-18W (Figure 2). The structure will allow water managers operational flexibility for the purposes of water supply, flood protection, and environmental restoration, including hydrologic restoration of the Loxahatchee Slough to provide water to meet the base flow requirements for the Northwest Fork of the Loxahatchee River. From August 10, 2005 until June 1, 2009, the SFWMD operated the gates on the G-160 at 15.5 ft. NGVD during the dry season and 15.0 ft. NGVD during the wet season because of difficulties reaching an agreement between the SFWMD and Northern Palm Beach County Improvement District, the City of Palm Beach Gardens and the South Indian River Water Control District. The 15.0 ft./15.5 ft. NGVD operating schedule that started in 2005 was so low that it had no effect on increasing water elevations within the Loxahatchee Slough. Because the G-160 structure was not operated above 15.5 ft. NGVD, the County ceased monitoring in September 2006. During the spring of 2009, the Florida Department of Environmental Protection mandated the SFWMD to begin to raise the elevation of the water in the C-18 canal by June 1, 2009 at 16.5 ft. NGVD during the wet season and 15.5 ft. NGVD during the dry season. When the SFWMD began to raise the elevation to 16.5 ft. NGVD in June 2009, the County resumed monitoring by performing the fall, wet season monitoring event. The monitoring plan was developed to assess the effects of the operation of the G-160 water control structure (and subsequent raising of water elevations) on the vegetation communities within the Loxahatchee Slough and to determine if restoration goals are being met.

Methods

A total of five permanent vegetation and hydrological monitoring stations were established in the Loxahatchee Slough Natural Area at pre-determined locations both east and west of the C-18 canal (see Figure 2). The pre-determined locations were selected because they are representative of major habitat types found within the Loxahatchee Slough, which are anticipated to be affected by the operation of the G-160 structure. At each of these five locations, three nested vegetation quadrats, one staff gauge, and one photopoint were established. The vegetation plots were positioned within the given community type using random compass directions and distances that were selected from a random numbers table and paced off as described in the SFWMD Save Our Rivers Environmental Monitoring Protocols (Van Horn and Van Horn 1993). The staff gauge and photopoint were then positioned centrally between the three vegetation quadrats at each station. The vegetation plots, staff gauges, and photopoints shall be monitored twice a year, once during the wet season (between August 1- September 15) and once during the dry season (between February 1 and March 15).

The vegetation plots are a nested design that includes a small (0.25m x 3m) herbaceous quadrat within a medium sized (1m x 12m) shrub quadrat, which is in turn contained within a larger (3m x 24m) canopy quadrat. The quadrat dimensions were permanently established in the field by installing four foot pieces of rebar (1/2 inch diameter) approximately two feet into the ground and covering them with a five-foot long PVC pipe (3/4 inch diameter) at each quadrat corner. The methods and monitoring definitions of herbaceous, shrub, and canopy are included as Attachment A. Vegetation parameters measured within the quadrats included species composition, density (total/unit area), cover [Daubenmire Cover Class (1-6)], and qualitative descriptions. Within the herbaceous quadrat, each individual plant was counted and recorded by species. An estimate of the vegetative cover (total surface area of the 0.25m x 3m quadrat covered by vegetation) was then recorded by species. This estimate was recorded as a particular Daubenmire Cover Class (1-6), each of which represents a range of percentages of vegetative cover (Attachment B). The qualitative observations (e.g. vigor of plant, overall appearance), and any other relevant observations (e.g. plant alive/dead, no herbaceous layer) were also recorded. Within the shrub quadrat and canopy quadrat, the same parameters were recorded as in the herbaceous quadrat.

The staff gauges were permanently established by installing 10 ft. painted signposts approximately four feet into the ground at each station. The elevations of the tops of these posts have been surveyed only at Stations 1 and 2 at this time. The readings are used to obtain water elevations relative to sea level (NGVD). The depth of the water within the quadrats was also measured.

The photopoints were established to take a composite panoramic photograph of the vegetation at each station from the same location, angle, and perspective during each survey event. The photopoint was permanently marked in the field with a 4 ft. long piece of rebar (3/4 inch diameter) and covered with a 5 ft. piece of PVC pipe (3/4 inch diameter). The photos were taken at the five photomonitoring stations using the method described in „Photomonitoring Protocol for Palm Beach County Natural Areas' (Attachment C). A Photomonitoring Record Form for each photostation described the purpose of the photopoint, location, direction of photos, and other information important for future monitoring events. Two additional photopoints were established outside of the vegetation plots to capture potential changes west (station 6) and east (station 7) of the hammock.

Data

Tables 1 and 2 summarize the results of the vegetation monitoring quadrats during the dry and wet season surveys conducted in March 2010 and September 2010. For more detailed information about vegetation structure and composition, the individual station quadrat data sheets for the 2010 surveys are included in Attachment B. The panoramic photos in Attachment D compare stations (1-5) from 2003 and 2006 (baseline events) to the second post operational monitoring event in 2010. Attachment D also includes two additional photostations (6 and 7) that compare the pine density in 2002 to 2010. Attachment E includes water level data, rainfall data and stage data from 2006-2010. The monitoring locations for all of the hydrological data are shown in Figure 3. Attachment F includes a summary of the vegetation data collected from 2006-2010.

Table 1: Summary of Dry Season 2010 Survey

Monitoring Station	Vegetative Community Type	Dominant Plant Species	Average Number of Individuals per Quadrat (Sample Standard Deviation=*s*)	Cover Class (DAUB)	Average Depth of Water at Station (in inches)
1	Swale	Herbaceous 1. *Eleocharis cellulosa* Shrub 1. *Cephalanthus occidentalis* Canopy No canopy layer	 259 (***s***=83.2) 1 (***s***=1.7) n/a	 1.3 0.3 n/a	20
2	Swale	Herbaceous 1. *Eleocharis cellulosa* 2. *Rhynchospora tracyi* Shrub 1. *Taxodium distichum* Canopy No canopy layer	 244 (***s***=53.2) 3 (***s***=3.1) 0.3 (***s***=0.6) n/a	 1.3 0.7 0.3 n/a	18
3	Swale	Herbaceous 1. *Eleocharis cellulosa* 2. *Fuirena scirpoides* Shrub No shrub layer Canopy No canopy layer	 136 (***s***=78.1) 18 (***s***=31.2) n/a n/a	 1.3 0.3 n/a n/a	16
4	Hydric Hammock	Herbaceous 1. *Psychotria nervosa* 2. *Blechnum serrulatum* Shrub 1. *Psychotria nervosa* 2. *Urena lobata* Canopy 1. *Sabal palmetto* 2. *Psychotria nervosa*	 9 (***s***=15.0) 7 (***s***=7.0) 17 (***s***=19.3) 6 (***s***=6.7) 5 (***s***=4.0) 3 (***s***=5.8)	 0.3 0.7 0.7 0.7 1.7 0.3	Dry
5	Wet Flatwoods	Herbaceous 1. *Dichanthelium commutatum* 2. *Blechnum serrulatum* Shrub 1. *Rapanea punctata* 2. *Serenoa repens* Canopy 1. *Pinus elliottii* var. *densa* 2. *Rapanea punctata*	 1 (***s***=2.3) 3 (***s***=4.6) 5 (***s***=5.7) 2 (***s***=2.9) 4 (***s***=3.1) 12 (***s***=13.2)	 0.3 0.3 0.7 0.3 1.3 1.3	Dry

Table 2: Summary of Wet Season 2010 Survey

Monitoring Station	Vegetative Community Type	Dominant Plant Species	Average Number of Individuals per Quadrat (Sample Standard Deviation=*s*)	Cover Class (DAUB)	Average Depth of Water at Station (in inches)
1	Swale	Herbaceous 1. *Eleocharis cellulosa* Shrub 1. *Cephalanthus occidentalis* Canopy No canopy layer	 198 (*s*=33.5) 1 (*s*=1.7) n/a	 2 0.3 n/a	25.7
2	Swale	Herbaceous 1. *Eleocharis cellulosa* 2. *Rhynchospora tracyi* Shrub 1. *Taxodium distichum* Canopy No canopy layer	 294 (*s*=55.9) 3 (*s*=3.5) 0.3 (*s*=0.6) n/a	 2.3 0.7 0.3 n/a	22.3
3	Swale	Herbaceous 1. *Eleocharis cellulosa* 2. *Fuirena scirpoides* Shrub No shrub layer Canopy No canopy layer	 179 (*s*=41.8) 15 (*s*=18.9) n/a n/a	 2 0.7 n/a n/a	24
4	Hydric Hammock	Herbaceous 1. *Psychotria nervosa* 2. *Blechnum serrulatum* Shrub 1. *Psychotria nervosa* 2. *Urena lobata* Canopy 1. *Sabal palmetto* 2. *Psychotria nervosa*	 9 (*s*=15.6) 6 (*s*=6.0) 12 (*s*=13.9) 6 (*s*=10.4) 6 (*s*=3.8) 4 (*s*=5.5)	 0.3 0.7 1.0 0.3 1.7 0.7	dry
5	Wet Flatwoods	Herbaceous 1. *Dichanthelium commutatum* 2. *Blechnum serrulatum* Shrub 1. *Rapanea punctata* 2. *Serenoa repens* Canopy 1. *Pinus elliottii* var. *densa* 2. *Rapanea punctata*	 10 (*s*=10.3) 3 (*s*=4.9) 4 (*s*=5.8) 1 (*s*=2.3) 4 (*s*=3.1) 16 (*s*=17.6)	 0.7 0.3 1.0 0.3 1.3 1.3	0.7

Discussion of Findings

In Tables 1 and 2, the data from each of the three vegetation quadrats at each of the five vegetation monitoring stations were averaged by herbaceous layer, shrub layer, and canopy layer. The detailed data sheets in Attachment B reflect the species composition and structure of each of the three layers within the specific nested quadrats. Only the two species with the dominant vegetation cover percentage in each of the five stations were included. The data in this report represents the second collection of post operation data. For comparison purposes, the 2006 data was used as the final baseline. Attachment F includes a summary of all of the vegetation monitoring events. Stations 1-3 (Swale) had some minor changes in the herbaceous layer and the shrub layer. *Rhynchospora tracyi* disappeared from the herbacecous layer in Station 1 in 2009 and was replaced by *Furiena scirpoides* in Station 3 in 2010. In 2009, *Hypericum fasiculatum* disappeared from the shrub layer in Station 2 and *Cephalanthus occidentalis* disappeared from the shrub layer in Station 3. In Station 4, *Psychotria nervosa* replaced *Erechtites hieraciifolius* in the herbaceous layer, the shrub layer had the same species but in lower numbers, and the canopy layer had *Rapanea punctata* and *Psychotria nervosa* fluctuate in dominance from 2006 to 2010. In Station 5, *Chamaecrista fasciculata* disappeared from the herbaceous layer, the shrub layer shifted dominance from *Urena lobata* and *Sabal palmetto* to *Rapanea punctata* and *Serenoa repens*, and the canopy layer lost some *Sabal palmetto* so that *Pinus elliottii* var. *densa* became the dominant species in 2009. Most of the changes in Stations 4 and 5 can be attributed to the extensive hog rooting in those plots. The 2006 Baseline conditions will continue to be compared with post-operation data in future reports.

The panoramic photographs taken at each of the photopoints give both quantitative (shrub and herbaceous layer heights) and qualitative representations of the vegetative community types described above (Attachment D). One change to note is in the photos of Station 4 (Hydric Hammock), there is a surge in shrub vegetation after Sept. 2004. This is attributed to the loss of canopy after the hurricanes of 2004 (Frances and Jeanne) and 2005 (Wilma) that affected Palm Beach County. Photopoint 6 appears to show the early stages of pine and wax myrtle mortality. These species would have moved into the wetlands during periods of lower water levels and would be drowned out when water depths and/or hydroperiod increase.

Another point of note is that the 2010 dry season was wetter than normal which may have attributed to the water levels reaching their highest levels during the 2010 wet season (Attachment E). Stations 1-3 averaged 18 inches of surface water in the 2010 dry season and 24 inches in the 2010 wet season. Station 4 was dry during both monitoring events and Station 5 was dry during the dry season but averaged 0.7 inches in the 2010 wet season. The 2009 and 2010 wet season monitoring events are the only years that Station 5 (Wet Flatwoods) had any measurable standing water. This is quite notable since there was below normal rainfall in the months of Aug., Sept., and October 2009, with no tropical storms or large low pressure systems affecting the region.

Literature Cited

Gann, G., K. Bradley and S. Woodmansee. 2002. Habitats in South Florida. The Institute for Regional Conservation. Miami, Florida.

Van Horn, M. and K. Van Horn . 1993. „Save Our Rivers' Environmental Monitoring Protocols. South Florida Water Management District. West Palm Beach, Florida.

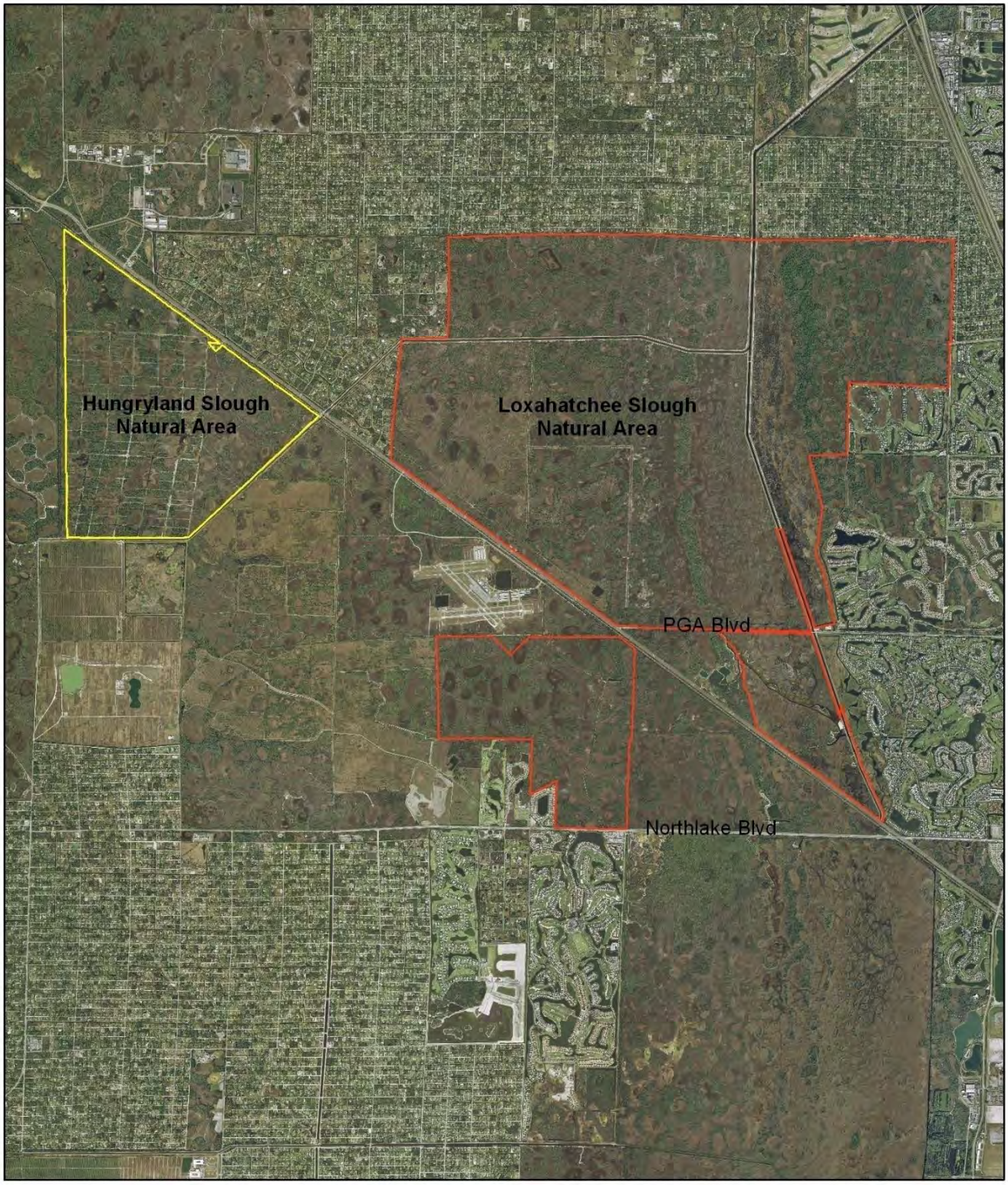


Figure 1: Hungryland Slough and Loxahatchee Slough Natural Areas Location Map

N

0 0.5 1 2 3 4 Miles

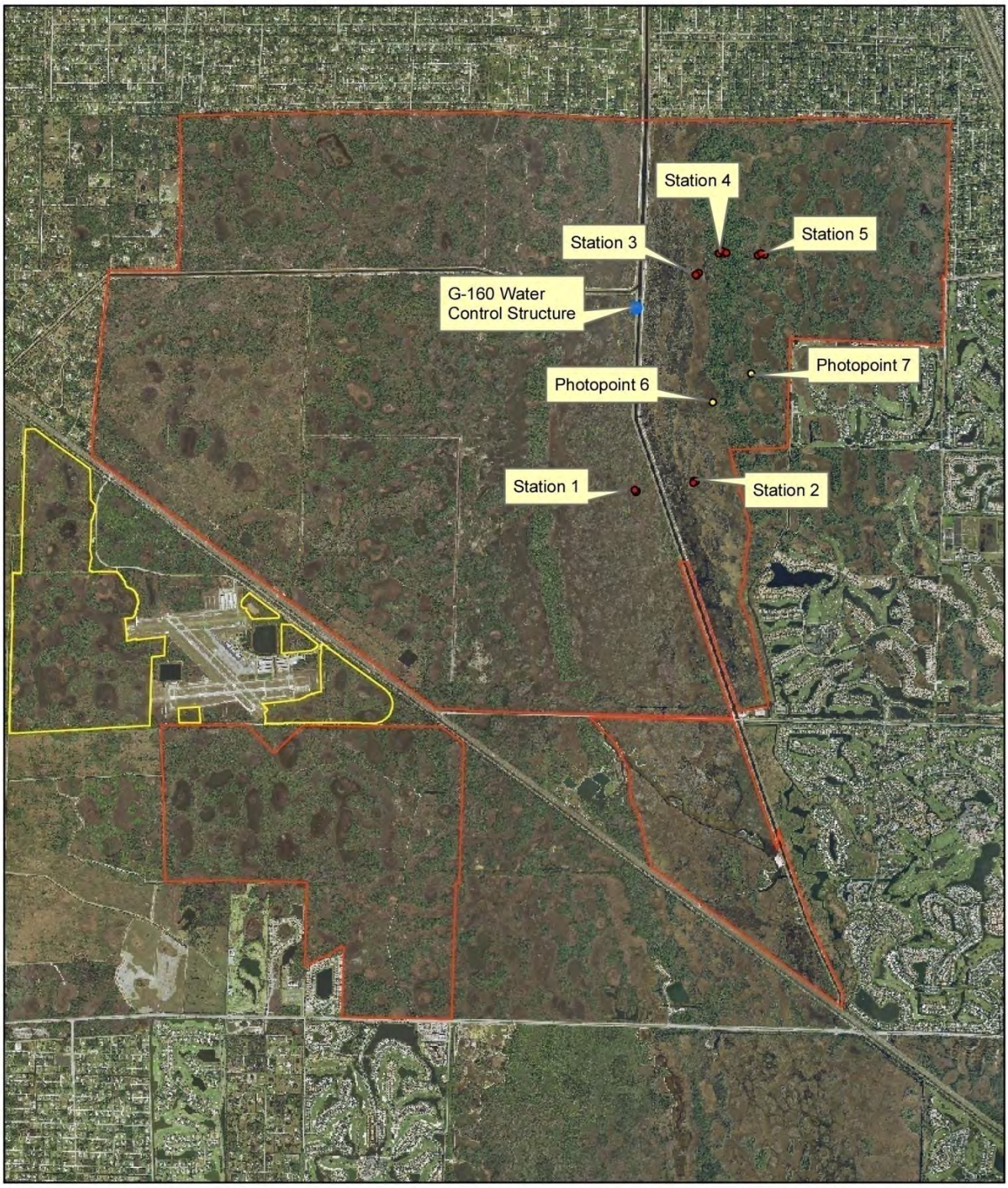


Figure 2: G-160 Vegetation Monitoring Stations

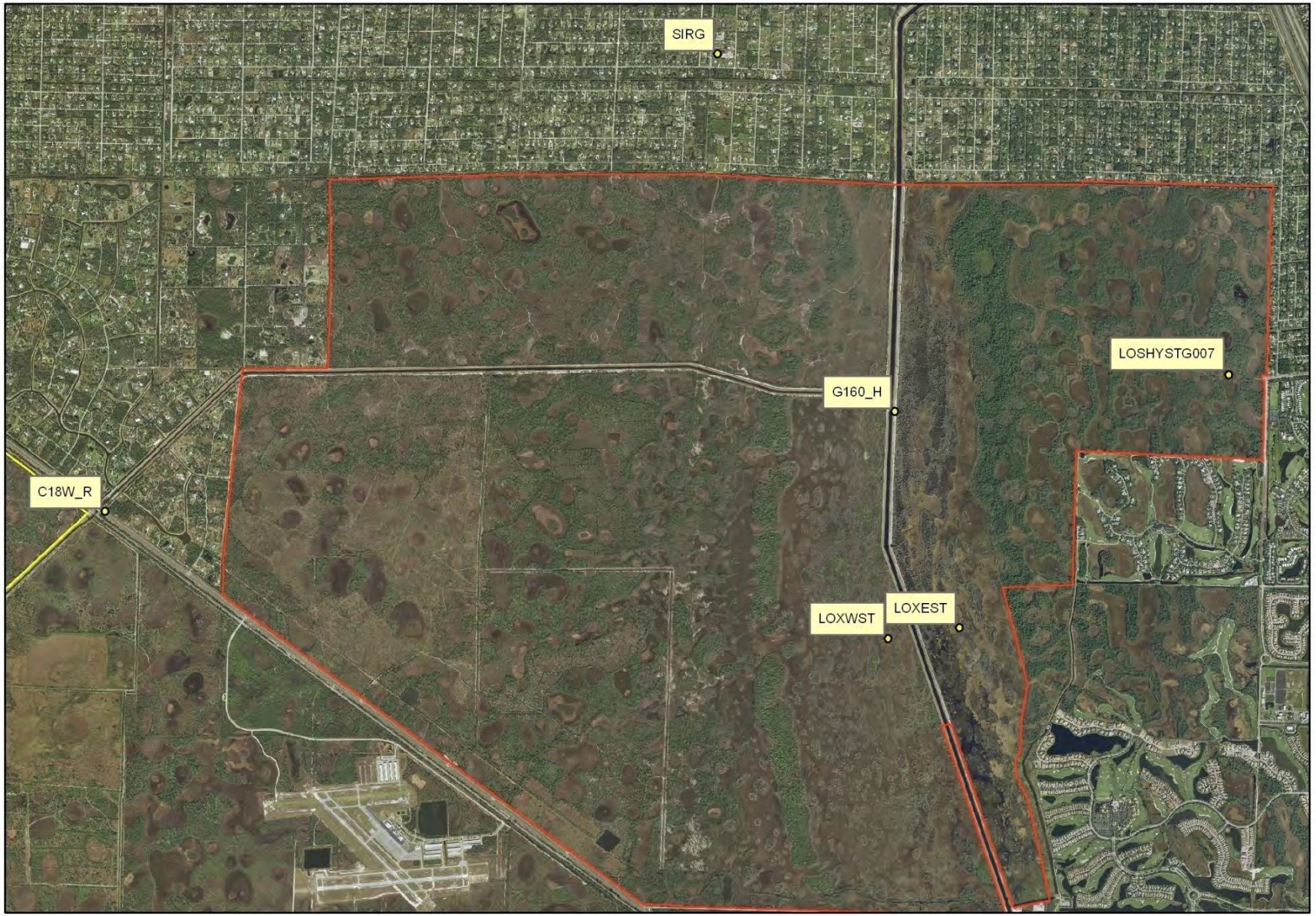


Figure 3: Hydrological Monitoring Stations

ATTACHMENT A

Definitions for G-160 Vegetation Monitoring Stations at the Loxahatchee Slough Natural Area

Herbaceous layer = any *non-woody* plants, *excluding* seedlings of woody species that are presently non-woody (e.g. *Sabal palmetto*, *Hypericum* spp.), but *including* vines (e.g. *Vitis* spp., *Toxicodendron radicans).* Only count plants with at least half of their roots *within* the plot.

Shrub layer = any *woody* plant above the ground and *less* than, or equal to, 2.5 meters (8.2 feet) tall, excluding vines (which will *only* be recognized in the herbaceous plot canopy cover). Count *all Hypericum* spp. and *all* seedlings of potentially woody species in this plot. Shrub canopy cover class will be determined using trees rooted *both* inside *and* outside the plot.

Canopy layer = any *woody* plant greater than 2.5 meters tall, excluding vines. Only count the number of trees with more than half their root system within the plot. *Do not* count *seedlings* of canopy species; these will be counted within the shrub layer plot. Canopy cover class will be determined using trees rooted *both* inside *and* outside the plot.

Note: Always use the *first three letters* of both the genus and species names in the **Species** column on the Veg. Plot Data Sheets.

ATTACHMENT B

Vegetation Quadrat Data Sheets

March & September 2010

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 1, Swale)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll

Date: 3 / 9 / 10

Station #: 1 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Note: String needs to be placed around the herbaceous plots to delineate their perimeters

Depth of water in plots: **20" (A), 20" (B), 20" (C)** Staff Gauge Reading: **17.30 ft NGVD** (SFWMD gauge)

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	354	2	
Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	224	1	

Shrub Plot (1x12 meters)			
Cep occ	3	1	stressed
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat C			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Herbaceous Plot (0.25x3 meters)			
Ele cel	199	1	
Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 2, Swale)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll, Frank Griffiths, Tom Lilly

Date: 3 / 9 / 10

Station #: 2 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Depth of water in plots: **18" (A), 18" (B), 18" (C)** Staff Gauge Reading: **16.78 ft NGVD** (SFWMD gauge)

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	189	1	
Utr sp	--	1	not able to count
Shrub Plot (1x12 meters)			
Seedlings of shrub or canopy species within plot			
Tax dis	1	1	
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	295	2	
Rhy tra	6	1	
Utr sp	--	1	not able to count

Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
<u>Quadrat C</u> **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	249	1	
Rhy tra	2	1	
Utr sp	--	1	not able to count
Shrub Plot (1x12 meters)			
			no shrub layer
			Hyp fas from previous data was not found
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 3, Swale)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll, Frank Griffiths, Tom Lilly

Date: 3 / 10 / 10

Station #: 3 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Depth of water in plots: **15" (A), 16" (B), 17" (C)** Staff Gauge Reading: **3.54** feet from top of gauge

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	60	1	
Rhy tra	11	1	
Furiena scirpoides	54	1	
Utr sp	--	1	not able to count
Shrub Plot (1x12 meters)			
			no shrub layer
			Cep occ from previous data not found
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	131	1	
Rhy tra	16	1	
Utr sp	--	1	not able to count

Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat C			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Herbaceous Plot (0.25x3 meters)			
Ele cel	216	2	
Utr sp	--	2	not able to count
Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 4, Hydric Hammock)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll, Frank Griffiths, Tom Lilly

Date: 3 / 10 / 10

Station #: 4 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Note: String needs to be placed around these plots to permanently delineate the perimeters

Depth of water in plot: **N/A** inches Staff Gauge Reading: **N/A (no staff gauge)** feet NGVD

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A			
Herbaceous Plot (1x3 meters)			hog damage
Ble ser	14	1	
Dic com	5	1	
Par qui	3	1	
Smi sp	2	1	
Tox rad	6	1	
Shrub Plot (1x12 meters)			
Ure lob	13	1	
Psy ner	13	1	
Psy sul	2	1	
Seedlings of shrub or canopy species within plot			
Phy ame	50	1	
Ure lob	15	1	
Que lau	5	1	
Sab pal	1	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Sab pal	9	2	
Eug axi	2	1	
Ile cas	1	1	
Ure lob	1	1	
Fic mic	1	1	
Per bor	1	1	
Mor rub	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Mor rub	1	1	
Sab palm		2	

Quadrat B			
Herbaceous Plot (1x3 meters)			
Vit rot	3	1	
Psy ner	26	1	
Shrub Plot (1x12 meters)			
Psy ner	38	3	
Rap pun	3	1	
Chr ica	1	1	
Seedlings of shrub or canopy species within plot			
Sab pal	4	1	
Que lau	5	1	
Ure lob	5	1	
Chr ica	1	1	
Psy ner	36	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Sab pal	6	2	
Psy ner	10	1	
Per bor	1	1	
Bac hal	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Que lau		2	
Quadrat C			hog damage
Herbaceous Plot (1x3 meters)			
Smi sp	4	1	
Ble ser	6	1	
Til set	2	1	
Dic com	1	1	
Tox rad	3	1	
Vit rot	2	1	
Unknown herb	17	1	
Shrub Plot (1x12 meters)			
Rap pun	3	1	
Ser rep	1	1	
Cal ame	1	1	
Ure lob	4	1	
Seedlings of shrub or canopy species within plot			
Ure lob	20	1	
Que lau	2	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Sab pal	1	1	
Que vir	1	1	

Rap pun	7	1	
Que lau	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Pin ell var. *den*	1	1	

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 5, Pine Flatwoods)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carrol

Date: 3 / 11 / 10

Station #: 5 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Note: String needs to be placed around these plots to permanently delineate the perimeters

Depth of water in plots: **N/A (A), N/A (B), N/A (C)** Staff Gauge Reading: **N/A** feet from top of gauge

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A			
Herbaceous Plot (1x3 meters)			hog damage
Smi sp	1	1	
Ble ser	8	1	
Rhy sp	2	1	
Dic ere	3	1	
Tox rad	3	1	
Shrub Plot (1x12 meters)			
Rap pun	1	1	
Ser rep	5	1	
Ile gla	1	1	
Seedlings of shrub or canopy species within plot			
Ure lob	10	1	
Pin ell var. *den*	4	1	
Myr cer	1	1	
Ile gla	5	1	
Que lau	1	1	

Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Pin ell var. *den*	1	1	
Sab pal	3	1	
Myr cer	1	1	
Rap pun	2	1	
Ile cas	1	1	
Ser rep	2	1	
Lyo fru	1	1	
Bac hal	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B			
Herbaceous Plot (1x3 meters)			hog damage
Cla jam	2	1	
Lud rep	1	1	
Rhy sp	1	1	
Ele bal	2	1	
Plu sp	1	1	
Shrub Plot (1x12 meters)			
Seedlings of shrub or canopy species within plot			
Sab pal	5	1	
Pin ell var. *den*	7	1	
Chr ica	2	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Pin ell var. den	3	1	
Sab pal	3	1	
Rap pun	27	2	
Chr ica	1	1	
Myr cer	2	1	
Ile cas	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Myr cer		1	

Quadrat C			
Herbaceous Plot (1x3 meters)			hog damage
Hyp ter	3	1	
Dic com	4	1	
Shrub Plot (1x12 meters)			
Rap pun	9	1	
Myr cer	2	1	
Sab pal	4	1	
Chy ica	1	1	
Seedlings of shrub or canopy species within plot			
Rap pun	4	1	
Sab pal	2	1	
Ure lob	1	1	
Pin ell var. den	1	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Pin ell var. den	7	2	2 dead pine trees not included
Sab pal	4	1	
Rap pun	7	1	
Ile cas	3	1	
Myr cer	2	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Pin ell var. den		1	

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 1, Swale)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll

Date: 9 / 16 / 10

Station #: 1 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Note: String needs to be placed around the herbaceous plots to delineate their perimeters

Depth of water in plots: **26" (A), 25" (B), 26" (C)** Staff Gauge Reading: **17.90 ft NGVD** (SFWMD gauge)

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited. A large amount of Bacopa sp. observed in area.
Ele cel	162	2	
Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	205	2	
Nym odor	1	1	

Shrub Plot (1x12 meters)			
Cep occ	3	1	stressed
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat C			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Herbaceous Plot (0.25x3 meters)			
Ele cel	228	2	
Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 2, Swale)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll

Date: 9 / 9 / 10

Station #: 2 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Depth of water in plots: **18" (A), 25" (B), 24" (C)** Staff Gauge Reading: **17.36 ft NGVD** (SFWMD gauge)

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	286	2	
Utr sp	--	1	not able to count
Pan hem	1	1	
Shrub Plot (1x12 meters)			
Seedlings of shrub or canopy species within plot			
Tax dis	1	1	
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	242	2	
Rhy tra	7	1	
Utr spp	--	1	not able to count

Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat C			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Herbaceous Plot (0.25x3 meters)			
Ele cel	353	3	
Rhy tra	3	1	
Utr purp	--	1	not able to count
Shrub Plot (1x12 meters)			
			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 3, Swale)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll, Frank Griffiths

Date: 9 / 8 / 10

Station #: 3 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Depth of water in plots: 23**" (A), 24" (B), 25" (C)** Staff Gauge Reading: **N/A** feet from top of gauge

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	163	2	
Rhy tra	8	1	
Fur sci	36	1	
Utr pur	--	2	not able to count
Shrub Plot (1x12 meters)			
			no shrub layer
			Cep occ from previous data not found
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B **Herbaceous Plot (0.25x3 meters)**			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Ele cel	226	2	
Rhy tra	11	1	
Utr pur	--	2	not able to count
Fur sci	8	1	

Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat C			Cannot see bottom of plot due to standing water, therefore, our ability to see plants that are completely under water is limited.
Herbaceous Plot (0.25x3 meters)			
Ele cel	147	2	
Utr pur	---	2	not able to count
Shrub Plot (1x12 meters)			no shrub layer
Seedlings of shrub or canopy species within plot			
Canopy Plot (3x24 meters)			no canopy layer
Trees *rooted* within plot			
Trees *not* rooted within plot but whose canopy contributes to canopy cover			

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 4, Hydric Hammock)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll, Frank Griffiths
Date: 9 / 9/ 10
Station #: 4 A, B, C
GPS Location: See attached aerial photo for exact locations Management Unit: n/a
General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Note: String needs to be placed around these plots to permanently delineate the perimeters

Depth of water in plot: **Dry** inches Staff Gauge Reading: **N/A (no staff gauge)** feet NGVD

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A			
Herbaceous Plot (1x3 meters)			hog damage
Ble ser	12	1	
Dic com	6	1	
Tox rad	6	1	
Par qui	2	1	
Smi sp	2	1	
Shrub Plot (1x12 meters)			
Ure lob	18	1	
Psy ner	8	1	
Psy sul	3	1	
Phy ame	1	1	
Seedlings of shrub or canopy species within plot			
Ure lob	40	1	
Que lau	5	1	
Rap pun	1	1	
Sab pal	1	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Sab pal	9	2	
Eug axi	2	1	
Ile cas	1	1	
Ure lob	1	1	
Fic mic	1	1	
Per bor	1	1	
Mor rub	2	1	
Psy ner	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Mor rub	1	1	
Sab pal	2	1	

Quadrat B			
Herbaceous Plot (1x3 meters)			
Vit rot	3	1	
Psy ner	26	1	
Par qui	2	1	
Shrub Plot (1x12 meters)			
Psy ner	27	2	
Rap pun	2	1	
Chr ica	1	1	
Seedlings of shrub or canopy species within plot			
Sab pal	5	1	
Que lau	5	1	
Ure lob	4	1	
Chr ica	1	1	
Psy ner	200	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Sab pal	8	2	
Psy ner	10	1	
Per bor	1	1	
Bac hal	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Que lau		2	
Quadrat C			hog damage
Herbaceous Plot (1x3 meters)			
Smi sp	4	1	
Ble ser	5	1	
Til set	2	1	
Dic com	1	1	
Tox rad	3	1	
Vit rot	4	1	
Unidentifed herb	17	1	
Shrub Plot (1x12 meters)			
Rap pun	3	1	
Ser rep	1	1	
Cal ame	1	1	
Seedlings of shrub or canopy species within plot			
Ure lob	12	1	
Rap pun	1	1	
Que lau	1	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Sab pal	2	1	
Que vir	1	1	
Rap pun	8	1	
Que lau	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Pin ell var. *den*	1	1	

Que lau	2	2	
Ile cas	1	1	
Sab pal	1	1	

Loxahatchee Slough Restoration and G-160 Monitoring Plan
Vegetation Quadrat Data Sheet (Station 5, Pine Flatwoods)

Note: See "Rules for Vegetation Monitoring Plots at the Loxahatchee Slough Natural Area" prior to conducting the surveys.

Observer (s): Melissa Tolbert, Harper Carroll, Frank Griffths

Date: 9 / 8 / 10

Station #: 5 A, B, C

GPS Location: See attached aerial photo for exact locations Management Unit: n/a

General Comments: Cover Class (DAUB) is determined using the Daubenmire Cover Scale:

Cover Class	Cover (%)
1	0-5
2	6-25
3	26-50
4	51-75
5	76-95
6	96-100

Note: String needs to be placed around these plots to permanently delineate the perimeters

Depth of water in plots: **dry (A), 2" (B), dry (C)** Staff Gauge Reading: ___feet from top of gauge

Species	# of individuals per quadrat	Cover Class (DAUB)	Comments (alive, dead,etc.)
Quadrat A			
Herbaceous Plot (1x3 meters)			hog damage
Smi sp	1	1	
Ble ser	9	1	
Dic ere	20	1	
Vitus sp	1	1	
Rhy col	5	1	
Tox rad	2	1	
Shrub Plot (1x12 meters)			
Rap pun	1	1	
Ser rep	4	1	
Ile gla	1	1	
Seedlings of shrub or canopy species within plot			
Ure lob	40	1	
Pin ell var. den	4	1	
Rap pun	2	1	
Chr ica	1	1	

Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Pin ell var. *den*	1	1	
Sab pal	3	1	
Myr cer	3	1	
Rap pun	3	1	
Ile cas	1	1	
Ser rep	2	1	
Lyo fru	1	1	
Bac hal	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Quadrat B			
Herbaceous Plot (1x3 meters)			hog damage
Cla jam	3	1	
Lud rep	1	1	
Rhy sp	1	1	
Ele bal	5	1	
Shrub Plot (1x12 meters)			
Seedlings of shrub or canopy species within plot			
Sab pal	1	1	
Pin ell var. den	7	1	
Chy ica	2	1	
Rap pun	1	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Pin ell var. den	3	1	
Sab pal	3	1	
Rap pun	36	2	
Chr ica	1	1	
Myr cer	3	1	
Per bor	1	1	
Ile cas	1	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Myr cer	1	1	
Rap pun	3	1	

Quadrat C			
Herbaceous Plot (1x3 meters)			hog damage
Dic ere	11	1	
Tox rad	3	1	
Eup cap			
Cha fas	3	1	
Shrub Plot (1x12 meters)			
Rap pun	11	1	
Myr cer	1	1	
Sab pal	4	1	
Chy ica	1	1	
Seedlings of shrub or canopy species within plot			
Sab pal	5	1	
Rap pun	2	1	
Ure lob	4	1	
Canopy Plot (3x24 meters)			
Trees *rooted* within plot			
Pin ell var. den	7	2	2 dead pine trees not included
Sab pal	5	1	
Rap pun	9	1	
Ile cas	3	1	
Myr cer	3	1	
Trees *not* rooted within plot but whose canopy contributes to canopy cover			
Pin ell var. den	1	1	
Ile cas	1	1	

ATTACHMENT C

Photomonitoring Protocol for Palm Beach County Natural Areas

(Updated 10/7/02)

The following is to be used as a guideline for site managers for establishing photopoints and taking the photographs at each photomonitoring station required per the site management plan. The standards established here are to be treated as minimum requirements. It is assumed here that all photopoints shall always be established in accordance with the appropriate site management plan in addition to the standards set below. Individual site managers may decide additional photopoints are necessary to adequately monitor a particular event (e.g. extreme high water conditions, wildfire, etc.), or more comprehensive photos (e.g. a photo encompassing a 180 degree field of view photo instead of only approximately 110 degrees) are necessary to assess the success of a particular management activity. Note: See the appropriate management plan and the Burn Monitoring Protocol Memo for appropriate timing of photomonitoring events.

Objective:

To obtain a qualitative, long-term visual record of changes in vegetative structure and/or condition over time, including the effects of planned management activities. The visual record can become semi-quantitative with the use of a density board and/or range pole.

Equipment Required for Establishing Photopoints:

- Photopoint monitoring record form (see attachment)
- Aerial photograph of site
- GPS unit
- Measuring tape
- Monument stakes (rebar and PVC)
- Compass
- Camera
- Tripod (must have compass degree increments of at least 45 degrees on camera mount for horizontal movement left and right (our Mangrotto 3030 tripod has this))
- Range pole and/or density board

Methods:

1) Location Selection:

Establish permanent photopoints in areas where planned management activities are anticipated to occur and in areas where natural vegetation succession (of management interest) is expected to occur. Examples of planned management activities include the following:

- prescribed burns
- exotic vegetation removal/herbiciding
- mechanical cutting of vegetation (e.g. Hydro-axe, Brontosaurus, roller-chopping, mowing, logging. etc.)
- construction of public use facilities and/or management roads
- wetland/upland restoration

- volunteer events
- tree plantings
- construction of water control structures on-site
- adjacent property owner activities (construction)

Examples of areas of natural vegetation succession of management interest include the following:

- known listed species populations being outcompeted
- early (e.g. post-wildfire) or late (e.g. fire-suppressed) successional vegetation communities
- new invasions of exotic species
- insect pest (e.g. pine beetles, Mexican bromeliad weevils) or plant disease outbreaks

Site management plans may dictate the number and general locations of photopoints (e.g. one photo point per management unit), but the abovementioned conditions shall be considered in the micrositing of the photopoints.

At a minimum, each* management/burn unit *shall contain at least one photopoint within a vegetation community that is expected to carry fire during a wildfire or prescribed burn.

In addition, if practical, every* vegetation community *on-site shall contain at least one representative photopoint which captures at least one of the abovementioned planned management activities and/or vegetation conditions.

Additional photopoints may be deemed necessary (to be determined by the site manager) in order to appropriately represent the vegetation conditions on site.

2) Establishing the Photopoint

The location from which the photograph is taken shall be permanently marked by placing rebar in the ground and covering it with a PVC tube. The rebar shall be placed *at least* 2 feet into the ground (or until completely stable) and the PVC covering should stand *at least* 4 feet above the ground (or until it is readily visible). The PVC can be left off if the point is in an area with a significant chance of being vandalized/removed or, the point can be easily encountered in the field in the future by ERM staff. Another rebar shall be placed in the ground at a reference point 15 feet from the photopoint in the direction of the central photo (i.e. one of four cardinal directions N, E, S, or W). This rebar should be *no more than* 3 feet above the ground and covering it with PVC will be optional. Both of these points can then be GPS'd with the Trimble Backpack unit (or other unit w/ sub-meter accuracy) and their location clearly described on the photopoint monitoring record form. Describing additional reference points (e.g. trees, structures, other unique features) may also make the point easier to re-locate in the future (e.g. photopoint is 28 meters at 114 degrees from 20" d.b.h. slash pine).

3) Taking the photo (Note: If the photopoint was established prior to this protocol, evaluate the significance of the difference between the previously taken photos and photos taken according to this protocol before initiating this methodology. If the site manager determines that significant information

will be lost by adopting this protocol, continue to take the photos according to the previously written instructions, otherwise, initiate this methodology during the next photo session.)

Take 3 photos to compose a panoramic image of the target vegetation. Each of the 3 photos will be taken at 45 degree intervals (use the degree graduation marks on the tripod to make this alignment). Set the tripod up so that the camera mount is at 4.5 feet above the ground directly over top of the rebar and at a 90 degree angle to the ground (bring a level if the photopoints are on excessively uneven terrain). In addition, set up the tripod so that the "0" on the dial with the degree graduations (below the camera mount on top of the tripod) is facing the center point of your 3 photo panorama. The center point of the middle photo should be in line with one of four cardinal directions N, E, S, or W (place the compass on top of the camera to assist with this alignment). Holding the bottom tripod handle and progressing from right to left, or left to right, take a photo at "45" degrees (middle dot between "0" and "90"), "0", and end at "45" on the other side from where you started (total of three photos). The range pole or density board shall be placed at the reference point 15 feet from the photopoint and included in the middle photograph. The range pole can be placed directly over top of the rebar.

Note: Always take your photos using the widest angle "zoom" possible (on either camera). Press the "w" on the zoom lever until the image stops zooming out. This will give sufficient overlap between the photos in order to arrange a composite panorama if needed. In addition, always take photos using the 1600x1200 image size (if using the Sony Cybershot, open "Menu" and select "File/Image Size/1600x1200", if using the Nikon, select "Medium" quality) for optimum image clarity and practical storage capacity.

4) Image Storage

Using Adobe Photoshop Elements, compile the three photos into a panoramic photo and save as a single file (JPEG) with the name of the site, management unit, and photopoint number within the unit (if applicable), and the date it was taken. This file can then be viewed and printed as needed. Save copies of this file to the "Master" photomonitoring CD under the appropriate site folder and year.

In addition, save *each* of the three individual photos taken at each photopoint individually, including the degree angle at which each photo was taken in the name of each file. These will be saved as back-up files of the panoramic mosaic if needed in the future.

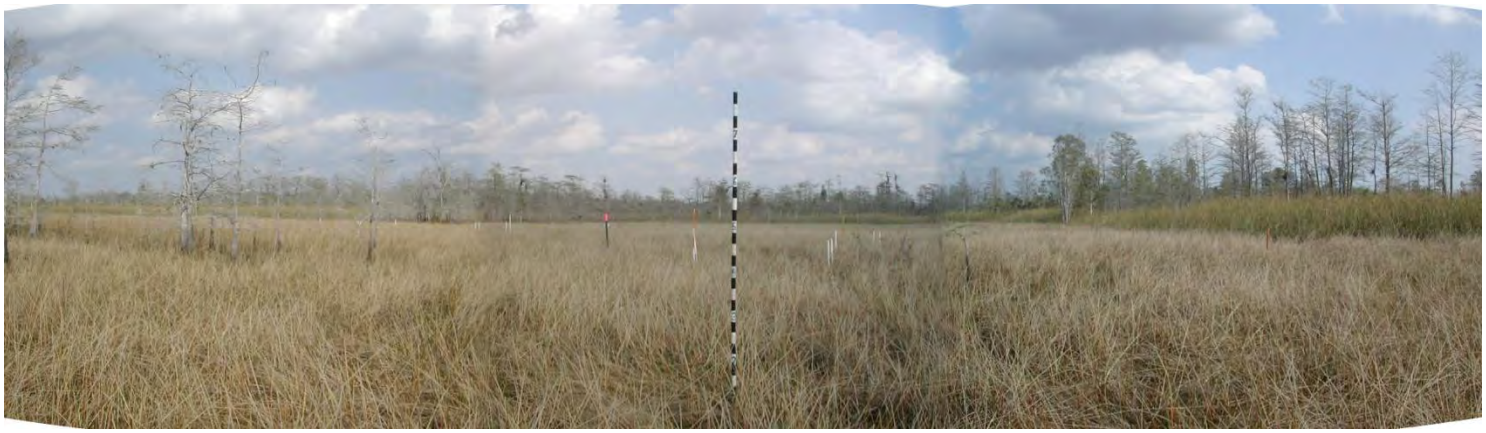
ATTACHMENT D

Photomonitoring

ATTACHMENT D - Panoramic Photos

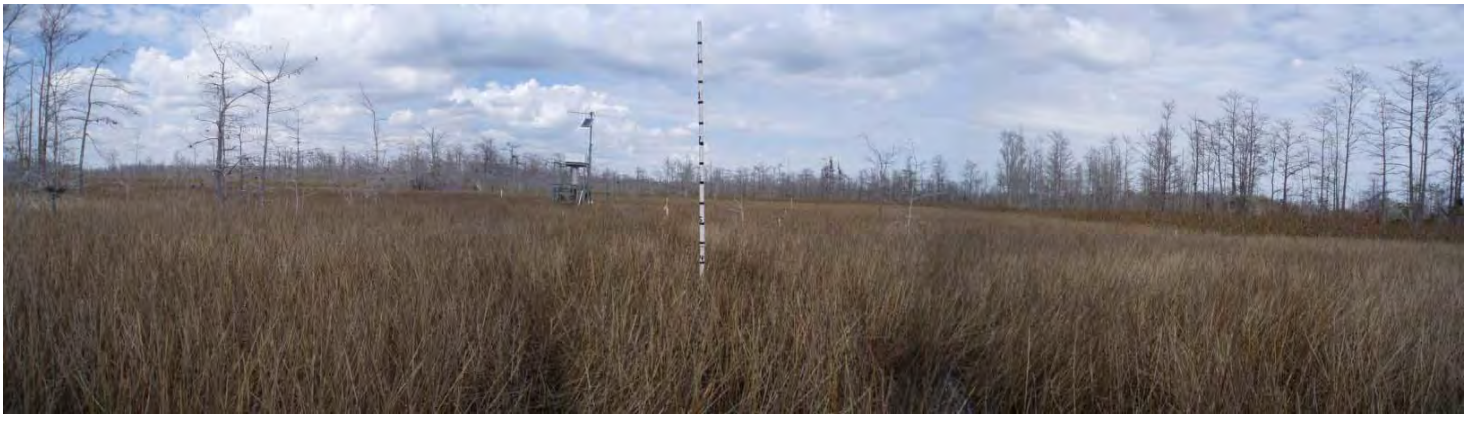
Photostation 1 - Swale

March 2003



March 2006

March 2010



ATTACHMENT D - Panoramic Photos (cont'd)

Photostation 2 - Swale

March 2003

March 2006

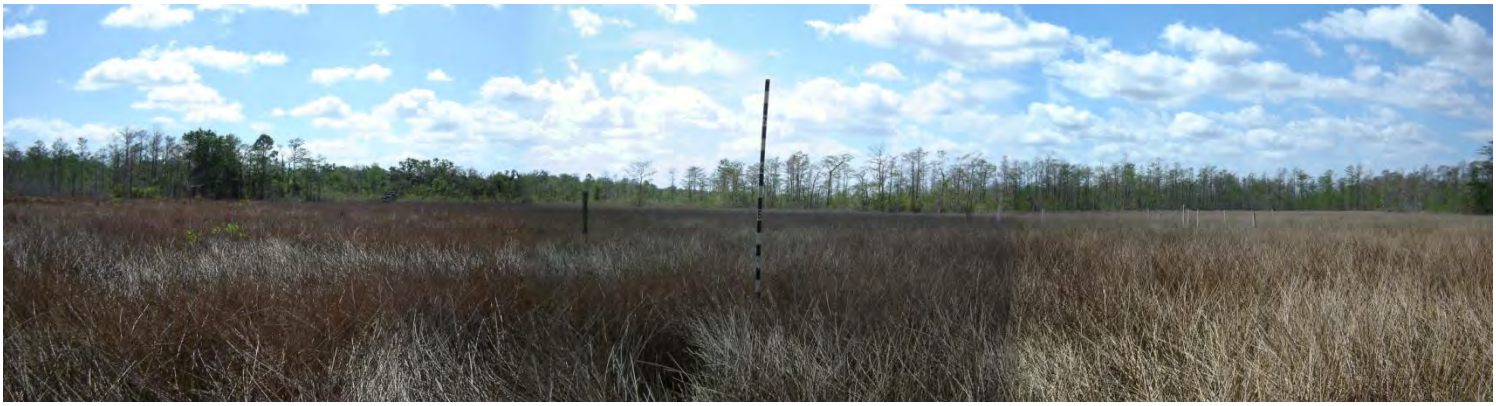
March 2010

ATTACHMENT D - Panoramic Photos (cont'd)

Photostation 3 - Swale

March 2003

March 2006



March 2010

ATTACHMENT D - Panoramic Photos (cont'd)

Photostation 4 – Hydric Hammock

March 2003

March 2006

March 2010

ATTACHMENT D - Panoramic Photos (cont'd)

Photostation 5 – Wet Flatwoods

March 2003

March 2006

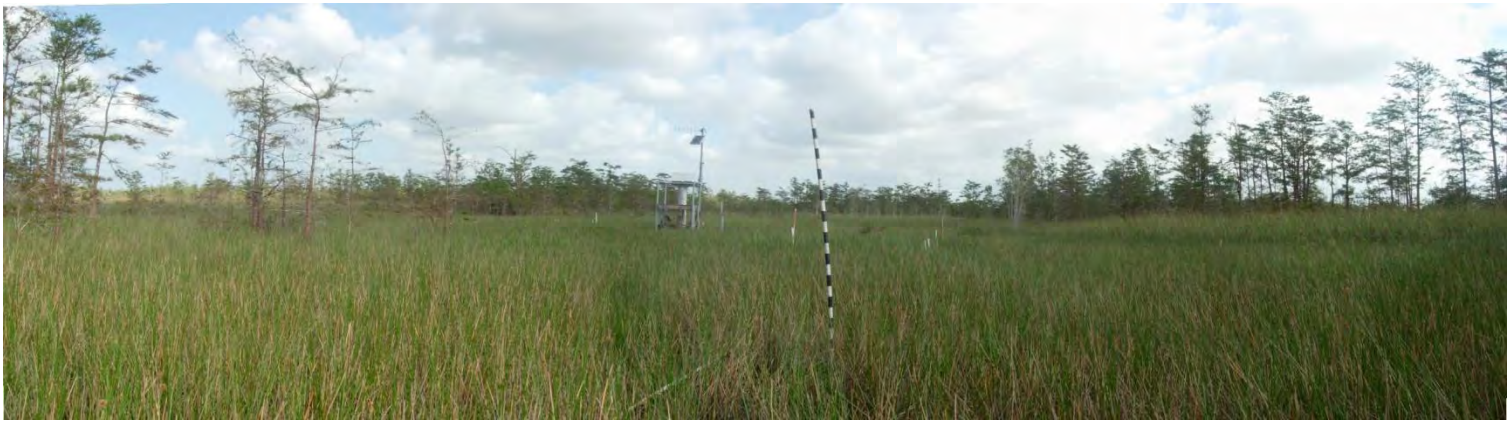
March 2010

ATTACHMENT D - Panoramic Photos

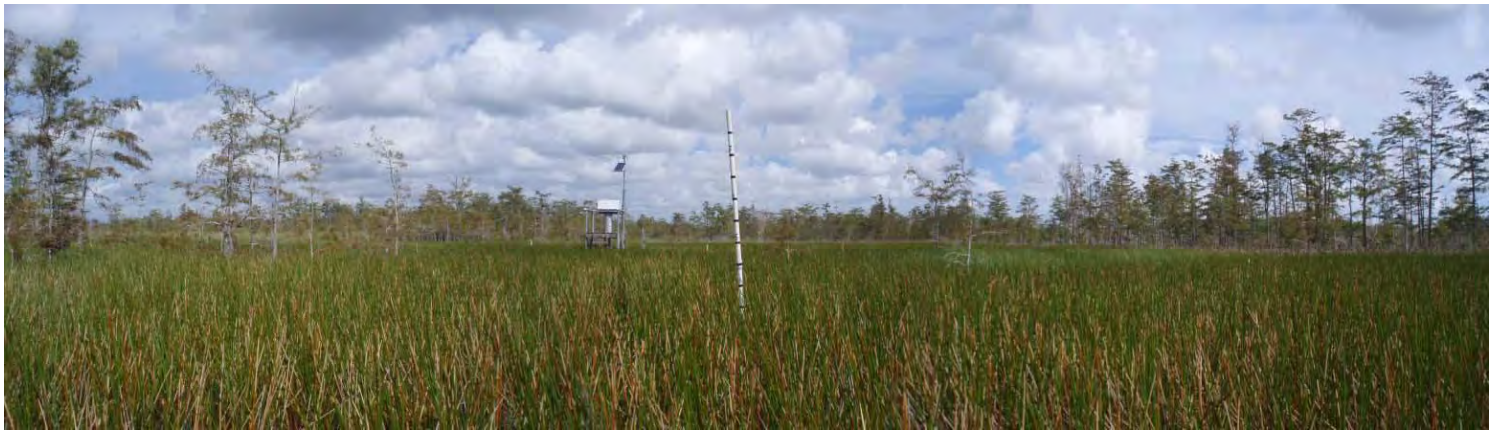
Photostation 1 - Swale

September 2003

September 2006



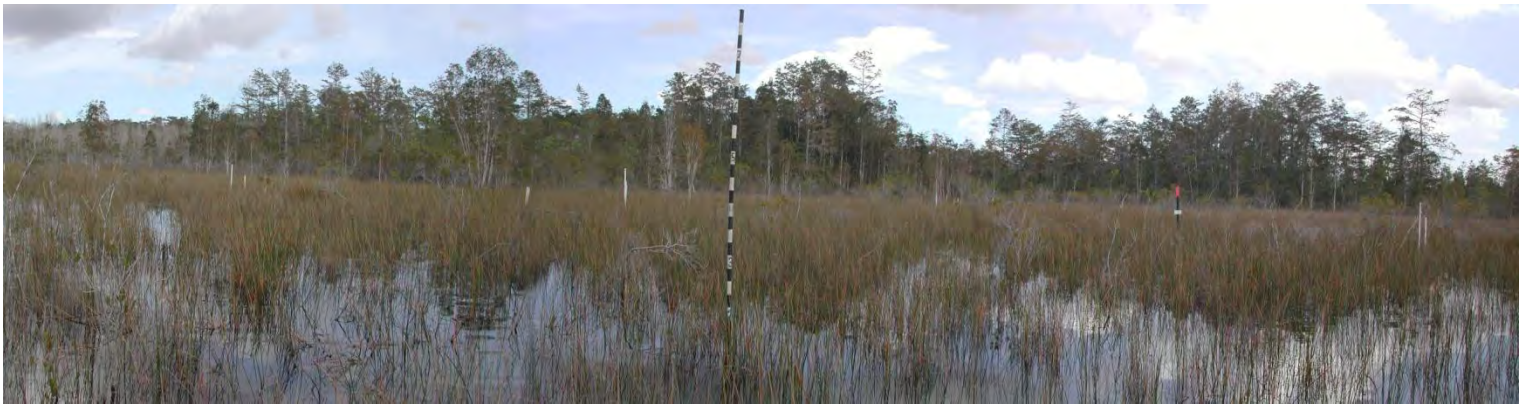
September 2010



ATTACHMENT D - Panoramic Photos (cont'd)

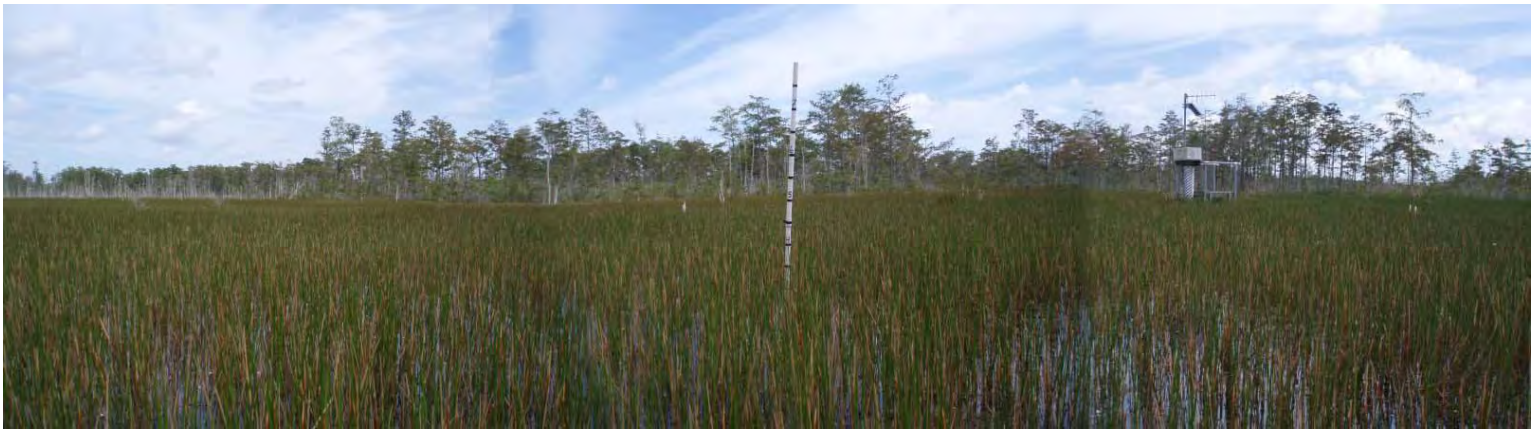
Photostation 2 - Swale

September 2003



September 2006

September 2010



ATTACHMENT D - Panoramic Photos (cont'd)

Photostation 3 - Swale

September 2003

September 2006

September 2010

ATTACHMENT D - Panoramic Photos (cont'd)

Photostation 4 – Hydric Hammock

September 2003

September 2006

September 2010

ATTACHMENT D - Panoramic Photos (cont'd)

Photostation 5 – Wet Flatwoods

September 2003

September 2006

September 2010

Photostation 6 – Pine Invasion

October 2002

September 2009

September 2010

Photostation 7 – Pine Invasion

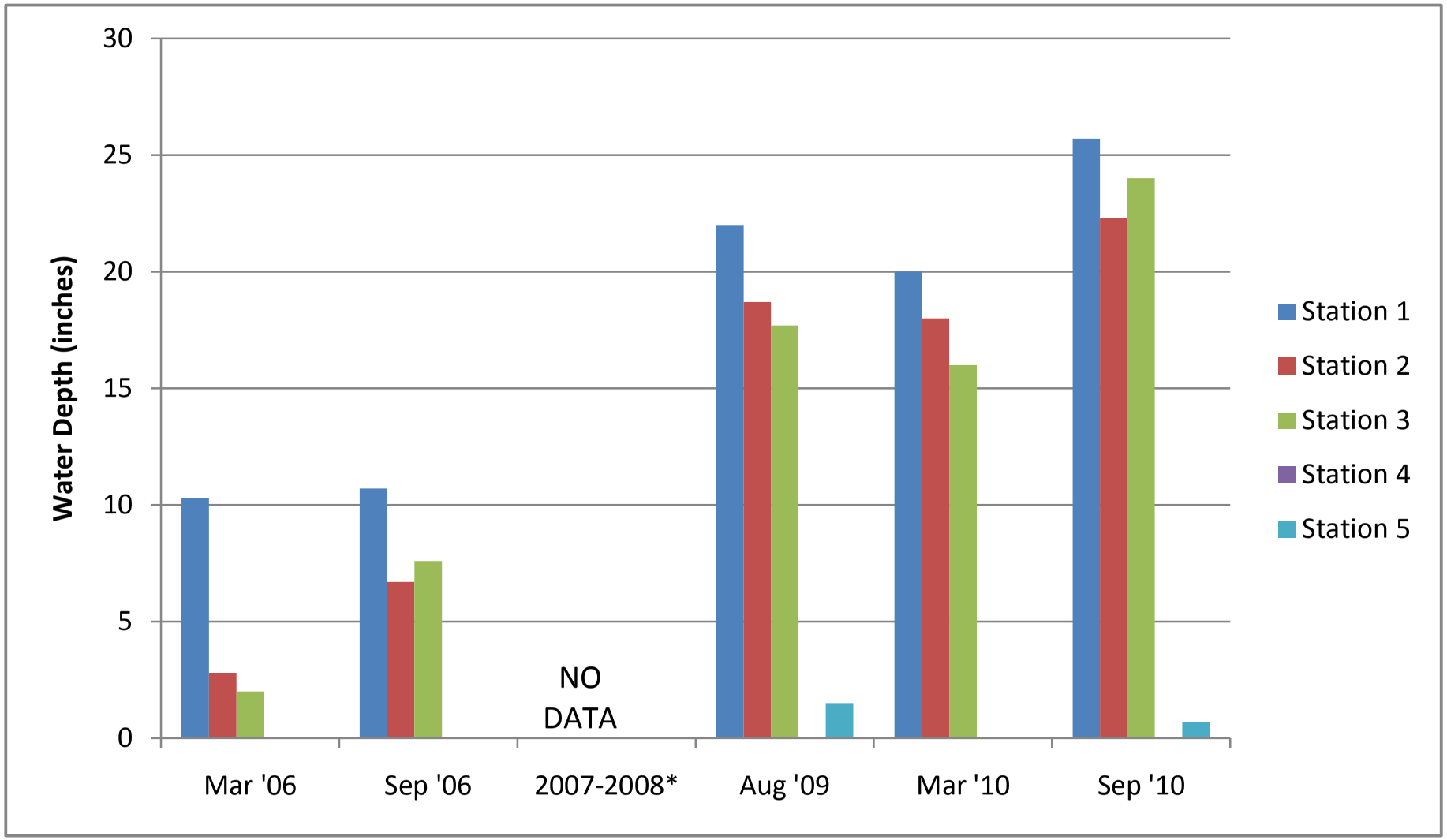
October 2002

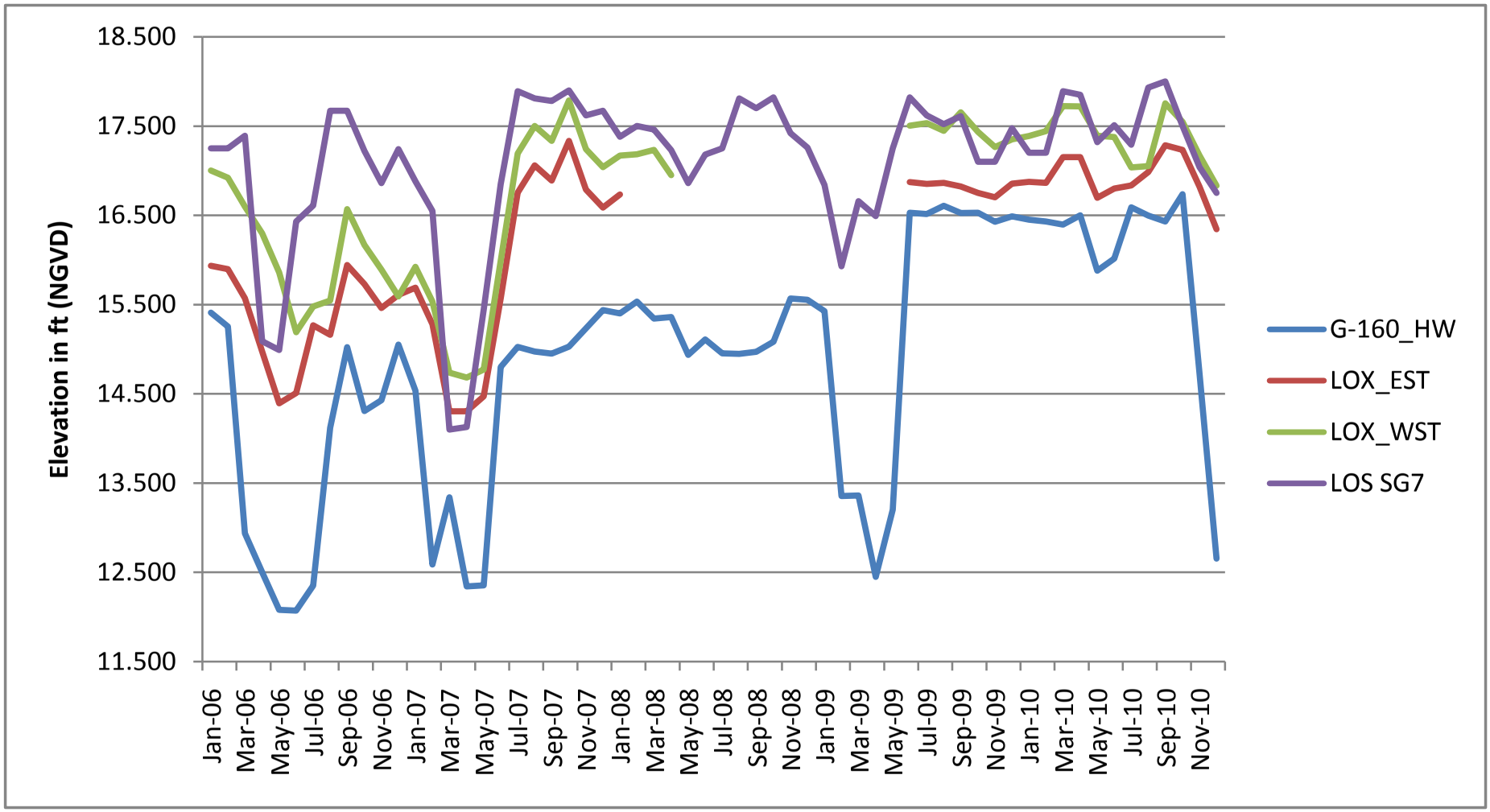
September 2010

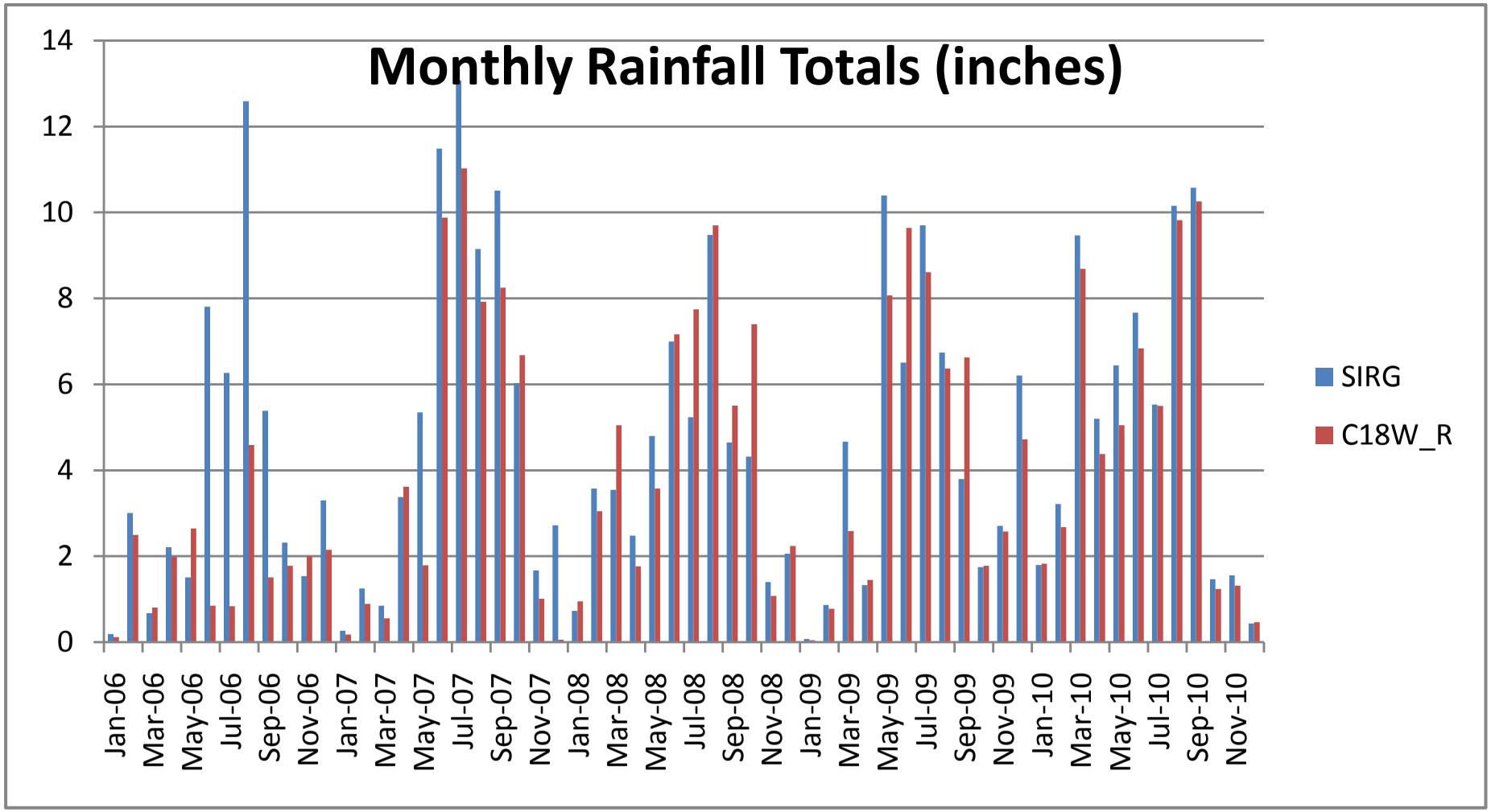
ATTACHMENT E

Water Levels, Rainfall and Stages

2006-2010


Water Depth (inches)
30
25
20
15
10
5
0
NO
DATA
Mar '06
Sep '06
2007-2008*
Aug '09
Mar '10
Sep '10
Station 1
Station 2
Station 3
Station 4
Station 5


Elevation in ft (NGVD)
18.500
17.500
16.500
15.500
14.500
13.500
12.500
11.500
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
G-160_HW
LOX_EST
LOX_WST
LOS SG7


Monthly Rainfall Totals (inches)
14
12
10
8
6
4
2
0
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
SIRG
C18W_R

ATTACHMENT F

Summary of Vegetation Data

2006-2010

Vegetation Monitoring: nested plots		Station 1 (Swale community dominated by Eleocharis cellulosa, little shrub, no canopy				Station 2 (Swale community dominated by Eleocharis cellulosa, little shrub, no canopy				Station 3 (Swale community dominated by Eleocharis cellulosa, little shrub, no canopy				Station 4 - Mature Hammock dominated by Psychotria nervosa, Blechnum serrulatum in understory, Quercus laurifolia, sabal palmetto in canopy				Station 5 Pine flatwoods, variable understory, dominated by Pinus elliottii var. densa and Myrsine floridana			
		Species Composition	Density (total unit/area)	Cover Class 1-6	Water Depth (inches)	Species Composition	Density (total unit/area)	Cover Class 1-6	Water Depth (inches)	Species Composition	Density (total unit/area)	Cover Class 1-6	Water Depth (inches)	Species Composition	Density (total unit/area)	Cover Class 1-6	Water Depth (inches)	Species Composition	Density (total unit/area)	Cover Class 1-6	Water Depth (inches)
BASELINE MONITORING																					
Dry Season - March 2006	Herba-ceous	*Elecharis cellulosa*	90 (s=50.5)	1.3	10.3	*Eleocharis cellulosa*	62 (s=24.0)	1	2.8	*Eleocharis cellulosa*	60 (s=40.0)	1	2.0	*Blechnum serrulatum*	9 (s=4.4)	1.3	Dry	*Blechnum serralatum*	2 (s=4.0)	0.3	Dry
		Rhynchospora tracyi	8 (s=7.5)	0.7		*Rhynchospora tracyi*	9 (s=4.5)	1		*Rhynchospora tracyi*	18 (s=16.7)	0.7		*Dichantheleum commutatum*	2 (s=1.7)	1		*Dichantheleum erectifolium*	4 (s=6.9)	0.3	
	Shrub					*Melaleuca quinquinervia*	0.7 (s=0.6)	0.7						*Psychotria nervosa*	33 (s=53.2)	1.7		*Rapanea punctata*	8 (s=10.8)	1	
		Cephalanthus occidentalis	1 (s=1.7)	0.3		*Taxodium distichum*	0.3 (s=0.6)	0.3		*Cephalanthus occidentalis*	0.3 (s=0.6)	0.3		*Urena lobata*	50 (s=74.2)	1		*Sabal palmetto*	3 (s=4.6)	0.7	
	Canopy													*Sabal palmetto*	5 (s=2.6)	2		*Sabal palmetto*	5 (s=3.8)	1.3	
		n/a (no canopy)	n/a	n/a		*N/a (no canopy)*	n/a	n/a		No canopy	n/a	n/a		*Rapanea punctata*	4 (s=6.9)	0.7		*Rapanea punctata*	8 (s=8.4)	1.3	
Wet Season - Sept. 2006	Herba-ceous	*Elecharis cellulosa*	200 (s=106.2)	1	10.7	*Eleocharis cellulosa*	125 (s=50.7)	1	6.7	*Eleocharis cellulosa*	223 (s=281.2)	1.3	7.6	*Blechnum serrulatum*	10 (s=5.5)	1	Dry	*Dichanthelium commutatum*	4 (s=6.4)	0.3	Dry
		Rhynchospora tracyi	43 (s=35.4)	1		*Rhynchospora tracyi*	72 (s=30.3)	1		*Rhynchospora tracyi*	47 (s=40.8)	0.7		*Erechtites hieraciifolius*	12 (s=20.2)	0.3		*Chamaecrista fasciculata*	5 (s=8.1)	0.3	
	Shrub					*Hypericum fasciculatum*	0.3 (s=0.6)	0.3						*Psychotria nervosa*	52 (s=79.9)	1.7		*Urena lobata*	13 (s=21.9)	0.3	
		Cephalanthus occidentalis	1 (s=1.7)	0.3		*Taxodium distichum*	0.3 (s=0.6)	0.3		*Cephalanthus occidentalis*	0.3 (s=0.6)	0.3		*Urena lobata*	142 (s=99.9)	1.3		*Sabal palmetto*	22 (s=22.5)	1.3	
	Canopy													*Sabal palmetto*	6 (s=2.5)	1.7		*Sabal palmetto*	5 (s=2.0)	1.3	
		n/a (no canopy)	n/a	n/a		*N/a (no canopy)*	n/a	n/a		No canopy	n/a	n/a		*Psychotria nervosa*	2 (s=1.5)	0.7		*Rapanea punctata*	20 (s=23.1)	1.3	
POST OPERATION MONITORING																					
Wet Season - Sept. 2009	Herba-ceous	*Elecharis cellulosa*	216 (s=81.5)	1.7	22	*Eleocharis cellulosa*	180 (s= 50.5)	1.3	18.7	*Eleocharis cellulosa*	167 (s=85.6)	1.3	17.7	*Psychotria nervosa*	78 (s=122.9)	0.7	Saturated	*Dichantheleum erectifolium*	4 (s=6.4)	0.3	1.5
						Rhynchospora tracyi	6 (s= 5.5)	0.7		*Rhynchospora tracyi*	21 (s=18.1)	0.7		*Blechnum serrulatum*	4 (s=2.0)	1		*Blechnum serrulatum*	2 (s=4.0)	0.3	
	Shrub					*Taxodium distichum*	0.3 (s=0.6)	0.3						*Psychotria nervosa*	21 (s=28.4)	0.7		*Rapanea punctata*	7 (s=9.8)	1	
		Cephalanthus occidentalis	1 (s=1.7)	0.3						*No shrub layer*	n/a	n/a		*Urena lobata*	14 (s=20.9)	0.7		*Serenoa repens*	2 (s=2.9)	0.3	
	Canopy													*Sabal palmetto*	5 (s=3.6)	1.7		*Pinus elliottii var. densa*	3 (s=2.5)	1.3	
		n/a (no canopy)	n/a	n/a		N/a (no canopy)	n/a	n/a		No canopy	n/a	n/a		*Rapanea punctata*	3 (s=3.8)	0.7		*Rapanea punctata*	12 (s=13.2)	1.3	
Dry Season - March 2010	Herba-ceous	*Elecharis cellulosa*	259 (s=83.2)	1.3	20	*Eleocharis cellulosa*	244 (s=53.2)	1.3	18	*Eleocharis cellulosa*	136 (s=78.1)	1.3	16	*Psychotria nervosa*	9 (s=15.0)	0.3	Dry	*Dichanthelium commutatum*	1 (s=2.3)	0.3	Dry
						Rhynchospora tracyi	3 (s=3.1)	0.7		*Fuirena scirpoides*	18 (s=31.2)	0.3		*Blechnum serrulatum*	7 (s=7.0)	0.7		*Blechnum serrulatum*	3 (s=4.6)	0.3	
	Shrub					*Taxodium distichum*	0.3 (s=0.6)	0.3						*Psychotria nervosa*	17 (s=19.3)	0.7		*Rapanea punctata*	5 (s=5.7)	0.7	
		Cephalanthus occidentalis	1 (s=1.7)	0.3						*No shrub layer*	n/a	n/a		*Urena lobata*	6 (s=6.7)	0.7		*Serenoa repens*	2 (s=2.9)	0.3	
	Canopy													*Sabal palmetto*	5 (s=4.0)	1.7		*Pinus elliottii var. densa*	4 (s=3.1)	1.3	
		n/a (no canopy)	n/a	n/a		N/a (no canopy)	n/a	n/a		No canopy	n/a	n/a		*Psychotria nervosa*	3 (s=5.8)	0.3		*Rapanea punctata*	12 (s=13.2)	1.3	
Wet Season - Sept. 2010	Herba-ceous	*Elecharis cellulosa*	198 (s=33.5)	2	25.7	*Eleocharis cellulosa*	294 (s=55.9)	2.3	22.3	*Eleocharis cellulosa*	179 (s=41.8)	2	24	*Psychotria nervosa*	9 (s=15.6)	0.3	Dry	*Dichanthelium commutatum*	10 (s=10.3)	0.7	0.7
						Rhynchospora tracyi	3 (s=3.5)	0.7		*Fuirena scirpoides*	15 (s=18.9)	0.7		*Blechnum serrulatum*	6 (s=6.0)	0.7		*Blechnum serrulatum*	3 (s=4.9)	0.3	
	Shrub					*Taxodium distichum*	0.3 (s=0.6)	0.3						*Psychotria nervosa*	12 (s=13.9)	1		*Rapanea punctata*	4 (s=5.8)	1	
		Cephalanthus occidentalis	1 (s=1.7)	0.3						No shrub layer	n/a	n/a		*Urena lobata*	6 (s=10.4)	0.3		*Serenoa repens*	1 (s=2.3)	0.3	
	Canopy													*Sabal palmetto*	6 (s=3.8)	1.7		*Pinus elliottii var. densa*	4 (s=3.1)	1.3	
		n/a (no canopy)	n/a	n/a		N/a (no canopy)	n/a	n/a		No canopy	n/a	n/a		*Psychotria nervosa*	4 (s=5.5)	0.7		*Rapanea punctata*	16 (s=17.6)	1.3	